Turner Endangered Species Fund

&

Turner Biodiversity Divisions

Annual Report

2020

Turner Endangered Species Fund

Turner Biodiversity

Turner Enterprises, Inc.

Swainson's hawk hunting Mexican free-tailed bats at the Jornada bat caves on the Armendaris Ranch in New Mexico

Magnus McCaffery, Val Asher, Cassidi Cobos, Levi Fettig, Carter Kruse, Eric Leinonen, Dustin Long, Hunter Prude, Grace Ray, Chris Wiese, & Mike Phillips

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Annual Report

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All photos not otherwise marked are TESF/TBD photos.

Cover Photo: Riparian growth and beaver colonization in response to grazing exclosures along the upper Vermejo River. These outcomes will improve habitat quality in the river, which is an important part of TBD's *Cutthroat Trout Initiative* which seeks to restore self-sustaining populations of native trout on Turner Ranches and improve the overall conservation status of native cutthroat trout subspecies. The project on the Vermejo River is unique as it is the only site where aboriginal Rio Grande cutthroat trout are known to remain on Turner Ranches.

Executive Summary

Every year, tens of thousands of species and attendant ecological actions, fine-tuned by time and place, disappear at the hand of man. These losses strip away the redundancy and certainty of nature and diminish the lives of millions of people. If these trends continue, the world will become a dismal place indeed, with silent springs and hot summers and little left to excite the senses except the weeds. Without doubt, the extinction crisis looms as one of humanity's most pressing problems.

In response to this crisis, Ted Turner and Mike Phillips along with Turner's family established the Turner Endangered Species Fund (TESF) and Turner Biodiversity Divisions (TBD) in 1997 to conserve biological diversity by ensuring the survival of imperiled species and their habitats, with an emphasis on private actions and private land.

TESF focuses on species protected under state or federal endangered species laws and is recognized by the U.S. Internal Revenue Service as a non-profit, private operational charity. To complement TESF, TBD operates under the auspices of the for-profit Turner Enterprises, Inc. (TEI), and focuses on vulnerable species that are at slightly less risk. Both organizations work on diverse ecological issues aimed at restoring individual species and their habitats. TEI oversees management of Turner properties in an ecologically sensitive and economically sustainably manner while promoting the conservation of native species.

TESF and TBD implement projects that are multidisciplinary, collaborative, and guided by the principles of conservation biology. These projects routinely employ cutting-edge theory and techniques, and draw from the disciplines of community ecology, population biology, molecular genetics, and evolutionary biology. Success requires working closely with state and federal agencies, universities, other conservation organizations, and zoological institutions. From the beginning, TESF and TBD have believed that wrapping many minds around problems leads to durable solutions. That belief notwithstanding, given the high profile and legal status of the species targeted, working closely with state and federal agencies has been a requisite. From receiving permits to technical advice and support, our relationships with government agencies have been supremely important.

Whether managing extant populations or restoring extirpated populations, the ultimate goal for both TESF and TBD is the restoration of viable populations of imperiled species. Self-sustaining populations of native species are the hallmarks of healthy or at least recovering landscapes.

TESF and TBD have made full use of those provisions of the Endangered Species Act (ESA), and related policies, which promote the involvement of private land in species recovery efforts. For example, we have executed candidate conservation agreements, safe harbor agreements, critical habitat exclusions, and innovative ESA section 10(a)(1)(A) permits. Through such administrative approaches we have advanced novel restoration projects without burdening other land management activities practiced on Turner properties.

Since inception, TESF and TBD have been involved in successful restoration projects for imperiled plants, birds, fishes, mammals, reptiles, an amphibian, and invertebrates. The projects have been of sufficient scope to promote the range-wide security of several species and make important intellectual contributions that advance conservation science and restoration ecology by offering new approaches to fieldwork and novel answers to cardinal questions such as: Restore to what? How does one justify the selection of one species over another? What is the role of research in restoration projects?

We are involved in worldwide conservation efforts including Half Earth, Nature Needs Half and the IUCN Private Protected Areas Specialist Group. In addition to advancing successful imperiled species restoration projects, including controversial efforts involving highly interactive species, our work has highlighted the value of strategically located tracts of private land to large scale conservation initiatives that transcend the boundaries of any single property. For example, our work has dovetailed nicely with well-known large-scale reserve design initiatives, including the Yellowstone to Yukon Reserve Design, Southern Rockies Ecosystem Project, and the Sky Islands Wildlands Network.

About Us

Turner Family, TESF Board of Trustees

The Turner family is committed to environmental efforts that promote the health and integrity of the planet. Ensuring the persistence of species and their habitats is one such effort that is critical for advancing worldwide peace, prosperity, and justice. The Turner family are acutely aware of and keenly supportive of the work of TESF and TBD.

Beau Turner
Chairman of the Board of Trustees for TESF; Vice Chairman of TEI

Beau oversees wildlife projects, is a Trustee for the Turner Foundation, Inc., and serves on the board of the Jane Smith Turner Foundation. He is passionate about getting youngsters outdoors and excited about nature. To achieve this, he founded the Beau Turner Youth Conservation Center in Florida.

Mike Phillips
Executive Director, TESF; Coordinator, TBD
mike.phillips@retranches.com

Mike co-founded TESF and TBD with Ted Turner in 1997. He received a M.Sc. in Wildlife Ecology from the University of Alaska in 1986. Mike's career focuses on imperiled species, integrating private land and conservation, ecological economics, and socio-political aspects of natural resource use. He was elected to the Montana legislature in 2006 and concluded his service in the state senate in December 2020.

Carter Kruse
Director of Conservation and Science, TEI, TBD, TIE
carter.kruse@retranches.com

Carter joined TBD in 2000. He has a Ph.D. in Zoology from the University of Wyoming. Carter developed the TBD Native Cutthroat Trout Conservation Initiative and administers a variety of projects that include water rights issues, native species conservation, and species management.

Val Asher
Field Biologist, TESF
val.asher@retranches.com
Val has served as wolf biologist since 2000. She worked closely with state and federal agencies as a wolf specialist from 2000-2009, and in 2010 began investigating how wolves affect ranched bison and wild elk populations on the Flying D Ranch. Val was part of the capture team in Canada during the Yellowstone/Idaho wolf reintroductions.

Magnus McCaffery
Senior Biologist, TESF
magnus.mccaffery@retranches.com
Magnus joined TESF in 2010. He is involved in efforts to conserve and restore Chiricahua leopard frogs in the Southwest, gopher tortoises and red-cockaded woodpeckers in the Southeast, and American burying beetles in the Midwest. He is a native of Scotland, where he graduated with a MSc in Wildlife Biology. A passion for ecology and wild places brought him to Montana, where he gained a PhD in Wildlife and Fisheries Biology from the University of Montana.

Eric Leinonen
Senior Biological Technician, TBD
eric.leinonen@retranches.com
Eric joined TBD in 2011 as a seasonal member of the Native Cutthroat Trout Conservation Initiative. In 2015 he became a full-time employee, where he works with cutthroat trout and provides support to other projects. Eric received a B.A. in Environmental Science and Geography from The University of Montana.

Cassidi Cobos,
Field Biologist, TBD
cassidi.cobos@tedturner.com
Cassidi joined TESF in 2014 and serves as a field biologist on the Chiricahua leopard frog project and manages the Mexican gray wolf efforts on the Ladder Ranch. She received a B.A. in Wildlife Science from New Mexico State University and is initiating a MS program in Wildlife Management at NM state university.

Chris Wiese
Senior Biologist, TESF
chris.wiese@retranches.com
Chris joined TESF in 2012. She oversees the bolson tortoise project on the Ladder and Armendaris ranches in New Mexico. Chris received her PhD in Cell Biology from the Johns Hopkins Medical School in 1996.

Barb Killoren
Office Manager, TEI
barb.killoren@retranches.com
Barb joined TEI in 2001 and assists TESF as office administrator. She manages office operations and provides support to the Executive Director, project managers and field personnel. Barb has a B.S. from the University of Wisconsin, Eau Claire.

Levi Fettig
Senior Biological Technician, TBD
levi.fettig@retranches.com

Levi joined TESF in 2015 as a seasonal technician working with prairie dogs and black-footed ferrets. In 2018, Levi began working full time with TBD on a variety of projects, including black-footed ferrets, prairie dogs, prairie chickens, fish and amphibians. Levi received a B.S. in Wildlife and Fisheries Science from Valley City State University.

Hunter Prude
Senior Biological Technician, TBD
hunter.prude@retranches.com

Hunter began working for TBD on the Armendaris Ranch in New Mexico in 2012, where he collaborates with New Mexico Department of Game and Fish to manage desert bighorn sheep in the Fra Cristobal Mountains. Hunter obtained a B.S. in Natural Resource Management; Wildlife Management from Sul Ross State University in 2011, and an M.S. in Wildlife Science from New Mexico State University in 2020.

Grace Ray
Rangeland Ecologist, TEI
grace.ray@retranches.com

Grace started her position as the Rangeland Ecologist for TEI in 2016. She develops and manages various habitat and species-based conservation projects on the western Turner properties and helps to oversee grazing and rangeland management across 16 key bison properties. She received her M.Sc. in Rangeland Sciences from Oregon State University in 2015.

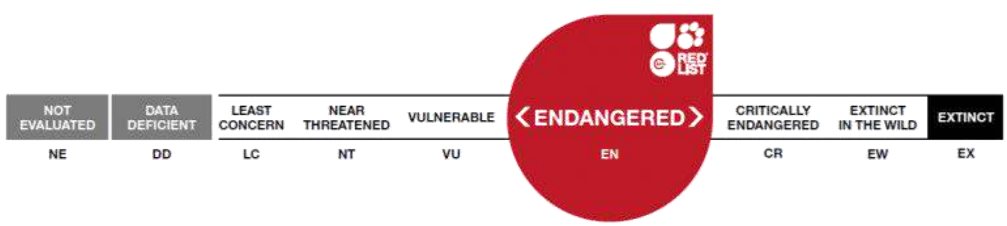
Acknowledgements

The work of TESF and TBD would be impossible without the support, assistance, and partnerships of numerous individuals and organizations. We would like to thank the TESF Board of Trustees and Turner Foundation for their deep commitment to the conservation of biodiversity; the ranch and plantation administrators, managers, and staff who go beyond their daily duties to make our projects a success; and our state and federal partners whose collaboration and support of our conservation and restoration programs help to enrich the biodiversity on Turner properties, and give us the opportunity to contribute to broader recovery goals for numerous at-risk species.

Inclusion of ICUN Red List Category

This year, in additional to using federal and state listing designations for project species, we will also be including **the International Union for Conservation of Nature's (IUCN) Red List status**, when applicable. The IUCN's Red List of Threatened Species is the world's most comprehensive information source on the global conservation status of animal, fungi and plant species, as well as a critical indicator of the health of the world's biodiversity. It uses detailed criteria, including "the range, population size, habitat and ecology, use and/or trade and threats" to evaluate the degree of risk of extinction facing a species.

Red List designations encompass nine categories: Not Evaluated, Data Deficient, Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild and Extinct.



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1. AMERICAN BURYING BEETLE

(*Nicrophorus americanus)*

THE IUCN RED LIST OF THREATENED SPECIES™

LEAST CONCERN (LC) | NEAR THREATENED (NT) | VULNERABLE (VU) | ENDANGERED (EN) | **CRITICALLY ENDANGERED (CR)** | EXTINCT IN THE WILD (EW) | EXTINCT (EX)

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

THREATENED

Nebraska Game & Parks

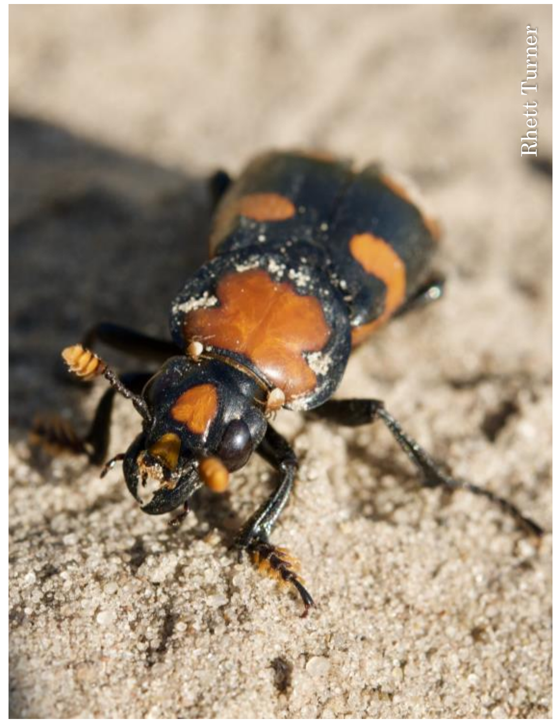
Nebraska Non-game & Endangered Species Conservation Act

ENDANGERED

South Dakota Game, Fish & Parks

South Dakota State Rank

S1: Critically imperiled due to extreme rarity



Biologists

Magnus McCaffery

Eric Leinonen

Threats – Habitat fragmentation is implicated in the decline of American burying beetles (ABBs). Loss and isolation of habitat reduced appropriately sized carrion prey needed for ABB reproduction, while increasing the vertebrate scavenger competition for these carcasses. Since the mid-19th century, some species in the favored weight range for ABBs have declined, or been eliminated, from historical ranges (Fig. 1.1), including the passenger pigeon (*Ectopistes migratorius*), greater prairie-chicken (*Tympanchus cupido*) and wild turkey (*Meleagris gallopavo*).

ABBs were reclassified from Endangered to Threatened with a Section 4(d) rule in 2020. The USFWS determined that the species is no longer in danger of extinction but remains affected by current and ongoing threats. Increasing temperatures due to climate change are projected to impact ABB populations in the foreseeable future. Likewise, ongoing urbanization and agricultural activities are expected to continue to impact ABB populations.

Locations

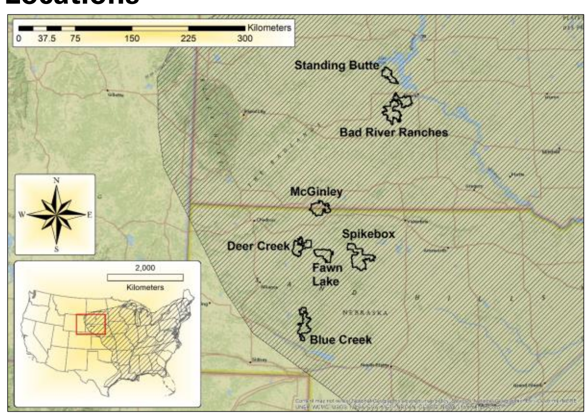


Fig. 1.1. Turner properties (Black polygons) in South Dakota and Nebraska that are within the historical range (hatched area) of the ABB.

Partners

U.S. FISH & WILDLIFE SERVICE | NEBRASKA GAME PARKS | SOUTH DAKOTA Game, Fish & Parks

Permitting

Background

The ABB is the largest silphid (carrion beetle) in North America, reaching 1.0 to 1.8 inches in length. During the daytime, ABBs are believed to bury themselves under vegetation litter or into soil. At night, ABBs are active from late spring through early fall, occupy a variety of habitats and bury themselves in the soil to hibernate for the duration of the winter. ABBs emerge from their winter inactive period when ambient nighttime air temperatures consistently exceed 59 degrees Fahrenheit (°F) (15 degrees Celsius (°C)). Reproduction occurs in the spring to early summer after this emergence. New adult beetles or offspring (called tenerals), usually emerge in summer, over-winter (hibernate) as adults, and comprise the breeding population the following summer. The ABB is native to at least 35 States in the United States, covering most of temperate eastern North America, and the southern borders of three eastern Canadian provinces. The species is believed to be extirpated from all but nine States in the United States and is likely extirpated from Canada. However, the current range is much larger than originally thought when the species was listed in 1989. Based on the last 15 years of surveys, the ABBs have been found to occur in portions of Arkansas, Kansas, Oklahoma, Nebraska, South Dakota, and Texas; on Block Island off the coast of Rhode Island; and in reintroduced populations on Nantucket Island off the coast of Massachusetts and in southwest Missouri, where a nonessential experimental population was established in 2012. Reintroduction efforts are also under way in Ohio, and survival of reintroduced ABBs into the next year (successful overwintering) was documented in 2019.

Adults and larvae depend on dead animals (carrion), e.g., cotton rats, pheasants, prairie dogs, ground squirrels, etc., for food and moisture. Adults also require adequate soil moisture, appropriate soil temperatures, and appropriate soil particle size to allow them to bury themselves and/or a carcass. Adequate soil moisture levels appear to be critical for ABBs, and they show a strong preference for moist, sandy loam soil with organic matter, but a specific threshold for soil moisture is unknown. When the nighttime ambient air temperature is consistently below 59 °F (15 °C), ABBs bury into the soil and become inactive.

For reproduction, ABBs need appropriately sized carrion, access to mates, and suitable soils. The optimum weight of carcasses is 3.5 to 7.0 ounces (80 to 200 g). Once an appropriate carcass has been found for reproduction, ABBs may compete amongst themselves or with other species for control of the carcass, typically until a single dominant male and female burying beetle remain. Once the pair wins the battle for the rights to the carcass, the successful couple buries the carrion, copulates, and constructs an underground cavity called a brood chamber around the carcass, although either sex is capable of burying a carcass alone. Once underground, both parents strip the carcass of fur or feathers, roll the carcass into a ball and treat it with secretions that form a brood chamber and retard growth of mold and bacteria. The female ABB lays eggs in the soil adjacent to the carcass where the eggs incubate for about 6 days before hatching into larvae that require parental care. Females reproducing on smaller carcasses produce fewer eggs than females reproducing on larger carcasses. ABBs will also cull their brood through cannibalism to increase size and survival of larvae in response to a less than adequately sized carcass.

There are seven Turner ranches within the historical range of the ABB (Fig. 1.1), yet the occupancy status of this imperiled species remains to be determined on these properties. TESF and TBD initiated a multi-year survey effort, commencing in 2020, to determine if ABBs are extant on these properties. The results of these baseline surveys will be used to inform future conservation, restoration, and/or research projects on behalf of ABBs on these properties.

Goal

To determine the baseline occupancy status of ABBs on Turner properties.

Objectives

To conduct ABB presence/absence surveys on seven Turner properties in South Dakota and Nebraska.

Activities in 2020

TESF and TBD biologists conducted ABB presence/absence surveys on Spikebox (Fig. 1.2) and McGinley (Fig. 1.3) ranches in Nebraska. Trapping of ABBs in the northern portion of their range (which includes Nebraska and South Dakota) is permitted during two periods of the year:

- Early Summer (June 7th – July 1st), which corresponds with ABBs emergence from hibernation and prior to beetles withdrawing underground for the larval rearing cycle. During this time trapping is permitted only when the average temperature at midnight is ≥ 60°F.
- Late Summer (August 7th – September 1st, corresponding to the period after the larval cycle when both senescent and teneral beetles are present.

ABBs are feeding habitat generalists and we deployed pitfall traps across a gradient of habitat types on the ranches during the early summer trapping period. The effective radius for traps to lure in ABBs is 0.8 km (0.5 miles). We therefore deployed traps across the focal properties with a minimum spacing of 1.6 km (1.0 mile) to identify areas of ABB occupancy (see Figs. 1.2 & 1.3 for trap locations).

We baited pitfall traps with previously frozen, 275 – 374 grams (9.7 – 13.2 ounces) laboratory rats (*R. norvegicus*). This bait was ripened for 3 to 7 days prior to trapping.

<u>Trap Setting Procedure</u>

1. Emplace pitfall trap in the ground.
2. Place 2.5 to 5.1 centimeters (1 to 2 inches) of loose, friable, moist soil in bottom of trap.
3. Place bait on top of the soil in the bottom of the trap.
4. All traps placed and baited by dusk each night.

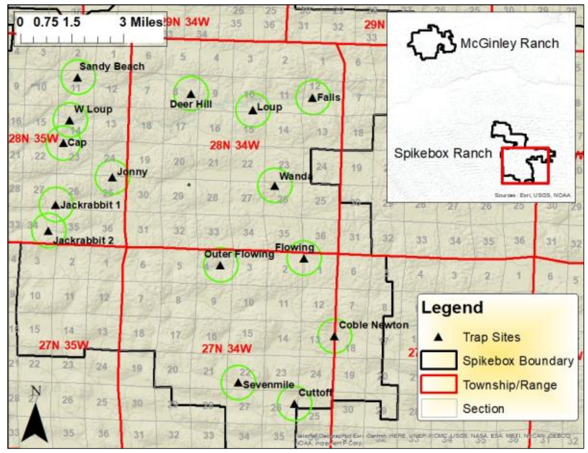


Fig. 1.**2**. Township, Range, Section information and ABB trap locations on Spikebox Ranch.

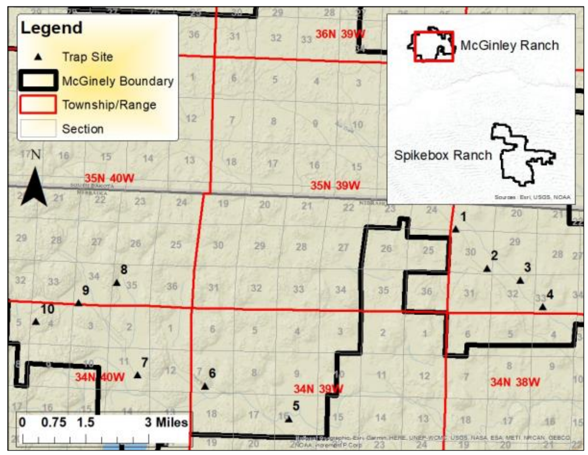


Fig. 1.3. Township, Range, Section information and ABB trap locations on for McGinley Ranch.

<u>Trap Checking Procedure</u>

1. All traps checked and cleared of captures by 12:00pm each day. If temperatures of ≥ 25°C (77°F) expected check traps by 10:00am.
2. Record/release Silphidae individuals (see below: *Processing Captures).*
3. Replace any bait that has dried out, maggoty, and/or no longer emits a pungent odor.
4. Replace/repair any disturbed parts of the trap.

<u>Processing Time</u>

Captured ABBs were processed as quickly as possible by two individuals and released within 30 minutes of checking the trap.

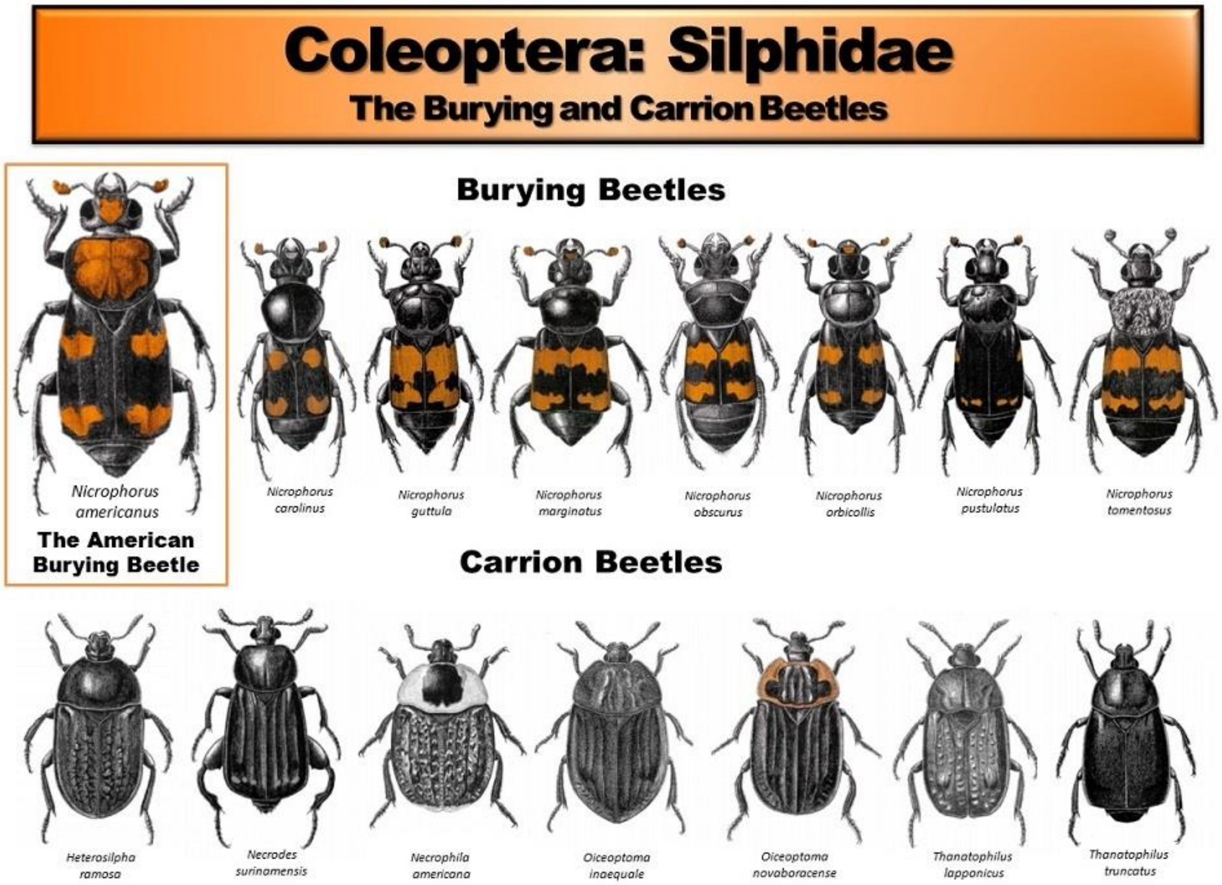


Fig. 1.4. Silphidae species that may be captured and recorded during ABB surveys.

Identification and Processing

1. All captured Silphidae species were identified (Fig. 1.4), enumerated, and recorded.
2. ***Location*** – At each trap, a GPS location was taken at the location of the trap and the general habitat characteristics of the trap site were recorded.
3. Upon capture and identification of an ABB, the following information was recorded:
   - ***Gender*** – The gender of ABBs is distinguishable by the orange-red marking located between the frons and mandibles on the head. These markings are rectangular on males and triangular on females (Fig. 1.5).
   - ***Age*** – ABBs that have pupated during the current active period will be recorded as new (i.e., newly emerged or teneral). ABBs pupated the previous year will be recorded as old (emerged during the previous active period and overwintered as adults). Teneral ABBs are distinguished from older ABBs by their softer bodies, a shinier appearance, and a pronotum that appears more orange (less red) and lighter in hue (Fig. 1.5). Older ABBs have a red rather than orange pronotum, are deeper in hue, are often missing body parts (especially legs or antennae), and their mandibles appear more worn at the tips. We recorded the ages of ABBs as old or young.
   - ***Photograph*** – A photograph of each captured ABB was taken.
   - ***Pronotal width*** – Measured using calipers in the field.
   - ***Release*** – After data collection, ABBs were released near the capture location, but at least 3 meters (10 feet) away from foot traffic along the transect and a minimum of 152 meters (500 feet) from any vehicle pathway. No ABBs captured in 2020 were injured or lethargic, and we had no mortalities.

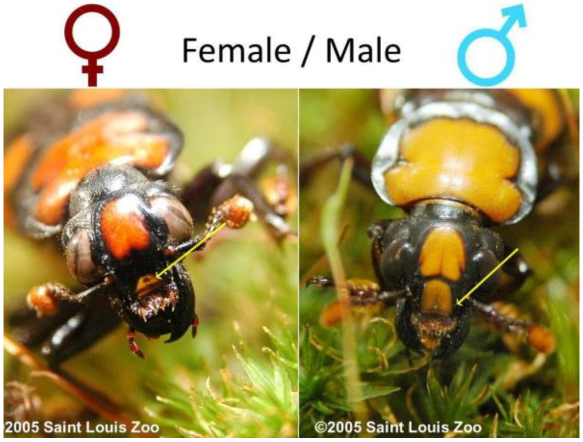


Fig. 1.5. Gender and age characteristics for ABBs. The gender of ABBs is distinguishable by orange-red marking located between the frons and mandibles (indicated by arrows) on the head. These markings are rectangular on males and triangular on females. *Left image*: This female is darker in hue and appears redder consistent with an older adult senescent coloring. *Right image*: This male is lighter in hue and appears more orange, consistent with characteristics of a teneral adult.

<u>Capture Results</u>

During the trapping period (June 13-15) on the Spikebox Ranch, we had a total of 3 ABB captures at two of our trap sites along the Loup River. In all we captured 5 *Nicrophorus* species: *N. americanus, N. orbicollis, N. marginatus, N. carolinus,* and *N. obscurus* (see a summary of captures in Table 1.1.

During the trapping period (June 16-17) on the McGinley Ranch, we had no ABB captures. In all we captured 3 *Nicrophorus* species: *N. orbicollis, N. marginatus, and N. carolinus,* and (see a summary of captures in Table 1.2.

Proposed Future Activities and Considerations

Our results for initial ABB surveys in 2020 will be used to focus future sampling effort along the Loup River on the Spikebox Ranch to better determine the distribution of ABBs on that ranch. We will also use the trapping experience we gained in 2020 to implement surveys at other Turner Ranches to identify previously unknown ABB populations in Nebraska and South Dakota and identify ABB conservation opportunities on Turner properties.

The capture of two ABBs in the "Loup Trap" confirmed the presence of the species on the Spikebox Ranch

Table 1.1. Summary of *Nicrophorus* captures at Spikebox Ranch.

Number of Captures During Trap Night (TN)

Trap Site	*N. americanus*			*N. orbicollis*			*N. marginatus*			*N. carolinus*			*N. obscurus*			Lat.	Long.
	TN 1	TN 2	TN 3	TN 1	TN 2	TN 3	TN 1	TN 2	TN 3	TN 1	TN 2	TN 3	TN 1	TN 2	TN 3		
Cap	0	0	0	0	0	2	6	6	8	35	15	21	0	1	0	42.40	-101.37
Coble Newton	0	0	0	0	0	0	13	9	12	32	34	57	0	0	0	42.32	-101.21
Cuttoff	0	0	0	0	0	0	11	11	8	31	26	28	0	0	0	42.29	-101.24
Deer Hill	0	0	0	0	0	0	9	10	11	47	40	47	0	0	0	42.42	-101.30
Falls	0	0	-	0	0	-	1	4	-	7	42	-	0	0	0	42.42	-101.23
Flowing Well	0	0	0	0	0	0	3	4	3	40	34	22	0	0	0	42.35	-101.23
Jackrabbit 1	0	-	-	0	-	-	1	-	-	36	-	-	0	-	-	42.37	-101.38
Jackrabbit 2	0	0	-	0	0	-	2	2	-	9	8	-	0	0	-	42.36	-101.38
Jonny	0	0	0	0	0	0	6	3	2	38	17	25	0	0	0	42.38	-101.34
Loup	2	0	0	0	2	0	9	1	3	25	17	1	0	1	0	42.41	-101.26
Outer Flowing Well	0	-	-	0	-	-	0	-	-	14	-	-	0	-	-	42.35	-101.28
Sandy Beach	0	0	-	0	5	-	3	1	-	50	11	-	1	0	-	42.42	-101.36
Sevenmile	0	-	-	0	-	-	3	-	-	23	-	-	2	-	-	42.30	-101.27
W. Loup	1	-	-	4	-	-	10	-	-	27	-	-	1	-	-	42.41	-101.37
Wanda	0	0	0	0	0	0	3	2	7	79	30	58	0	0	0	42.38	-101.25

Table 1.2. Summary of *Nicrophorus* captures at McGinley Ranch.

Number of Captures During Trap Night (TN)

Trap Site	*N. americanus*		*N. orbicollis*		*N. marginatus*		*N. carolinus*		*N. obscurus*		Lat.	Long.
	TN 1	TN 2	TN 1	TN 2	TN 1	TN 2	TN 1	TN 2	TN 1	TN 2		
1	0	-	0	-	4	-	5	-	0	-	42.99	-101.85
2	0	-	0	-	6	-	4	-	0	-	42.98	-101.83
3	0	0	0	0	0	3	0	7	0	0	42.97	-101.81
4	0	0	2	0	0	4	0	5	0	0	42.96	-101.80
5	0	0	0	0	1	11	1	6	0	0	42.92	-101.92
6	0	0	0	0	0	2	3	9	0	0	42.93	-101.96
7	0	0	0	0	0	0	0	22	0	0	42.37	-101.38
8	0	0	0	0	2	2	13	14	0	0	42.36	-101.38
9	0	0	0	0	7	2	13	20	0	0	42.38	-101.34
10	0	0	0	-	1	-	29	-	0	-	42.41	-101.26

2. ARCTIC GRAYLING

(*Thymallus arcticus)*

LEAST CONCERN LC | NEAR THREATENED NT | VULNERABLE VU | ENDANGERED EN | CRITICALLY ENDANGERED CR | EXTINCT IN THE WILD EW | EXTINCT EX

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

NOT LISTED

Montana Fish, Wildlife & Parks

Montana State Listing Designation

Species of Greatest Conservation Need

Biologists

Eric Leinonen

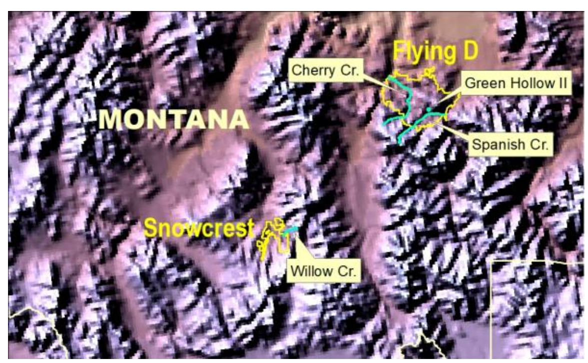
Carter Kruse

Threats – Arctic grayling are widespread throughout drainages of the Arctic and northern Pacific oceans. However distinct populations in Michigan (now extinct) and southwestern Montana have declined significantly due to competition from non-native trout and habitat alterations, especially from water withdrawals. Fluvial (river-dwelling) Arctic grayling in Montana were once widespread in the Missouri River basin. Over the past 100 years, populations declined significantly in both range and abundance; currently the species occupies approximately 4% of historic range in Montana. Prior to ongoing restoration efforts, Montana's fluvial arctic grayling could be found only at very low densities in an 80 km reach of the Big Hole River. In 2010 the USFWS ruled that the Upper Missouri River Distinct Population Segment (DPS) of arctic grayling was warranted for listing under the Endangered Species Act but precluded by higher priorities. By August 2014 the USFWS determined that conservation efforts by federal, state, and private organizations had improved the species status to a point where listing was no longer warranted. Arctic grayling are considered a Species of Greatest Conservation Need by Montana Fish Wildlife and Parks (MTFWP).

Partners

Funding *Funding/Management*

Locations



Recognition

MTFWP & USFWS Arctic Grayling Conservation Award (2014)

Background

TEI has been a partner in grayling conservation in Montana since 1998 when Big Hole fluvial arctic grayling were stocked into Green Hollow Reservoir II on the Flying D Ranch to establish a conservation brood stock. The brood stock was intended to serve as a genetic reservoir for Big Hole grayling and a source of grayling eggs for restoration projects across southwestern Montana. Over the past 20 years, TBD has provided invaluable assistance towards grayling restoration by managing the reservoir and brood stock population for these purposes. In 2002 a fish barrier was constructed on Green Hollow Creek above the reservoir to prevent grayling from moving into and spawning in the creek channel. Since 2003 TBD has worked to remove non-native trout from the reservoir and inflowing creek. Each spring TBD staff assist MTFWP with disease sampling and spawning of grayling. Over the past six years (2015-2020), Green Hollow II grayling have provided about 2 million eggs for research on reintroduction of grayling in Michigan, reintroduction projects throughout southwest Montana, and large-scale restoration in Yellowstone National Park.

Unusually high spring runoff in 2011 deposited large amounts of gravel in the Green Hollow Reservoir II inlet below the barrier and despite efforts to disrupt spawning, grayling naturally reproduced below the fish barrier in 2012-15. Since 2016 a bypass system has been installed annually for about 4 weeks in the spring to reduce spawning in the creek inlet. The wild born offspring from 2012-15 resulted in too many grayling in the brood pond and smaller average adult sizes. In 2015 a decision was made to transfer some of the post-spawn grayling from Green Hollow II to lower Green Hollow Creek (below Green Hollow Reservoir I). Since then, nearly 1,800 adult grayling have been moved following the spring spawn. These fish have unrestricted movement into Spanish Creek and, ultimately the Gallatin River, thus represent the first stocking of fluvial arctic grayling into the Gallatin River system since their local extinction. Additionally, grayling have escaped from Green Hollow II and established a self-sustaining population in Green Hollow Reservoir I (e.g., Main House Pond). Fish from this population likely have and will continue to escape into Spanish Creek, providing a chronic, soft introduction of grayling to the Spanish Creek watershed. MTFWP has confirmed angler reports of grayling caught in the Gallatin River and Flying D fishing guides also report numerous grayling caught in Spanish Creek. Electrofishing surveys have yet to document natural reproduction in either the Gallatin River or Spanish Creek.

TBD staff introduced grayling into lower Cherry Creek (below Cherry Falls and outside of the WCT restoration project area) for the first time in 2016 and have continued annual spring introductions since that time. A total of 135,000 fertilized eggs have been stocked into lower Cherry Creek using remote stream-side incubation (RSI) devices from 2016-20. RSI's improve hatching success and allow newly hatched grayling to volitionally leave the incubator and enter the stream habitat. Table 2.1 details the past few years of Green Hollow Grayling egg production, fish transfers to lower Green Hollow Creek, and RSI stocking efforts into lower Cherry Creek.

Goals

Maintain a conservation brood stock of Big Hole fluvial arctic grayling in Green Hollow Reservoir II to support range-wide restoration efforts. Restore self-sustaining populations of arctic grayling on Turner Ranches and surrounding landscapes to improve their conservation status.

Objectives

To manage fluvial arctic grayling in Green Hollow II in a manner that promotes a healthy arctic grayling brood stock supporting restoration efforts in southwestern Montana. The brood fish will be disease free, average 10 inches in length, and provide at least 200 adult females for spawining and 300,000 eggs for restoration each year. Arctic grayling restoration on Turner Ranches will be implemented in at least two sites, exhibit densities of 20 adult fish (i.e., ≥100 mm total length) per km, with successful recruitment (i.e., young of year or multiple age/size classes present) at least once every three years.

Table 2.1. TBD Grayling conservation work by the numbers.

Year	No. Females spawned	No. Eggs produced	Fecundity	Transferred to Creek	Cherry Creek RSI
2016	113	129,360	1,144	536	10,000
2017	200	481,910	2,409	0	20,000
2018	205	264,880	1,292	279	25,000
2019	170	400,900	2,358	680	40,000
2020	183	*324,792*	1,774	300	40,000

Activities in 2020

TBD prepared for the annual spring grayling spawn at Green Hollow II. We netted and held several hundred grayling in early May (Fig. 2.1). A total of 183 females were spawned on May 14th, producing around 324,792 eggs for grayling restoration in southwest Montana. Average female size increased each year, but total number of females fell short of the 200-female objective. To maintain genetic diversity and quality of the Green Hollow brood, MTFWP added 225 Big Hole River lineage grayling to the pond in July. To prepare for these additional fish, around 250 adults were moved into lower Green Hollow Creek after the May egg-take.

Fig. 2.1. Male arctic grayling in holding tank prior to spawning.

We introduced another 40,000 grayling eggs into lower Cherry Creek (below Cherry Falls and outside of the WCT restoration project area) via remote stream-side incubation (RSI) devices in 2020 (Fig. 2.2). The RSI's were placed in a controlled flow environment (i.e., irrigation ditch) rather than in the stream to provide the hatching grayling a higher chance of short-term survival once they leave the RSI's (Fig. 2.3). After flowing in the ditch for some distance below the RSI's, the water and newly hatched grayling were diverted back into the creek.

Modest electrofishing monitoring efforts in the spring and fall of 2020 failed to capture grayling in lower Green Hollow, Spanish, or lower Cherry creeks. Nevertheless, Flying D fishing guides and MTFWP continue to confirm angler catch of grayling in Spanish Creek and the Gallatin River.

Fig. 2.2. Eyed grayling eggs ready for placement in RSI's (see Fig. 2.3).

Fig 2.3. Remote streamside incubators (RSI's) with grayling eggs placed in an irrigation ditch alongside lower Cherry Creek.

3. BLACK-FOOTED FERRET

(*Mustela nigripes*)

THE IUCN RED LIST OF THREATENED SPECIES™

LEAST CONCERN	NEAR THREATENED	VULNERABLE	ENDANGERED	CRITICALLY ENDANGERED	EXTINCT IN THE WILD	EXTINCT
LC	NT	VU	EN	CR	EW	EX

U.S. Fish & Wildlife Service

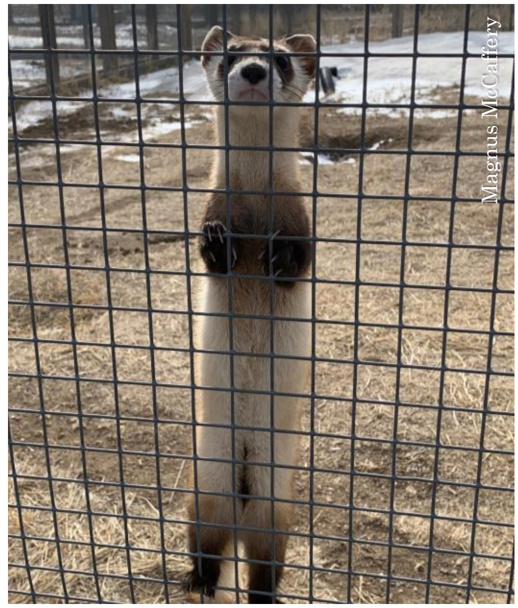
Listing Status under the Endangered Species Act

ENDANGERED

New Mexico Department of Game & Fish

New Mexico State Listing Designations

Species of Greatest Conservation Need; Protected Furbearer

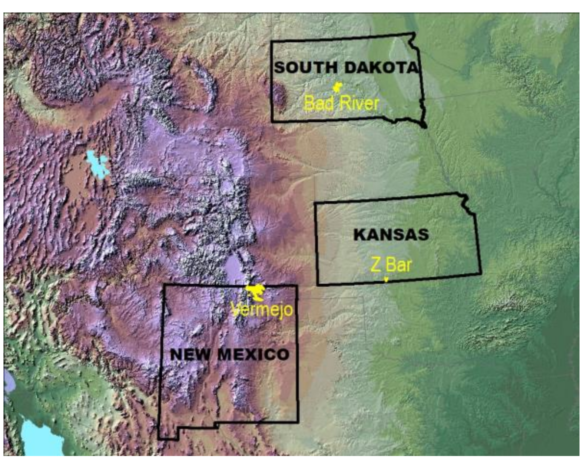


Biologist

Magnus McCaffery

Threats – Threats to black-footed ferrets include disease, habitat loss, and related declines in prey. Conversion of native grasslands to agricultural land, widespread prairie dog eradication programs, and non-native diseases, such as plague, have reduced ferret populations to less than 2% of their original range.

Locations



Partners

BLACK-FOOTED FERRET RECOVERY IMPLEMENTATION TEAM

TESF is a member of the Executive Committee of the Black-Footed Ferret Recovery Implementation Team (BFFRIT). The Executive Committee includes representatives from 40 organizations that represent federal, state, tribal, non-profit, private, and international entities (see page border for collaborating members). As an Executive Committee member, TESF is involved with reviewing the overall management and direction of the Recovery Program and provides board policy and planning guidance to the US Fish & Wildlife Service and the BFFRIT subcommittees (Conservation, Education and Outreach, and Species Survival Plan Subcommittees).

Background – Black-footed ferrets are an obligate predator of prairie dogs and prairie dogs historically required bison grazing throughout a large portion of their historic range in order to persist. Hence, the black-footed ferret project is a natural fit for many Turner properties, providing an opportunity to merge commodity production and native recovery.

All captive and wild black-footed ferrets alive today can be traced to the last seven wild individuals that were captured at Meeteetse, WY in the mid-1980s. Today, black-footed ferrets remain one of the planet's rarest mammals with a wild population of less than 300 individuals.

TESF's contribution to ferret recovery began in 1998 with the construction of an outdoor preconditioning facility at Vermejo. Naïve, cage reared ferrets were placed in outdoor pens that simulated a wild environment. Ferrets in these pens lived in active black-tailed prairie dog (*C. ludovicianus*) burrows and were exposed to live prairie dog prey. Here, they honed natural predatory instincts which prepared them for the wild. Females bred, whelped, and weaned kits in these pens. Ferrets preconditioned or born in outdoor pens, and exposed to live prey, have higher post-release survival rates than those that have not. From 1999-2006, 393 ferrets were preconditioned at Vermejo's facility.

From 2005-2007 at Vermejo, and 2009-2011 at Bad River Ranches, TESF took the next step in preconditioning ferrets by implementing a wild preconditioning approach. At Vermejo, female ferrets and their kits were released onto a 1,000-acre prairie dog colony, surrounded by electric netting to reduce the risk of ferret mortality from terrestrial predators (e.g., coyotes and badgers) as they adjusted to life in the wild. At Bad River, we used a similar strategy, but without electric netting. After 1-3 months of wild preconditioning, ferrets were captured and transported to permanent release sites. Of the ferrets released for wild preconditioning, we recaptured 48% at Vermejo (n=75) and 45% (n=37) at Bad River for transport to permanent release elsewhere.

In 2008, we began year-round ferret releases on black-tailed prairie dog colonies at Vermejo and in 2009 TESF documented the first wild-born ferret in New Mexico in over 75 years.

Despite our best efforts to establish a population of ferrets at Vermejo that would contribute to federal recovery objectives (Table 3.1) – an effort that involved increasing black-tailed prairie dog acreages from 500 acres to over 10,000 acres and releasing 196 ferrets – it became clear from ferret survival rates over a 9-year period, that it was unlikely that Vermejo's black-tailed prairie dog colonies could support a stable ferret population. Although the ferrets generally did well on these colonies, with reproduction documented when spring precipitation was sufficient to support a robust prairie dog population, these good years were routinely offset by drought years in which prairie dog pup survival rates were below 10%, causing the ferret population to collapse. During these drought years we documented the loss of all female ferrets and their kits, although male ferrets appeared to be largely unaffected. Due to the failure of ferrets to survive and reproduce during drought years, and the likelihood that droughts will become more frequent and severe, in 2013 we decided to withdraw from ferret releases for the foreseeable future on black-tailed prairie dog colonies at Vermejo.

2012 marked the first year TESF began ferret releases on the Gunnison's prairie dogs which occupy the high elevation mountain meadows of Vermejo. Historical records indicate 89% of the ferret specimens collected in New Mexico were captured on Gunnison's prairie dogs and one of the last specimens collected in the state was trapped on Vermejo at Castle Rock (Fig. 3.1). Survival and reproduction rates of ferrets living on Gunnison's colonies at Vermejo suggests a population of ferrets that meet delisting requirements could be established, provided we are able to control sylvatic plague.

Fig. 3.1. Castle Rock represents one of Vermejo's high elevation mountain meadows that supports Gunnison's prairie dogs.

Currently there are two options available to mitigate plague on prairie dog colonies: (1) application of insecticide at prairie dog burrows (deltamethrin dust or fipronil grain) which kills the fleas that serve as the vector for plague, and (2) distributing Sylvatic Plague Vaccine (SPV) bait on colonies to vaccinate prairie dogs against the disease. However, an SPV field trial in 2017 at Bad River was not effective at controlling plague, while deltamethrin proved effective. Fipronil grain has also been shown by research to be an effective plague mitigation approach. However, all these plague management techniques are expensive when the chronic, annual treatment of large acreages is required (Table 3.1). A novel application approach for fipronil is currently under development by Randy Matchett of the USFWS, whereby lower doses of fipronil are formulated into bait-form (FipBit). This formulation holds promise as a relatively cost-effective technique for managing plague.

Table 3.1. Estimated costs of various plague mitigation methods.

Method	Cost/acre
Deltamethrin dust	25.00^{\Phi}$
Fipronil grain	$26.50 $^{\Phi}$
SPV	$23.41 $^{\Phi}$
FipBit*	5.85^{\Psi}$

* = Not yet available. Under development
Φ = Product cost + estimated application costs
Ψ = Estimated cost of bait production + application

Goal – Restore black-footed ferret populations to three Turner properties.

Objectives – Contribute to federal black-footed ferret recovery objectives (Table 3.2) by reintroducing black-footed ferrets onto large/stable prairie dog complexes (i.e., ferret habitat) on Turner properties:

Table 3.2. Black-Footed Ferret Recovery Criteria.

Downlisting	*Delisting*
Maintain captive breeding population: ‣ ≥280 adults (105 males, 175 females), ‣ distributed among ≥3 facilities.	Maintain captive breeding population: ‣ ≥280 adults (105 males, 175 females), ‣ distributed among ≥3 facilities.
Free-ranging black-footed ferrets: ‣ totaling ≥1,500 breeding adults, ‣ in ≥10 populations, ‣ in ≥6 of 12 States within historical range of the species, ‣ with ≥30 breeding adults in any population, ‣ ≥3 populations on Gunnison's and white-tailed prairie dog colonies. ‣ Maintain these for ≥3 years prior to downlisting.	Free-ranging black-footed ferrets: ‣ totaling ≥3,000 breeding adults, ‣ in ≥30 populations, with ≥1 population in each of ≥9 of 12 States within historical range of the species, ‣ with ≥ 30 breeding adults in any population, ‣ and ≥10 populations with 100 or more breeding adults, ‣ ≥5 populations on Gunnison's/white-tailed prairie dog colonies ‣ Maintain these for ≥3 years prior to delisting.
Maintain ~247,000ac (100,000ha) of prairie dog occupied habitat at reintroduction sites.	Maintain ~494,000 ac (200,000 ha) of prairie dog occupied habitat at reintroduction sites.

Bad River Ranches

- Establish a 607 ha (1,500 acres) Conservation Zone (CZ) at Bad River Ranches' Ash Creek Recovery Area (ACRA).
- Maintain CZ prairie dog complex at densities of ≥ 3.63 prairie dogs/ha.
- Attain extensive prairie dog coverage within CZ and establish/manage a black-footed ferret population.

Vermejo Park Ranch

- Determine if the habitat and management at Vermejo could support CZs on Gunnison's and black-tailed prairie dog sites.

Z Bar Ranch

- Establish a 404 ha (1,000 acres) CZ at Z Bar.
- Maintain CZ prairie dog complex at densities of ≥ 3.63 prairie dogs/ha.
- Attain extensive prairie dog coverage within CZ and establish/manage a black-footed ferret population.

Black-tailed prairie dog colony on Bad River Ranches

Supporting Rationale for Objectives

Our objectives will assist with federal recovery criteria (Table 3.2) for free-ranging black-footed ferrets by establishing large, protected prairie dog complexes on Turner properties. These complexes will serve as ferret reintroduction sites once sufficient prairie dog acreages have been achieved.

Management of reintroduction sites aims to maintain stable prairie dog complexes, with minimum densities of 3.63 prairie dogs/ha across at least 2,156 ha (5328 acres). While it is anticipated that prairie dog densities at our reintroduction sites will exceed 3.63 prairie dogs/ha, this density threshold serves as a benchmark for meeting the breeding requirements of black-footed ferrets (Biggins et al. 1993; Tuckwell & Everest 2009).

A prairie dog colony complex represents the basic management unit of black-footed ferret recovery and is defined as a group of prairie dog colonies distributed so that black-footed ferrets can migrate among them commonly and frequently (Forrest et al. 1985). A prairie dog colony subcomplex is a smaller unit within a larger complex. The inter-colony distances of 7-km and 1.5-km are used to determine which colonies are included in a complex and subcomplex, respectively, based upon recorded black-footed ferret movements (Biggins et al. 1993, 2006).

Population viability analysis modeling of black-footed ferrets in the Conata Basin, South Dakota suggests that approximately 10,000 acres (4,047 ha) of prairie dog colonies connected by a maximum distance of 1.5 km are required to sustain a ferret population with greater than 90 percent probability of persistence over 100 years (CBSG 2004). While our areal prairie dog coverage will not meet this 10,000-acre threshold, each property's prairie dog complex will be composed of colonies that are separated by no more than 1.5 km, and active management will be implemented as appropriate to maintain the viability of the ferret population.

In toto, if we can attain 100% prairie dog coverage within potential CZs, we estimate that Turner properties could contribute around 118 ferret family groups (2 adults and 2 kits) across three populations, and encompass three states within the species' historical range, including one Gunnison's prairie reintroduction site.

Strategies

- Plague management to maintain prairie dog complexes (where appropriate).
- Targeted prescribed fire and bison grazing to maintain prairie dog complexes and stimulate prairie dog colony growth (where appropriate).
- Monitoring prairie dog areal extent and densities to inform black-footed ferret reintroductions, and the number of ferret family groups to manage for at reintroduction sites.
- Black-footed ferret reintroductions, monitoring, and management once large prairie dog acreages have been achieved. If prairie dog coverages are maximized to 100% of actual and potential CZs on the three properties could allow Turner properties to support over 100 black-footed ferret family groups (Table 3.3).

Behind bars at the National Black-Footed Ferret Conservation Center in Colorado

Table 3.3. Black-Footed Ferret Reintroduction Sites on Turner properties, assuming 100% prairie dog coverage within potential/actual CZs.

Site	*CZ (ha)*	*§Density (P)*	*# ferret family groups$^{\Psi}$ supported (R)*
BRR	607	62	49
VPR	1,334	20	33
Z Bar	404	75	39

** Equation from Biggins (1993):*

$$R = \sum_{i=1}^{n}(\boldsymbol{A_i} \times \boldsymbol{P_i}) \div \mathbf{763} \; \boldsymbol{for} \; (\boldsymbol{A_i} \times \boldsymbol{P_i}) \geq \mathbf{272.5}$$

where…
R = number of ferret family groups supported by prairie dog complex,
A = area of colony with at least 3.63 prairie dogs/ha,
P = prairie dog density (per ha) in area A,
763 = prairie dog numbers required to support one ferret family group$^{\Psi}$ for 1 year,
272.5 =minimum prairie dog number needed to support one ferret family group for 1 year,
i = colony number, and
n = the number of colonies in the complex.
Ψ = ferret family group of 2 adults and 2 kits
§ = 2005 prairie dog density estimates

Activities in 2020

Due to travel restrictions resulting from the COVID-19 pandemic, we scaled back fieldwork on the black-footed ferret program. We did not implement any actions at Vermejo or Z Bar in 2020, and instead prioritized the essential task of mitigating plague at Bad River Ranches.

Bad River Ranches, SD: The black-tailed prairie dog complex in the Ash Creek Recovery Area (ACRA) at BRR was impacted by plague in 2018, declining from 1,800 acres to ~ 300 acres. 2019 mapping indicated a remaining coverage of 303 acres. We dusted 167 acres of this area in 2019. In 2020 we estimated prairie dog colony acreage in the ACRA of BRR by driving the perimeter of each prairie dog colony with a Global Positioning System (GPS) unit. The active perimeter of each colony was recorded on the GPS as a track file and then downloaded to ArcGIS. In September 2020, we mapped a total of 337 acres of occupied black-tailed prairie dog habitat at the ACRA, existing as four discrete colonies (Fig. 3.2).

We treated 100% of the 337 acres of existing black-tailed prairie dog colonies (Fig. 3.2) in the ACRA with fipronil grain. Fipronil is an insecticide that targets fleas, and fipronil grain is an alternative approach to dusting with deltamethrin. To treat the area, we deposited a ½ cup of the fipronil-laced grain at each active prairie dog burrow using an ATV equipped with a prairie dog baiter.

We aim to continue rebuilding this CZ to comprise a prairie dog complex of ≥ 1,500 acres in the coming years with a view to future black-footed ferret reintroductions.

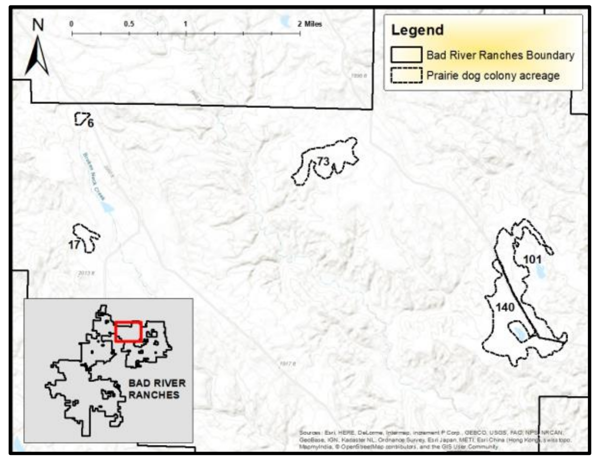


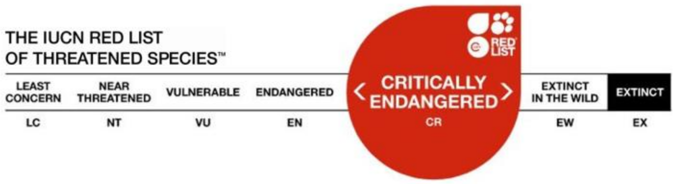
Fig. 3.2. Results of prairie dog colony mapping at BRR, with location and acreages of ACRA's black-tailed prairie dog colonies. 100% (i.e., 337 acres) of these colonies were treated with fipronil grain in September 2020.

Proposed Future Activities and Considerations – In 2021, we aim to increase the acreage of prairie dog complexes within Conservation Zones on BRR and Z Bar. For BRR, this will involve targeted bison grazing and application of fipronil bait to prairie dog complexes. At Z Bar, we aim to enroll the property in the Safe Harbor program for black-footed ferrets, and expand the existing 300-acre prairie dog Conservation Zone through a trifecta strategy of mowing, prescribed fire, and focused bison grazing.

We will also continue to support efforts to develop FipBits. Once all safety and regulatory approvals for this plague mitigation technique have been resolved, we stand ready to help with the production of FipBits by producing the bait in TESF's Bozeman lab.

4. BOLSON TORTOISE

(*Gopherus flavomarginatus)*



Project Biologists


Chris Wiese


Scott Hillard

Threats – Population decline, and range contraction are due to collection for food as well as habitat loss. Recent estimates suggest fewer than 2,000 bolson tortoises remain in the wild.

Locations

Partners (see Appendix 4.1)

The Appleton Family | Lynnie Appleton | Jim Jarchow, DVM | Heidi Hubble | Matt Keeling | Tricia Rossetie | Andrew Lincourt | Dennis Bramble, PhD | Howard Hutchison, PhD | Donald Miles, PhD | Taylor Edwards, PhD | Robert Murphy, PhD | Peter Koplos, DVM | Stephen Divers, DVM | Sean Graham, PhD | Vicky Milne, DVM | Susan Serna

Background – To prevent the extinction of bolson tortoises in the wild, we are working to establish free-ranging populations on the Ladder and Armendaris ranches in New Mexico. These ranches lie at the northern tip of the species' prehistoric range. The largest and rarest of the six North American tortoise species, the bolson tortoise once ranged throughout most of the Chihuahuan desert, but its current range now comprises only a small area in north central Mexico where the states of Durango, Chihuahua, and Coahuila meet. Due to a suite of political, social, economic, and safety issues, the status of the bolson tortoise in the wild is largely unknown. The last population survey, conducted in the 1980s, estimated a population of fewer than 10,000 animals. However, continued habitat degradation and loss make it likely that this number has since decreased.

The bolson tortoise reintroduction project started with a group of 30 tortoises that were collected and bred over a period of nearly 40 years by a private individual in Arizona. This collection was donated to TESF in 2006: 26 adults (plus 7 hatchlings) were moved from Arizona to the Armendaris to serve as a captive breeding colony for our reintroduction program. Four tortoises (2 males, 2 females) were donated to the Living Desert Zoo and Gardens State Park in Carlsbad, NM (LDZG), where they are on exhibit.

Successful breeding programs on the Armendaris and at the LDZG have hatched over 800 new tortoises since 2006. Hatchlings and juveniles are kept on native forage in outdoor, predator-proof enclosures until they are large enough to be released (about the size of the native box turtle, or ~100 mm shell length). Tortoise growth rates depend both on the weather and forage availability. It typically takes between 3 and 6 years for a hatchling bolson tortoise to reach 100 mm.

With their powerful front legs, tortoises dig burrows in which they spend over 95% of their time (Fig. 4.1). The burrows are an important part of a healthy desert ecosystem – providing shelter for myriad other species of mammals, birds, reptiles, and insects.

Fig. 4.1. An adult bolson tortoise basks just inside its burrow on the Armendaris Ranch; bolson tortoises spend upwards of 95% of their time in or near their burrow.

Goal – We aim to establish a free-ranging, minimally managed, wild bolson tortoise populations in the northern Chihuahuan Desert.

Objectives

Captive population – During the next 20 years, we will use captive breeding to produce juveniles to build a large captive population of bolson tortoises.

Wild Population – We will use the captive population to establish up to four wild bolson tortoise colonies on suitable private and/or public lands in the U.S. Each colony will have at least 250 adults, and exhibit: a male to female ratio of around 1:1, stable or positive population growth, and evidence of reproduction.

Activities in 2020

As of December 2020, the bolson tortoise project is comprised of 24 (11:13) adult bolson tortoises on the Armendaris Ranch, four adult tortoises (2:2) at the Living Desert Zoo and Gardens State Park, and two adults (1:1) at the El Paso Zoo. Together, they serve as the founder population for all juveniles produced by the project. The pair of adult tortoises at the El Paso Zoo have not yet contributed offspring. To date, the project has produced over 940 hatchlings, and in 2020, we saw 644 (70%) of these juvenile tortoises alive. During the period 2012-2020, a total of 238 larger juveniles (shell length > 100 mm) have been equipped with transmitters and moved from predator-proof enclosures to predator-accessible enclosures. 185 (78%) of these radio-transmittered juveniles were confirmed to be alive in 2020.

Personnel – The work for this project was carried out by TESF biologists Chris Wiese and Scott Hillard with help from two technicians (Eugene Dicks, Matt Keeling) whose main responsibilities consisted of feeding and watering juvenile tortoises in the headstart pens on the Ladder Ranch (April – October) and helping with tracking tortoises.

Successes and milestones of 2020

The bolson tortoise project reached important milestones in 2020:

- Following a series of communications with NMDGF and USFWS about permitting a "wild" population of bolson tortoises on the Armendaris and Ladder, we organized a field day in October for agency staff to visit the Armendaris and learn more about the bolson tortoise project on the Turner Ranches. This facilitated the issue of relevant permits for TESF to begin releasing tortoises on the Armendaris in 2021. Released tortoises will be studied for 3-5 years to understand the behavior, habitat use, and survival of bolson tortoises in northern Chihuahuan desert habitat.
- We continued the "nesting" research project initiated in 2016. In 2020, we allowed tortoises to nest undisturbed at the Cedar Tank pen. We expect upwards of 50 hatchlings to hatch from these natural nests by summer 2021. To date, we have found and collected 14 of them.
- We continued to take care of ~450 young tortoises in headstart pens. In addition, we regularly tracked ~160 radio-transmittered larger juvenile tortoises housed in outdoor enclosures on the Armendaris and Ladder Ranches.
- In 2020, we stepped up the testing and probing of the oldest and largest female juvenile tortoises for signs of sexual maturity. Dr. Brian Henen (Fig. 4.2) visited the bolson tortoise project in early October 2020 to lend his ultrasonography expertise to assessing the reproductive status of the adult and subadult female bolson tortoises. Bolson tortoises are hypothesized to reach sexual maturity around 15-20 years of age but known age and size of maturing bolson tortoises producing their first egg(s) have not been documented. The oldest female juvenile in our group was 14 years old in 2020. Dr. Henen found that the juvenile bolson tortoises in our project are not yet producing eggs. Furthermore, Dr. Henen documented a total of 134 large oocytes in the reproductive adult females, with all individuals contributing to this count. It will be interesting to see how the oocyte number in the fall relates to total number of eggs produced in the following year.

Fig. 4.2. Dr. Brian Henen uses ultrasonography to detect large oocytes (immature eggs) in adult female bolson tortoise "J"; these large oocytes presumably are the precursors to next year's eggs.

- We moved additional large juvenile tortoises from the headstart pen to the recently renovated "Deep Well" tortoise pen in 2020 to make room in the headstart pen for the more vulnerable smaller tortoises. The Deep Well pen now houses 65 large juvenile tortoises as well as four genetically redundant adult males that were removed from the "Cedar Tank" pen to allow us to better manage tortoise genetics.
- The newest addition to our adult female breeding group, Abby Q, who is on breeding loan to the El Paso Zoo, once again produced a clutch of eggs in 2020 - but unfortunately these appeared to be infertile. The likely reason for this is that Abby Q and her mate, "EP", are only slowly warming up to one another. However, they were observed mating multiple times in fall of 2020. Thus, we are hopeful that Abby's 2021 clutches will produce viable offspring. These would add important genetic diversity to the growing bolson tortoise population in the US.
- To deepen our knowledge of the genetics of our bolson tortoise breeding group, we initiated a collaboration with Dr. JJ Apodaca (Tangled Bank Conservation). Dr. Apodaca uses cutting-edge molecular techniques to study the genetics of various turtle species and is excited about collaborating on our bolson tortoise recovery efforts.
- In the fall of 2019, we began a study of the desert box turtle (*Terrapene ornata luteola*) population near the current bolson tortoise

pens on the Armendaris. In 2020, we continued to find and mark box turtles in the area near the bolson tortoise pens and collected blood samples for genetic analysis as well as recorded morphometric and location data to gain a better understanding of the interactions between box turtles and bolson tortoises in the future. There currently is a paucity of knowledge about the ecology and habitat use of the species of desert box turtle on the Armendaris and Ladder Ranches. We hope to begin expanding our study to include box turtle health information in 2021.

- We continue to collaborate with researchers from Ohio University to study the thermal ecology of desert tortoises (a project that was initiated in 2019). Field work had to be suspended for 2020 due to COVID but will hopefully commence in 2021.
- We also expanded efforts to develop non-invasive and simple methods to sex young tortoises. We collected blood samples from about 30 hatchlings and young tortoises to test a novel method to identify male tortoises based on Western blot analysis to detect the presence of Anti-Mullerian hormone, which occurs only in male hatchlings. The analysis of the blood samples will take place in 2021.
- In 2020, we learned of three large potential bolson tortoises from the community in Williamsburg and Las Cruces. Hoping to identify additional genetically pure bolson tortoises to add to our breeding group, we drew blood from the large male, dubbed "King", that was found in Las Cruces, and submitted the sample for genotyping analysis (results pending). King (Fig. 4.3) exhibits some morphological features of the gopher/bolson tortoise hybrids we have previously encountered in southern New Mexico and four of which reside in the "tortugarium" hybrid sanctuary at the Ladder Headquarters, but only genotyping can identify hybrids for certain. If he is a pure-blooded bolson tortoise, the plan is for King to join Abby Q and EP at the El Paso Zoo. If, on the other hand, he is a hybrid, he will join the four current residents of the tortugarium on the Ladder Ranch. As to the other two "wild" tortoises that were seen near Williamsburg about two years ago, we believe that one of them was already found by local residents and brought to our attention about 1.5 years ago. Genetic analysis revealed that he is a hybrid, and he thus became one of the inaugural members of the Ladder tortugarium in 2019. The third tortoise remains at large.

Fig. 4.3. "King" is a large male tortoise who exhibits some hybrid features but also closely resembles pure-blooded bolson tortoises. We are currently awaiting genotyping results for King.

Captive Breeding Program

Captive adults and subadults – The captive bolson tortoise group on the Turner Ranches consists of 24 adult bolson tortoises: 13 females and 11 males (Table 4.1). An additional 4 tortoises (2 males, 2 females) reside at the LDZG in Carlsbad, NM. In 2018, a new breeding pair was established at the El Paso Zoo. It consists of a large male (EP, found feral in El Paso in 2011) and a large adult female ("Abby Q") that was acquired from the Albuquerque BioPark in February of 2018. EP and Abby Q have not yet produced any offspring. The El Paso Zoo also houses two subadult tortoises (1:1) that were donated to the El Paso Zoo from the Turner Ranches in 2010. Lastly, three bolson tortoise subadults from the Turner group were loaned to the Turtle Conservancy in 2017. They reside at the Behler Center in Ojai, CA.

Table 4.1: Adult and subadult bolson tortoises in the 2020 captive population. LDZG, Living Desert Zoo and Gardens State Park in Carlsbad, NM; TC, Turtle Conservancy.

Tortoise location	Sex	ID
Turner ranches	Female	1,2,4,A,F,G,J,K,L,P,S,T,X
Turner ranches	Male	B,C,D,H,M,N,O,U,W,Y,Z
LDZG	Female	CBF, Mrs. Belaroux (Mrs. B)
LDZG	Male	CBM, Mr. Belaroux (Mr. B)
El Paso Zoo	Female	Abby Q (adult)
El Paso Zoo	Male	EP (adult)
El Paso Zoo	Female	07-CB12 (juvenile)
El Paso Zoo	Male	09-F1 (juvenile)
Behler Center (TC)	Male	11-CB81, 11-CB82, 13-CB120

Husbandry strategies (adult tortoises) – Our approach to managing the adult breeding colony is to be as hands off as possible. Towards this end, we surveyed and health-checked the TESF tortoises in the fall of 2020 but otherwise monitored them only visually. We continued to intensively manage adult females during nesting season (April – July). In addition, we moved four genetically redundant adult males (B, O, H, and N) from the Cedar Tank pen that holds the females to the Deep Well pen to alleviate some stress on the females.

Hatchling production – In most years, we use three steps to produce hatchlings as part of our captive breeding objective:

1. Monitor tortoise nesting using a combination of radiography, weight monitoring, palpation, and direct observation to determine number and maturity of eggs carried by each female tortoise (Fig. 4.4).
2. As the time for nesting approaches, move gravid females to smaller enclosure where they choose nest sites and nests are protected in place.
3. Collect hatchlings, mark them with a unique code, and bank blood for future genetic studies and paternity testing.

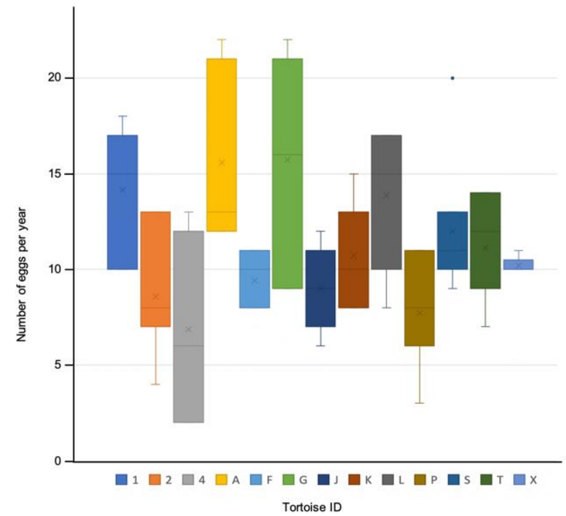


Fig. 4.4. Number of eggs/year for each adult female tortoise on the Armendaris Ranch. Eggs were detected by radiography between 2012 and 2019 (no data for 2017). Horizontal lines in each bar indicates the average. For most females, the number of eggs varies from year to year and probably depends on resource availability. Tortoise "X" is an exception, as she seems to make around ten eggs most years. Most tortoises produce two clutches in a year, but 1-3 clutches were routinely produced in the years represented here.

This protocol has produced at least 50 hatchlings each year between 2010 and 2020. For 2020, we wanted to determine the number of nests and/or hatchlings we would be able to find if we allowed tortoises to nest naturally within their enclosure. We located ten nests out of an expected 30-35 nests. Nests were left in place. Four of the nests were later littered with eggshells, suggesting that they had hatched. We searched for and found 16 hatchlings, of which we collected 14. Two hatchlings could be seen deep in rodent burrows, but we were unable to reach and extract them before onset of hibernation.

Hatchlings – Hatchlings were weighed, measured, and marked with a unique tag that is attached to the shell with two-part epoxy (the tortoises eventually receive PIT-tags as well, but not until they are much larger). We also generated a photographic record for each hatchling and drew a drop of blood for banking and hormone analysis for sexing. Hatchlings were then transferred to the headstart facility on the Ladder Ranch.

The 14 tortoises that hatched on the Armendaris in 2020 bring the total number of tortoises produced by our captive adults to over 900 since project inception.

Hatching success rates – Because we did not follow egg production and nesting as carefully in 2020 as in previous years, hatching success rates in 2020 could not be calculated.

However, overall hatching success rates were relatively consistent for the years 2010 to 2019 and range from a low of 53.4% in 2015 to a high of 69.4% in 2011. Assuming that the 2020 hatching success rate was about average, we would expect about 50 hatchlings in 2020.

Juvenile headstarting – The objective of the headstarting component of the captive bolson tortoise program is to produce large numbers of tortoises for eventual release by maximizing juvenile survival rates until individuals attain a size that is relatively resistant to predation (~100 mm shell length). This involves:

- In most years, overwintering hatchlings indoors during their first winter while providing ample forage and summer-like temperatures.
- Holding juveniles in covered, predator resistant outdoor enclosures until they reach 100 mm shell length.
- Provisioning tortoises with supplemental food (mostly native forage) and water as needed.
- Surveying juvenile tortoises once a year in fall to monitor growth rates (Fig. 4.5) and health.

Since 2006, our captive population has grown from 37 to about 650 tortoises in the population at the end of 2020. The overall survivorship of our captive bolson tortoise juveniles is around 70%, compared with wild juvenile survival rates of between one and 3%

All juvenile tortoises not large enough to be held in unprotected enclosures were managed in headstart enclosures in 2020 with supplemental feeding and watering (Fig. 4.6). Headstart pen maintenance includes grass-clipping and weeding to remove non-forage plants from the enclosures. Wild globemallow plants, wild grape leaves, and prickly pear fruit were harvested from the Turner ranches and provided in the enclosures 3-5 times a week for supplemental feeding (Fig. 4.6).

While individual growth rates vary between animals, headstarted tortoises appear to be growing at acceptable rates (>10% per year) using these protocols.

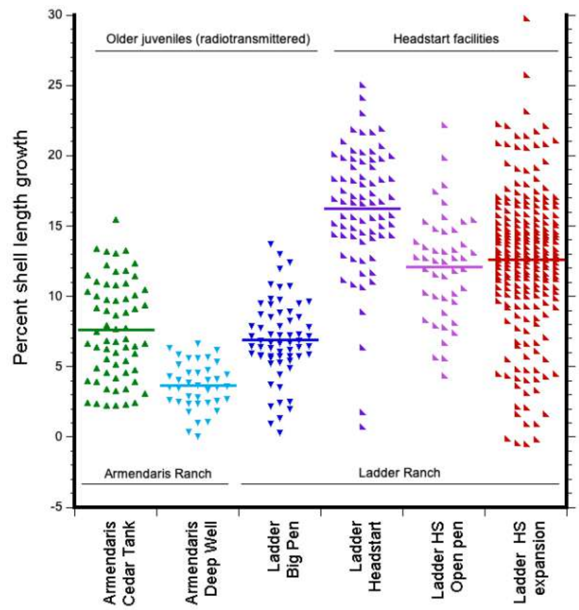


Fig. 4.5. 2020 growth of juvenile tortoise cohorts in subsidized and unsubsidized locations, expressed as percentage of shell length gain in 2020. Triangles = individual tortoises. Colored horizontal lines = mean growth for cohort. Cedar Tank, Deep Well and Ladder Big Pen are predator-accessible unsubsidized enclosures on the Armendaris and Ladder, respectively, that hold radio-transmittered juveniles that subsist on local native forage; Ladder Headstart and Ladder HS expansion are predator-proof subsidized enclosures that hold smaller juveniles. Ladder open pen holds larger juveniles that also receive additional (native) forage and water on a regular basis. This graph shows the effectiveness of our headstart protocols to achieve robust growth.

Fig. 4.6. Prickly pear fruit ("tuna") are a highly sought-after treat for bolson tortoises.

Tortoise Surveys and Health Checks – The usual yearly in-person health checks by reptile veterinarian Dr. Jim Jarchow, DVM, were suspended in 2020 due to COVID. Our health checks during tortoise surveys (weights and measures) in fall 2020 revealed only one small tortoise (CT13) that failed to thrive. We decided to keep CT13 up over winter 2020/2021 to determine whether provisioning it with extra resources will overcome its failure to thrive.

One other tortoise was found with health issues in 2020: male tortoise "O", which had not been seen earlier in the year, was found in mid-September 2020 in a burrow that seemed to have partially collapsed during the winter months but now was open once again. Tortoise O's shell looked unusually dry and scarred. Dr. Jarchow diagnosed this as "keratin degradation from chronic dampness and opportunistic growth of soil saprophytes, bacterial and possibly fungal (Fig. 4.7).

Fig. 4.7. Tortoise O's shell issues: keratin degradation from chronic dampness.

Scrubbing the affected areas with Betadine is usually effective in eliminating the infection but the scutes will remain permanently scarred." We suspect that Tortoise O had been interred in the collapsed burrow but eventually dug himself out. Based on Dr. Jarchow's recommendation, we treated "O" with betadine for three weeks. Aside from the scarred shell, Tortoise O looked and acted normal for the rest of the tortoise active season.

In 2020, we weighed and measured over 600 juvenile tortoises and outfitted 75 juveniles with PIT tags. We also drew blood on 44 hatchling and juvenile tortoises for blood banking and/or hormone assays. Furthermore, we outfitted 20 juveniles with radio-transmitters and swapped out failing transmitters for 24 others.

Release studies – In the fall of 2012, we began outfitting large juveniles (> 100 mm shell length) with transmitters and moving them from the predator-proof headstart enclosures to the predator-accessible fenced areas that also house (or could house) the adults on the Armendaris and Ladder Ranches. Although the ultimate goal is to establish unfenced wild populations, the fenced "releases" provide important information regarding the behavior and predation pressures for released tortoise juveniles until all of the required state and federal permits are in place to allow true, unfenced releases. For example, the release studies thus far revealed that in most years, most of the juvenile tortoises do not travel long distances from the release site. Since 2012, we have transferred a total of 238 juvenile tortoises to predator-accessible (but fenced to comply with permit requirements) enclosures on the Armendaris and Ladder ranches. Of these, we found 178 (78%) to be alive in 2020. We added a total of 45 juvenile tortoises from headstart pens to open enclosures in 2020.

These release studies also revealed that, in general, tortoises were lost for a number of reasons, but not due to one specific predator over others. Problems associated with environmental conditions that contributed to increased incidents of bacterial and fungal infections caused by particularly wet winter conditions were an important factor as well.

In 2017, we obtained a small grant from the Mohamed bin Zayed Species Conservation Fund to outfit ten juvenile tortoises smaller than 100 mm shell length (70 mm - 90 mm) with transmitters and release them in predator-accessible pens to begin to understand predation pressures on small tortoises. All ten tortoises that were part of the study in 2017 were still alive in 2020, but by now have outgrown the experiment. We plan to outfit a new cohort of 10 small tortoises with transmitters to repeat the experiment in 2021.

Future Activities and Considerations – Our major objectives for 2021 will be to:

- Release juveniles outside of enclosures on the Armendaris Ranch. This release will serve as the foundation of a 3–5-year research project to study the survivorship, habitat use, and movement patterns of bolson tortoises in the northern Chihuahuan desert and will also begin to establish free-ranging wild bolson tortoise populations.

- Continue building a robust captive population of tortoises as a source for wild releases.
- Continue to seek and collaborate with additional partners to expand the scope of the bolson tortoise project.
- Continue our search for additional breeding adult tortoises to introduce additional genetic diversity into our breeding group.
- Develop a Safe Harbor Agreement for bolson tortoises on the Turner Ranches.

The methods we will employ to achieve these objectives will include:

- Collecting the hatchlings from genetically underrepresented females, including Abby Q.
- Surveying (weights and measures) tortoises at least once a year.
- Increasing forage availability in headstart pens by supplying native plants harvested from the environment.
- Enhancing available forage in headstart pens.
- Transferring juveniles to free up space in the headstart pens.
- Monitoring released juveniles to track survivorship and movements.

Outreach and other activities – We continued to work with Julia Joos, a graduate student in Don Miles's lab at Ohio University, though the planned 2020 field trip had to be cancelled due to COVID restrictions. Julia is studying the thermal ecology of *Gopherus* species to model the effects of climate change on long-term tortoise survivorship. Julia is planning on returning to the Armendaris Ranch in 2021 for a more extended field season (6 weeks).

We also hosted four SWCA Environmental Consulting staff members in September 2020 to help with development of methods to survey large areas for tortoises and burrows using drones.

We organized a field day in October 2020 to introduce personnel from the NMDGF and USFWS to the bolson tortoise project and discuss plans for establishing wild populations on the Turner Ranches.

Several other visits and events planned for 2020 had to be rescheduled or cancelled due to COVID restrictions.

Appendix

Appendix 4.1. Contributors to the Bolson tortoise project 2006-2020

Type of Support	Individual/Organization
Funding	The Turtle Conservancy Lynnie Appleton AZA Chelonian TAG
Veterinary	Dr. Jim Jarchow, DVM Dr. Peter Koplos, DVM El Paso Zoo
Tortoise Donation	The Appleton family Albuquerque BioPark Susan Serna
Equipment/ Supplies Donation	San Antonio Zoo Dr. Peter Koplos, DVM Holohil Systems Ltd Texas State Aquarium
Volunteer Labor	Heidi Hubble, Matt Keeling, Tricia Rossettie, Dan Martin, Andrew Lincourt, TTR staff, Ladder Ranch staff (Brian O'Dell, John Hurd, Dustin Long, Manny Martinez)
Training	Dr. Stephen Divers, DVM *Endoscopy training*
Intellectual	Dr. Sean Graham
Research	Dr. Vikki Milne, DVM *Endoscopy. Temperature dependent sex determination*
	Dr. Dennis Bramble, PhD (Emeritus)
	Dr. Howard Hutchison, PhD (Emeritus)
	Dr. Donald Miles, PhD Julia Joos, MS *Tortoise thermal ecology*
	Dr. Taylor Edwards, PhD *Bolson tortoise genetics*
	Dr. Robert Murphy, PhD *Bolson tortoise genomics*
	Dr. Brian Henen, PhD *Bolson tortoise reproductive biology*
	Dr. JJ Apodaca, PhD *Bolson tortoise genetics*
	Dr. Charles B. Shuster, PhD *Bolson tortoise sex hormone assays*

5. CHIRICAHUA LEOPARD FROG

(*Lithobates chiricahuensis)*

Project Biologists

Cassidi Cobos

Carter Kruse

Magnus McCaffery

Threats – Range-wide decline of Chiricahua leopard frogs (CLF) due to a suite of factors, including:

- Disease
- Invasive species
- Habitat degradation and loss
- Increased drought event severity/duration

Location

Project Partners

Administrative *Administrative* *Research: Dr. Jamie Voyles*

Background – TESF has worked in partnership with the USFWS, and the NMDGF to conserve the CLFs on the Ladder Ranch since 2001. The conservation value of the Ladder Ranch's 62,950 ha of diverse habitat in New Mexico cannot be overstated. As home to the last, large CLF population in New Mexico, the Ladder Ranch plays a crucial role in the survival of this species. The ranch is one of four CLF Management Areas within the Mimbres-Alamosa CLF Recovery Unit (Fig. 5.1). From a broader conservation perspective, the Chihuahuan Desert Ecoregion is a WWF Global 200 Priority Ecoregion, conservation of which will help maintain a broad diversity of Earth's ecosystems, and the Ladder Ranch itself is recognized as a Key Conservation Area by The Nature Conservancy. Numerous factors are involved in the range-wide decline of this species, including disease, nonnative species invasions, habitat degradation, and an increase in the severity and duration of drought events. Perhaps in response to reduced natural habitat availability and drying climatic conditions, CLF have been found to naturally colonize man-made livestock water tanks.

This behavior motivated us to adapt these tanks for use as escape-proof CLF refugia. These serve the purpose of temporary holding facilities for small, putatively unique populations that are at high risk of extirpation in the wild.

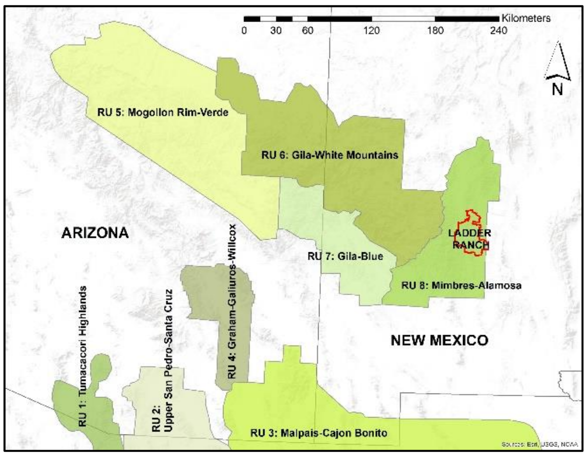


Fig. 5.1. The Ladder Ranch is a CLF Management Area within Recovery Unit (RU) 8.

Goal – To maintain viable CLF population levels on the Ladder Ranch and to contribute to range-wide recovery of the species.

Objectives

Population Objective – Over the next 10 years, we will ensure CLF occupancy of at least 70% of suitable lentic habitats in at least two major drainages on the Ladder Ranch to maintain a minimum of two CLF populations (comprised of > 1 subpopulations) on the Ladder Ranch. At least one subpopulation in each drainage will exhibit a geometric mean growth rate over a five-year period of $\lambda \geq 1.0$.

Habitat Objective – Monitor and manage natural wetlands, stock-water pond habitats, and stream channels in at least two major drainages on the Ladder Ranch (e.g., Seco and Las Palomas creeks) to provide high quality and secure overwintering, breeding, foraging, and dispersal habitat that meets the life history requirements of all life stages of CLFs in to support viable populations on the Ladder Ranch.

Captive Breeding Objective – Over the next 10 years, and in coordination with the USFWS, we will hold adult CLFs from up to nine populations from across the species' range in the captive Ladder Ranch ranarium facility. Adults from each population will be held in isolated population-specific cages and managed to promote breeding. All viable egg masses produced will be managed to optimize successful tadpole emergence, and tadpoles will be reared to late tadpole stage (Gosner 30+) prior to transference to suitable habitat or other captive holding facilities in coordination with the USFWS to assist with this agency's range-wide species recovery objectives.

Captive Holding Objective – Over the next 10 years, we will coordinate with the USFWS to hold captive CLFs from any location within the species' range in up to five artificial refugia sites on the Ladder Ranch (i.e. stock tanks, that will conserve genetically or geographically unique stocks of CLFs in peril (i.e., habitat destruction and disease), or CLFs that require a temporary relocation for their survival (e.g. during a drought that dries a stock tank, a population threatened by ash or sediment flow). Refugia may also serve as a source of egg masses, tadpoles, and adult CLFs for translocation to recovery sites, for augmentation, or to repopulate habitats after environmental disasters. Surplus CLFs from these facilities may also be used for research purposes.

Research Objective – Over the next 10 years, we will work collaboratively with state, federal, and/or academic partners to design and carry out work on at least one research/monitoring project on the Ladder Ranch per year, to inform and support CLF recovery actions and adaptive management. Results from these studies will be used in reports and/or submitted for peer-reviewed publication.

Supporting Rationale for Objectives

The 62,950 ha Ladder Ranch in Sierra County, NM is recognized in the federal CLF recovery plan as an area with a high potential for successful recovery actions, and as such is designated as a CLF Management Area within Recovery Unit (RU) 8 (Fig. 5.1.).

The ranch supports a large CLF population in both natural wetlands and artificial stock water sites. For the frog to be considered for delisting, the recovery plan mandates that each RU has: (i) at least two CLF metapopulations located in different drainages, and at least one isolated population, that exhibit long-term persistence and stability; (ii) aquatic breeding habitats that are protected and managed; (iii) the additional habitat required for population connectivity, recolonization, and dispersal is protected and managed, and that (iv) causes of decline have been reduced or eliminated, and commitments to long-term management. Specific actions to achieve recovery include: (a) protecting remaining populations; (b) identifying and managing currently unoccupied sites and establishing new populations; (c) augmenting populations; (d) monitoring populations; € implementing research to support recovery actions and adaptive management.

Activities in 2020

Wild population monitoring – We monitored all known sites occupied by wild CLF during 2020. Minimum count data from this survey work suggests that the Ladder Ranch population remains robust (Table 5.1). However, this population continues to be largely confined to a single drainage (Seco Creek). Our long-term strategy is to improve the likelihood of CLF persistence on the Ladder by augmenting existing populations and expanding the species' distribution through the creation of a network of natural and artificial wetlands. In 2014, we improved wetland habitat in Las Palomas drainage, and translocated CLF into one of these sites. However, since the sites were created, plains leopard frogs have colonized the area and frogs have tested positive for the fungal pathogen *Batrachochytrium dendrobatidis (Bd)*.

Habitat actions on the Ladder Ranch –

- Cattails were manually removed from Johnson well.
- Cattails were manually removed from Pague well.
- Fish well was dried in attempt to reduce upstream movement by plains leopard frogs (PLF). All visible frogs were captured during this activity. CLF were transferred to Johnson well and all hybrids were euthanized.
- The overflow plumbing at the LM Bar steel tank was fixed and we created additional wetland/pond habitat that connects the existing earthen pond and steel tank overflow.
- Repaired standpipes in No. 2

Table 5.1. 2020 minimum CLF counts at wild sites.

	Minimum Counts			
Site Name	**EM**	**TP**	**MM**	**AD**
[a]Circle 7	0	0	0	1
[b]Davis (Lower)	0	20	11	38
[b]Davis (Upper)	1	10	32	32
[b]N. Seco	107	10	100	154
[b]Pague	5	50	78	87
[b]LM Bar	45	10	49	45
[b]Fish	5	10	0	38
[b]Johnson	70	>100	100	317
[b]S. Seco	0	50	0	0
[b]S. Seco tinaja	0	20	0	0
[c]Artesia	0	0	0	2
[c]Ash Canyon tinaja	0	0	5	6
KEY: **a=Las Palomas drainage** **b=Seco drainage** **c=Ash Canyon drainage**	EM=egg mass TP=tadpole MM=metamorph AD=adult			

Captive refugia program

One of the refugia tanks on the Ladder Ranch (Avant) was stocked with an egg mass and over 1,500 tadpoles from the Beaver Creek source population in 2020 (Table 5.2). Overall, the Ladder's refugia tanks produced 30 viable egg masses in 2020 (Table 5.3).

Table 5.2. Number of egg masses (EM), Tadpoles (T), and metamorph (MM)/adult-form (AF) frogs from source populations (Pop.) stocked into USFWS captive refugia tanks on the Ladder Ranch in 2020.

Refugia	Pop.	EM	T	MM/AF
Antelope	Seco	0	0	0
No. 2	Seco	0	0	0
Seco Well	San Fran	0	0	0
Fox	Animas	0	0	0
Avant	Beaver Cr.	1	1,538	0
Wildhorse	Cuchillo	0	0	0

Table 5.3. Captive refugia egg masses in 2020.

Refugia	No. Egg Masses	No. Viable
Antelope	0	0
Seco Well	11	11
Wildhorse	6	6
Fox	3	3
No. 2	7	7
Avant	3	3

Captive breeding: ranarium program

The ranarium (Fig. 5.2) housed adults from eight off-ranch source populations, spanning three CLF Recovery Units, as well as adults from three on-ranch populations (Table 5.4). Egg masses produced in adult cages were transferred to the integrated tadpole rearing facility.

Table 5.4. CLFs in ranarium cages during 2020.

Cage No.	Source population	No. ♂/♀	Date of entry
1	Seco X Cuchillo	0/2 2/0	5/22/19 7/11/19
2	Alamosa	2/2 1/0	7/27/19 5/22/20
3	Beaver Cr.	2/0	3/29/11
4	ASDM/Kerr N. F. Negrito Divide/LM	2/0 0/1 1/1 1/1	4/26/12 9/18/12 5/6/13 6/12/20
5	Diamond Cr.	2/0	11/2/15
6	Blue Cr.	3/1 0/1 0/2	6/16/14 5/1/15 11/2/15
7	Moreno Spr. Moreno Spr. Moreno Spr. Moreno Spr.	1/0 4/1 0/2 4/4	6/28/12 10/17/12 10/29/13 5/14/20
8	Open	-	
9	Las Animas Cave Cr.	4/2 1/4	6/13/13 6/13/15

KEY:
Cr. = Creek
W.S. = Warm Springs
Spr. = Springs
LM = Long Mesa
Metas = metamorphs

Fig. 5.2. Ladder Ranch ranarium.

There are ten tadpole rearing tanks in the ranarium, which can hold around 1,500 tadpoles each. In 2020, 47 viable egg masses were transferred from adult cages to tadpole tanks (Table 5.5). Tadpoles from these masses were released into the wild, or into captive refugia holding tanks in consultation with the USFWS (Tables 5.5 & 5.6).

The Ladder ranarium produced over 14,000 tadpoles in 2020. These tadpoles were released to wild or captive sites across New Mexico on both public and private lands.

Table 5.5. Ranarium egg mass production and management.

Cage	Source Pop.	# Egg Mass	Egg Mass Laid	TP Exit Date	TP transfer to
1	Seco x Cuchillo	1 1	4/16/20 6/4/20	6/9/20 8/4/20	Cuchillo Wrm. Spr.
2	Alamosa	1 1 1 1 1 1 2	4/2/20 4/3/20 5/1/20 5/20/20 6/7/20 6/8/20 8/20/20	5/21/20 5/21/20 6/17/20 6/17/20 8/6/20 8/6/20 10/1/20	JER
3	Beaver Cr.	1 1.5 1 1 1 1 3 1 0.5	4/2/20 4/4/20 4/19/20 4/21/20 5/1/20 5/17/20 5/26/20 6/25/20 8/21/20	9/3/20 9/3/20 9/3/20 9/3/20 6/22/20 6/22/20 6/22/20 8/26/20 10/6/20	Beaver Cr, Feedlot
4	San Fran	1 1 1 1 1	5/9/20 6/14/20 6/25/20 7/6/20 8/2/20	6/12/20 8/3/20 8/3/20 8/3/20 9/25/20	Hell's Hole, Tularosa River
5	Diamond	1 1 1 1	5/1/20 6/7/20 6/23/20 9/9/20	6/22/20 8/26/20 8/26/20 10/6/20	Black Creek
6	Blue Cr.	1 1 1 1 1 1	5/1/20 5/17/20 6/16/20 6/22/20 6/24/20 7/6/20	6/17/20 6/17/20 6/17/20 8/6/20 8/6/20 8/6/20	JER
7	Moreno	1 3	7/8/20 8/1/20	10/6/20 10/6/20	East Tank
9	Animas	2 2 1 1 1	5/17/20 6/7/20 6/17/20 7/10/20 7/24/20	5/18/20 6/8/20 7/20/20 9/3/20 9/3/20	Cave Creek, Artesia

KEY:
Alamosa = Alamosa Warm Springs
Animas = Animas Creek
Diamond = Diamond Creek
Beaver Cr.= Beaver Creek
Blue Cr. = Blue Creek
San Fran = San Fran Haplotype
Moreno = Moreno Warm Springs
TP = Tadpoles

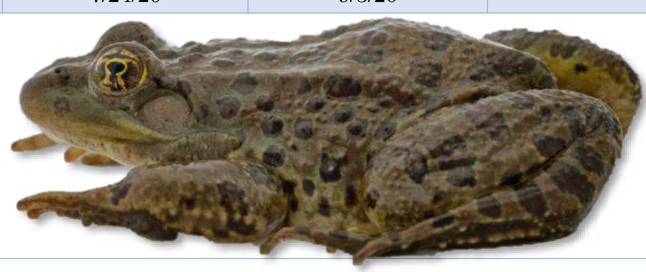


Table 5.6. Production and disposition of offspring produced at the ranarium in 2020.

Date	Source	EM	TP	Meta	Release type
5/18/20	Animas	2	-	-	W
5/18/20	Beaver	2.5	546	-	C
5/18/20	Beaver	2	920	-	C
5/21/20	Alamosa	2	286	-	C
6/8/20	Animas	2	602	-	W
6/8/20	Animas	2	-	-	W
6/9/20	Seco x Cuchillo	1	284	-	-
6/12/20	San Fran	1	54	-	W
6/17/20	Alamosa	2	853	-	C
6/17/20	Blue	2	1	-	C
6/17/20	Blue	1	-	-	C
6/22/20	Beaver	5	852	-	W
6/22/20	Diamond	1	66	-	W
7/20/20	Animas	1	194	-	W
8/3/20	San Fran	3	422	-	W
8/4/20	Seco x Cuchillo	1	127	-	W
8/6/20	Alamosa	2	656	-	C
8/6/20	Blue	3	2780	-	C
8/26/20	Beaver	1	429	-	W
8/26/20	Diamond	2	152	-	W
9/3/20	Animas	2	52	-	W
9/25/20	San Fran	1	147	-	W
10/1/20	Alamosa	2	1035	-	C
10/6/20	Beaver	0.5	72	-	C
10/6/20	Diamond	1	347	-	W
10/6/20	Moreno	4	1636	11	W

KEY:
Animas = Animas Creek
Diamond = Diamond Creek
Beaver = Beaver Creek
Blue = Blue Creek
San Fran = San Fran Haplotype
Moreno = Moreno Warm Springs
Seco = Seco Creek
Cuchillo = Cuchillo Negro Warm Springs

EM = # of egg masses
TP = # of tadpoles
Meta = # of Metamorphs
W = Wild
C = Captive

Hybridization – Over the last few years Plains leopard frogs (*Lithobates blairi*) have been detected in Animas, Seco, and Las Palomas drainages. In 2018, while capturing frogs at Johnson well, we found several odd-looking frogs that had characteristics of both CLF and PLF (Fig. 5.3). CLF and PLF hybridization has not been previously recorded.

We conducted two studies to investigate if these two species were hybridizing. First, we set up four artificial tanks and crossed CLF and PLF (2 CLF females x 2 PLF males, 2 PLF females x 2 CLF males, 2 CLF females x 2 CLF males, 2 PLF females, 2 PLF males). Unfortunately, no breeding occurred in any of the tanks. The second part of our study focused on whether the odd-looking frogs we were seeing in the wild were genetically hybrids. To do this, we collected 20 CLF, 20 PLF, and 20 hybrid looking frog toe clippings from a variety of locations on the ranch. All samples were sent to Pisces Molecular for analysis and the results showed evidence of hybridization between the two species.

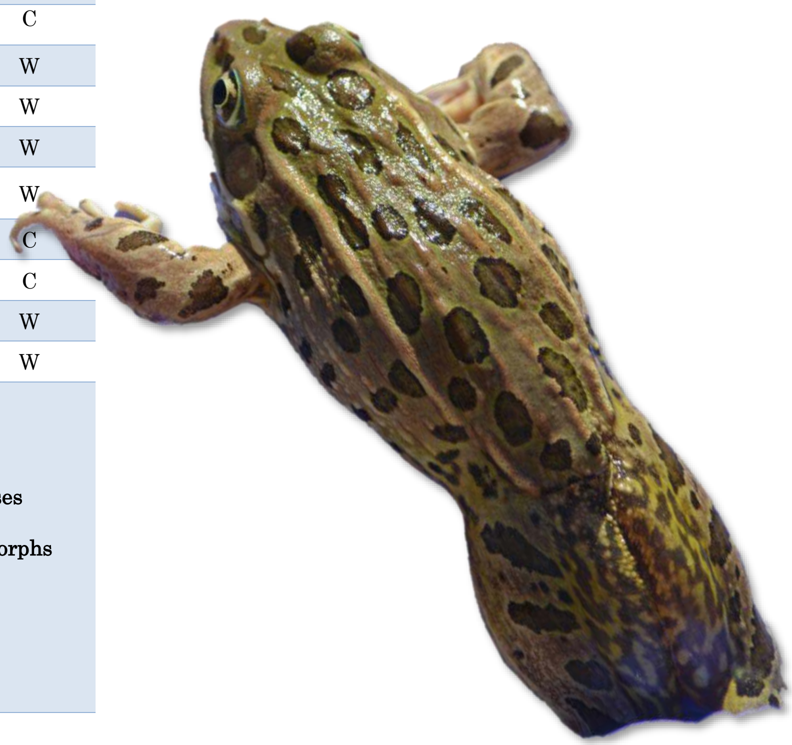


Fig. 5.3. Hybrid CLF x PLF found at Johnson well.

6. CUTTHROAT TROUT

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

NOT LISTED

Westslope Cutthroat Trout
(*Oncorhynchus clarki lewisi)*

Montana Fish, Wildlife & Parks

Montana State Listing Designation

Species of Greatest Conservation Need

Rio Grande Cutthroat Trout
(*O. c. virginalis)*

New Mexico Department of Game & Fish

New Mexico State Listing Designations

Species of Greatest Conservation Need

Biologists

Eric Leinonen

Carter Kruse

Threats – Cutthroat trout have declined due to competition and introgression with introduced salmonids, as well as habitat degradation and exploitation. Westslope cutthroat trout (WCT) once occupied about 90,800 km of streams and rivers in the upper Columbia and Missouri basins of Montana, Wyoming, and Idaho. The overall range of genetically pure populations has been reduced by 76%, with habitat loss most pronounced east of the Continental Divide where range contraction has exceeded 95%. Montana Fish Wildlife and Parks classifies this the subspecies as a Species of Greatest Conservation Need. Rio Grande cutthroat trout (RGCT) historically ranged in about 10,700 km of habitat in the upper Rio Grande basin of Colorado and New Mexico. Now, genetically pure RGCT are restricted to around 8% of their historical range, and the subspecies is considered a Species of Greatest Conservation Need by the New Mexico Department of Game and Fish and Colorado Parks and Wildlife. Both WCT and RGCT have been petitioned for listing under ESA but found not warranted, in part because of conservation activities underway.

Partners

Funding/Management

Management

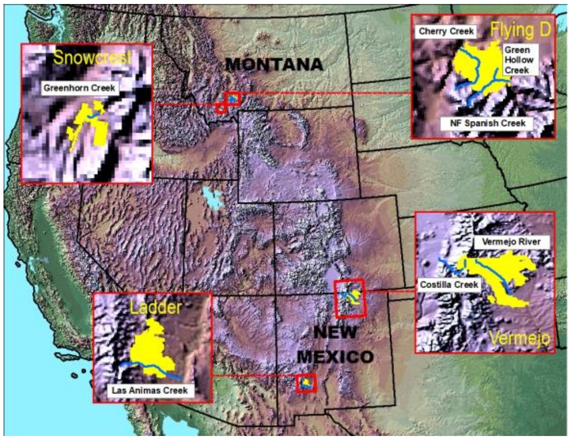
Research/Funding

Funding

Research

Research/Management

Locations



Project Recognition

- Collaborative Group Award (MT AFS)
- Collaborative Aquatic Stewardship Award (USFS)
- Conservation Achievement Award (AFS)
- President's Fishery Conservation Award (AFS)
- NM Governor's Excellence Award for Wildlife Conservation
- Sustaining Forest and Grassland Award (USFS)

Background

Range-wide conservation agreements among management agencies and non-governmental organizations are in place to guide conservation and restoration activities for WCT and RGCT across jurisdictional boundaries. Objectives outlined in these documents include: securing and monitoring known cutthroat trout populations; seeking opportunities to restore or found new populations, especially over large areas and including private lands; identifying or locating any additional wild populations; coordinating conservation activities among resource agencies and non-governmental organizations; and providing public outreach and technical assistance. These range-wide objectives for cutthroat trout conservation are consistent with the mission of Turner Enterprises and fit within the land management framework on the Turner Ranches. Most importantly, the Turner family has been supportive of cutthroat restoration, embracing the risks inherent with large-scale native trout restoration. The TBD program developed a *Cutthroat Trout Initiative* to catalyze cutthroat restoration or conservation activities on 400 km of stream across the seven projects described below (Table 6.1). This is the most comprehensive and ambitious private effort on behalf of native cutthroat trout. Efforts to restore or conserve cutthroat trout are underway in seven streams on four ranches, with the overall goal of improving the range-wide status of RGCT and WCT and preventing listing under the ESA using the following strategies:

- Selection of reintroduction sites that encompass large geographic areas and have high quality, diverse habitats capable of supporting robust cutthroat populations with diverse life-history strategies.
- Elimination of non-native competitors at reintroduction sites through physical and/or chemical renovation/prevention of recolonization.
- Establishment of a self-sustaining cutthroat population large enough to withstand environmental and demographic stochasticity and likely to persist over the long-term (>100 years) with little or no human intervention.
- A monitoring strategy that includes research partnerships to evaluate key project aspects and allows adaptive management of all strategies and methods.

The cutthroat trout is native to the Rocky Mountain and coastal areas of the western US and is classified into as many as 14 subspecies. The seven major inland subspecies of cutthroat trout historically occupied most accessible cold-water environments from Canada to southern New Mexico. However, all subspecies have incurred significant range reductions primarily due to competition and introgression with introduced salmonids, but also from habitat degradation and exploitation. Lahontan (*O. c. henshawi*) and greenback (*O. c. stomias*) cutthroat trout are listed as threatened under the ESA and the other inland subspecies have either been petitioned for listing under the ESA or are considered species of concern by state and federal agencies. Recovery and conservation efforts are underway for all major subspecies, with many notable successes; however, such efforts are hindered by ongoing non-native invasions, limited opportunities for large-scale projects, social resistance, changing habitat conditions (e.g., climate change), and past, widespread introductions of cutthroat trout subspecies outside their native ranges.

Table 6.1: 2001 Turner Native Cutthroat Trout Initiative						
Catalyze cutthroat trout restoration or conservation activities in 400 km of stream.						
Stream	Ranch	Species	Partners	Size (km)	Type	Status
Costilla	**Vermejo**	**RGCT**	**NMDGF, CPW, TU, USFS, USFWS**	**175**	**Piscicide**	**Project complete Research and monitoring ongoing**
Cherry	**Flying D**	**WCT**	**MT FWP, USFS, WCS, USFWS, MSU, ISU**	**100**	**Piscicide**	**Project complete Research and monitoring ongoing**
Las Animas	**Ladder**	**RGCT**	**NMDGF, USFS**	**48**	**Piscicide**	**Project complete Monitoring ongoing**
Greenhorn	**Snowcrest**	**WCT**	**MT FWP, USFS, BLM, MT FF**	**32**	**Piscicide**	**Project complete Research and monitoring ongoing**
Vermejo	**Vermejo**	**RGCT**	**NMDGF, USFWS, NMSU**	**45**	**Electrofishing Piscicide Biological**	**Hybrid removal ongoing Barrier/piscicide planning YY brook trout research ongoing Monitoring ongoing**
NF Spanish	**Flying D**	**WCT**	**MT FWP, USFS, NFWF, WNTI, MT FF, TU, NWE**	**30**	**Piscicide**	**Piscicide treatment ongoing**
Green Hollow	**Flying D**	**WCT**	**MT FWP**	**4**	**Electrofishing**	**Removals ongoing Eradication (95%)**

The Turner organization and ranches are ideally situated to play an important role in cutthroat trout conservation. The Flying D, Snowcrest, Vermejo, and Ladder ranches all contain large, connected sections of high-quality cold-water stream habitat within the historical range of WCT and RGCT. In conjunction with neighboring public lands these ranches encompass entire stream headwaters, an important consideration when prioritizing and securing restoration sites. Although small restoration projects (e.g., <15 km of stream) are important to preserve presence and genetic variability on the landscape, cutthroat conservation projects most likely to succeed over the long-term are those encompassing large areas that connect multiple, local sub-populations and allow expression of multiple life histories; thus, inferring a better chance of withstanding localized extinctions and changing habitat conditions.

Through the *RGCT* and *WCT Range-Wide Conservation Working Groups*, TBD has partnered with public agencies and other private organizations to implement two of the largest cutthroat trout restoration projects ever undertaken in the United States.

Cherry Creek – Planning for the Cherry Creek Native WCT Project on the Flying D Ranch was initiated in 1997. Logistical and legal issues delayed field work (e.g., piscicide application) until 2003. Chemical application was completed in 2010 and restocking by 2014. The project encompasses approximately 100 km of stream habitat and 3 ha of lake suitable for cutthroat trout.

Introductions of WCT into Cherry Creek were done primarily by stocking eyed eggs into remote streamside incubators (RSIs). Approximately 37,000 eyed eggs were stocked into RSIs from 2006-2010 which resulted in 27,000 surviving fry. Another 8,850 hatchery reared fry were stocked into the lower portions of the project area (e.g., the Butler Reach), along with about 6,500 age-1 triploid WCT. This was the first time triploid WCT had been successfully produced and stocked into Montana waters. Annual monitoring of the restored WCT population from 2012-20 shows that the number of fish increased rapidly post-treatment and is now similar to pre-treatment population abundance and average size. The WCT population in Cherry Creek exceeds a conservative estimate of 50,000 individuals.

The Cherry Creek project is a significant conservation achievement for WCT on the east side of the continental divide. This project increases the extent of stream occupied by WCT in the Madison River basin from 7 km to over 100 km or from 0.3% of historical occupancy to almost 5%. On an even larger scale, prior to the Cherry Creek project, WCT occupied an estimated 750 km (4.2%) of their historic range in the Missouri River Drainage;

nearly all of these populations were in 1st or 2nd order streams, restricted to 8 km of habitat or less, and with flows of 0.08 m^3/s or less. The Cherry Creek project increased occupied habitat by 100 km and included a 4th order watershed with as much as 0.57 m^3/s stream flow. Perhaps more importantly the success of, and lessons learned from the Cherry Creek project has catalyzed several other cutthroat trout re-introduction projects in southwestern MT and across the region. For example, by 2015, WCT occupied an estimated 1,030 km (5.8%) of historical range in the Missouri River Drainage due to restoration activities. Montana Fish Wildlife and Parks (MTFWP) has conducted annual mark-recapture electrofishing population estimates in a 6.4 km section of the Madison River immediately adjacent to the Cherry Creek confluence since 1967 to monitor naturalized populations of rainbow trout and brown trout (*Salmo trutta*) in the river. Few, if any, cutthroat trout were historically captured in this section. MTFWP began capturing WCT in 2012, and in March 2016, captured 130 WCT between 180- and 360-mm. Anglers are now pursuing WCT in the river and reporting their catches to FWP. In 2016, anglers reported catching WCT in the river as far as 37 km downstream of Cherry Creek.

A Candidate Conservation Agreement with Assurances (CCAA) regarding the Cherry Creek project was signed in 2009. This document established that if TBD allowed WCT to be established in the Cherry Creek project area TEI would not be held to additional regulatory obligations if WCT were listed under ESA in the future. Further, the document preemptively permits any incidental take of WCT that might occur during regular ranching or recreational activities if the species was listed.

Five graduate students have worked on the Cherry Creek project and several scientific articles have been published in the North American Journal of Fisheries Management, Transactions of the American Fisheries Society, and Restoration Ecology, as well as a book chapter entitled "*Collaboration, Commitment, and Adaptive Learning Enable Eradication of Nonnative Trout and Establishment of Native Westslope Cutthroat Trout into One-Hundred Kilometers of Cherry Creek, a Tributary to the Madison River Montana*". Research and monitoring regarding genetic variability, growth, survival, and movement of the recovering WCT continues.

Costilla Creek – The Costilla Creek Native RGCT Project on Vermejo Park Ranch in New Mexico and Colorado is the most ambitious watershed renovation project ever completed on behalf of any cutthroat trout, encompassing approximately 175 km of stream habitat (60% on Vermejo Park Ranch, remainder on Carson National Forest) and 18 lakes (all on Vermejo). Fieldwork on the Vermejo portion of the project was initiated in 2002 and completed in 2016 with the 2nd treatment of Costilla Reservoir. Restocking of RGCT with multiple age classes of hatchery reared fish was completed in 2019. The project represents a 20% increase in the amount of stream occupied by genetically pure RGCT within their historical range.

This project would not have been initiated without Turner support and is the flagship restoration effort on behalf of RGCT for the New Mexico Department of Game and Fish (NMDGF). Planning and implementation of the Costilla Project is largely responsible for the development of consistent NM state guidelines regarding the use of piscicides, and for re-development of NMDGF native cutthroat trout hatchery brood stock; both important steps for range-wide conservation of the species.

The project was not without short-term setbacks. Following the initial treatment (2002) and restocking of upper Costilla Creek (i.e., first phase of the project) rainbow trout (*O. mykiss*) were inadvertently introduced by NMDGF into the restoration area. Despite best efforts to physically remove, rainbow x cutthroat hybrids were detected by 2007 and phase I was retreated in 2008. However, the Colorado sourced fish used to restock the phase the second time was determined, with advancements in genetic testing, to contain Colorado River cutthroat trout genetics and treated for a 3rd time in 2014 to remove those fish. Ultimately the entire project area was successfully treated and restocked by 2019. Population monitoring is conducted on an annual basis and suggests that restored RGCT populations in the upper watershed (earlier treatments) are similar in size and abundance to pre-project levels and increasing steadily in the lower project area. 2019 gill netting sample in Costilla Reservoir showed that RGCT in the reservoir were already up to 14 inches in size.

A CCAA regarding the Costilla Creek project was signed in 2013. Like the Cherry Creek project, this CCAA document recognizes the conservation actions implemented by TBD on behalf of RGCT and provides operational assurances to Vermejo Park Ranch should the species become listed under ESA.

Vermejo River – This is the only project in the *Cutthroat Trout Initiative* where aboriginal cutthroat trout are known to remain on Turner Ranches. This conservation population of RGCT on Vermejo Park Ranch is threatened by competition with nonnative brook trout (*Salvelinus fontinalis*), hybridization with rainbow trout, and declining habitat quality (e.g., increased stream temperatures and turbidity). In an effort to maintain the population TBD removed approximately 29,000 brook trout from the upper 36 km of the Vermejo River from 2010-16. More importantly, 20 confirmed rainbow *x* cutthroat trout hybrids and 1 rainbow trout (from Leandro Creek in 2015) were removed from the watershed from 2010-15. The source of this low-level rainbow trout invasion was unknown, but unscreened fishing ponds on upstream neighbors were initially suspected. Unfortunately, in 2016 an additional five rainbow trout and 15 hybrids were found in Leandro Creek. These fish were almost certainly the result of rainbow trout escaping from Vermejo's fishing lakes via overflow. A focused effort was made in 2017 to detect and remove rainbow and hybrid rainbow *x* cutthroat trout from Leandro Creek. In 2017 a 15 km section of Leandro Creek was intensively shocked to remove all brook trout, as well as any other fish two years old or younger (e.g., potential hybrids). With this effort 1548 brook trout were removed, 560 adult RGCT were captured and released, and 630 young rainbow, cutthroat, and/or hybrid trout were removed. A subsample of 63 young fish (10%) was genetically tested and 23 were confirmed hybrids. Thus, we estimate that up to 230 cutthroat *x* rainbow hybrids were removed from Leandro Creek. Vermejo Park Ranch has been encouraged to monitor lake water levels more closely and screen lake outlets to prevent escape; both Munn and Bernal Lake outlets have been fitted with fish screens. TBD is working with Vermejo Park Ranch on a more permanent solution for conservation of cutthroat trout in the Vermejo River, which might include future piscicide renovation. So far, physical removal of non-native or hybrid trout has helped keep the genetic status of Vermejo River RGCT at least 99% pure, but it is an unsustainable activity over the long term and a more permanent resolution to the hybridization issue is needed.

In 2017 TBD and Vermejo Park Ranch agreed to a proposal from NMDGF to stock "Trojan" YY brook trout males into Leandro Creek as part of an experiment to determine if a high proportion of hatchery derived (with hormone treatment) YY males stocked into a population, coupled with physical fish removal, can drive it to extinction by producing only normal XY male offspring (i.e., YY male x XX female = only XY "normal" males). A successful outcome could provide an alternative to chemical removal of brook trout. This work is ongoing and being administered by NMDGF and NM State University, supported by TBD.

Drought cycles and chronic over browsing by wildlife and livestock have negatively impacted the riparian habitat along the upper Vermejo River. Reduced riparian vegetation and limited woody plant recruitment have destabilized banks and impacted water quality to the detriment of native fishes and riparian obligate species. In 2014 and 2015 TBD received $141,000 in grants (50% cost share) from New Mexico Partners for Fish and Wildlife (US Fish and Wildlife Service) to construct ten ½ mi long x 8 ft high exclosure fences along sections of the upper Vermejo River. The fences are designed to exclude large ungulate grazing. Two exclosures were completed in 2014, four more in 2015, and two additional in 2016. Construction of the final two fences occurred in 2017. Ultimately, the goal is to enhance riparian conditions over the next decade and restore beaver (*Castor canadensis*) to promote long-term riparian health, RGCT persistence, and natural water storage in the upper Vermejo system. Monitoring of improvements inside the exclosures is underway and includes vegetative photo points, water temperature measurements, fisheries surveys, and macroinvertebrate collections.

Las Animas Creek – This project was undertaken to restore the native fish community (i.e., RGCT, Rio Grande sucker, and Rio Grande chub; *see Rio Grande sucker and chub project*) to the upper 48 km of Las Animas Creek. Approximately half of the project area is located on the Ladder Ranch, with the remainder on the Gila National Forest. All three species are of conservation concern and have been petitioned for listing under ESA (RGCT were determined to be not warranted for listing in 2014). This project experienced administrative and political delays since its conception in 1998; however, a draft environmental assessment (DEA) by the USFS for the project was issued in early 2014. The DEA concluded a rotenone treatment to remove non-native longfin dace (*Agosia chrysogaster*) and hybridized rainbow *x* Yellowstone cutthroat trout from the project area was the best option to restore the native fish community. However, while the DEA was being developed the 138,000-acre Silver Fire burned the entire Gila National Forest portion of the watershed in summer 2013. Subsequent monsoon rains resulted in multiple, significant debris, sediment, and ash flows, drastically changing the instream habitat. Population surveys in 2014, 2015, and 2016 indicate that the fire and its aftermath killed or displaced most of the fish in the project area. Non-native longfin dace survived in off-channel refugia not impacted by debris flows and were observed in 2015. Limited numbers of Rio Grande chub were also observed for the first-time post fire in 2016. Hybrid trout and Rio Grande sucker appeared to have been extirpated by the effects of the fire. Subsequently, NM Department of Game and Fish and TBD decided not to conduct a rotenone treatment to remove the longfin dace. Electrofishing surveys in 2018-20 continue to confirm the extirpation of non-native hybrid trout and native Rio Grande sucker due to the 2013 Silver Fire, as well as a robust recovery of non-native long fin dace and a slower recovery of native Rio Grande chub in Las Animas Creek. A 2016 watershed assessment indicated that instream habitat was sufficiently recovered to support a small population of RGCT, thus NMDGF stocked 198 RGCT from Canones Creek into upper Las Animas Creek on the Gila National Forest in 2017 and 2018. This will provide an important replicate and genetic reservoir for that population. TBD has captured and moved several hundred Rio Grande suckers from Palomas Creek into two locations on Las Animas Creek in attempt to restart the extirpated sucker population, with no evidence of success yet. Sixty Rio Grande chub were also stocked into Las Animas Creek to supplement the recovering chub population.

NF Spanish Creek – WCT are nearly extinct in the Gallatin River watershed. Restoring WCT to approximately 30 stream km in upper NF Spanish Creek on the Flying D Ranch would be a significant conservation gain and establish an important beachhead for additional WCT restoration in the Gallatin watershed. Currently only 0.5% of the historically occupied stream habitat (1,690 km) in the Gallatin watershed contains genetically pure WCT. The majority of this project is on public land, thus MTFWP and the USFS administered the public scoping and environmental assessment process. A public scoping letter for the project was published in early 2016 and an EA was drafted. Construction of a fish migration barrier to prevent non-native trout from moving upstream into the project area was completed in fall of 2018. Piscicide treatment was initiated in headwater lakes Chiquita and Big Brother in 2019.

Greenhorn Creek – This 32-km project area, including the NF and SF of Greenhorn Creek, was successfully treated with rotenone for two consecutive years in July 2013 and 2014. The project partners conducted extensive electrofishing and eDNA surveys in 2015 to determine if non-native trout persisted. The detection and removal of a single brook trout delayed introduction of WCT until 2016. In August of 2016 Greenhorn Creek was stocked via a wild transfer of 322 adult fish from six remnant populations of WCT in the upper Missouri River Basin. 319 additional WCT from the same six sources were stocked in 2017 and a final 51 fish were translocated from Jack Creek to Greenhorn Creek in

August of 2018. Starting in 2019 TBD funded a graduate student through University of Montana to look at genetic diversity and population demographics following restoration in Greenhorn Creek. This project is ongoing, but sampling in 2019 and 2020 provide evidence that the population is growing rapidly. Once a viable population of WCT recovers, this project will represent the largest population of WCT in the Ruby River watershed.

Green Hollow Creek – In an effort to reduce disease and competitive pressures on the Green Hollow II Arctic grayling conservation brood stock (*see grayling project*), TBD has mechanically (i.e., electrofishing) removed brook and rainbow trout from upper Green Hollow Creek since 2003. Since 2006 only brook trout have been captured. In 2010, the focus of the removal program shifted from reduction to elimination in anticipation of reintroducing WCT to upper Green Hollow Creek (above Green Hollow Reservoir II). Removal activities are conducted opportunistically as scheduling allows. The total number of fish removed to date is 14,936 and annual catch has been less than 100 individuals the last five years, down from a high of over 3,500 fish in 2012, albeit with much reduced effort. Continued focused effort will be needed over the next 3-5 years to remove all brook trout from upper Green Hollow Creek. MTFWP is exploring upper Green Hollow as a potential refugia site for Gallatin Drainage WCT stocks.

Goals – Restore or enhance self-sustaining populations of native cutthroat trout on Turner Ranches and surrounding landscapes to improve conservation status of subspecies. Contribute information on cutthroat trout to the scientific community to improve our understanding of these subspecies and their conservation status.

Objectives – Over a two-decade period TBD will lead or catalyze restoration or improvement of native cutthroat trout stocks in 400 km of stream (Table 6.1) within the interior Rocky Mountain west to advance the species conservation and recovery, serve as a model for large scale conservation efforts on private landscapes, and contribute to conservation science through innovation, implementation, and research in the field. Cutthroat trout restoration and conservation projects will include at least two subspecies of cutthroat trout, be implemented in at least 6 sites, and include at least one meta-population (multiple, connected streams) restoration effort per subspecies. Restored populations will be allopatric and exhibit minimum mean densities of 100 adult (i.e., ≥ 120 mm total length) fish per kilometer with successful recruitment (i.e., young of year fish or multiple age/size classes present) at least once every three years. TBD will work with state and federal partners to advance the overall species conservation and recovery by implementing research and monitoring opportunities that result in publication of at least five peer reviewed scientific articles.

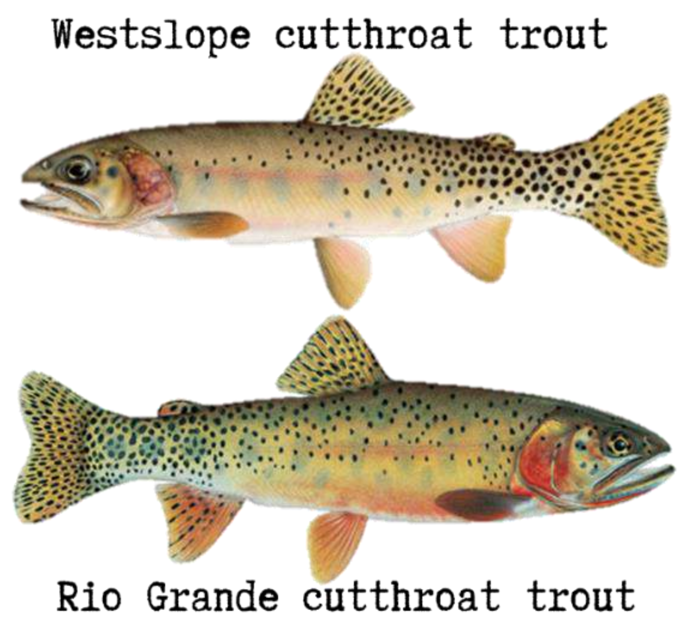
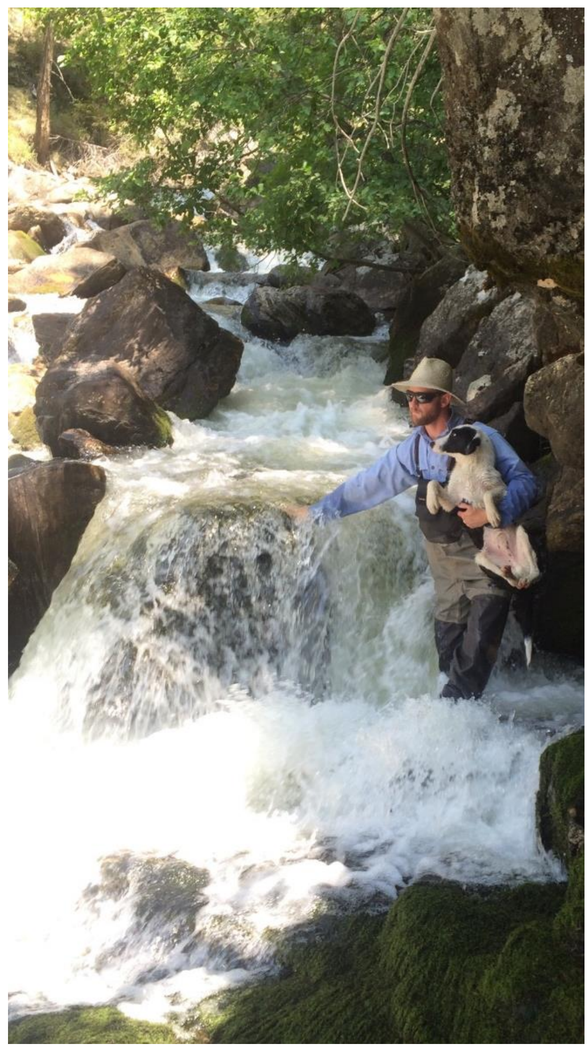


Fig. 6.1. A healthy WCT captured in Butler Reach of Cherry Creek, September 2020.

Activities in 2020

Cherry Creek – Five long-term monitoring sites were sampled in 2020. Results indicate that the restored WCT population continues to do well (Fig. 6.1), with anglers reporting high catch rates. No non-native trout have been captured in the project area since piscicide treatments were completed in 2010. Research efforts on Cherry Creek have been scaled back, but several data sets related to the restoration and population recovery continue to be analyzed for publication. In 2020 project partners finalized a manuscript entitled "*Evaluation of Remote Site Incubators to Incubate Wild- and Hatchery-Origin Westslope Cutthroat Trout Embryos*" that was accepted for publication in the North American Journal of Fisheries Management. TBD maintained a partnership with University of Idaho to assist with genetic analyses related to success of founder stocks. A scientific manuscript regarding relative founder stock success in Cherry Creek is under development. TBD continues to look for a disease free, genetically related source of Rocky Mountain sculpin to stock into the Cherry Creek restoration area. We tested Rocky Mountain sculpin from Elk Creek on the Flying D Ranch as a potential source, but they were genetically divergent from sculpin found in lower Cherry Creek and not a good candidate for translocation. Lower Cherry Creek is not a viable source for sculpin due to presence of whirling disease.



TBD fish crew, Eric and Frank, below Cherry Falls: the terminal barrier for the Cherry Creek westslope cutthroat conservation project

Costilla Creek – A reduced level of annual monitoring within the lower reaches of the project area indicated steady recovery of a self-sustaining RGCT population. Wild-born young-of-year and age 1 RGCT observed throughout lower Costilla and lower Casias creeks provided evidence of two successful reproductive events following initial introduction of hatchery sourced fish. Fish numbers and average size within these lower sites are below but returning to levels measured pre-treatment. Guest anglers used the Costilla Basin in growing numbers in 2020 and averaged nearly 5 fish caught per hour when effort and catch were recorded. Work continued on removing the three large temporary fish barriers that facilitated the restoration - in 2019 the upper fish barrier on Costilla Creek was removed and in 2020 the Casias Creek fish barrier was removed (Fig. 6.2a and b). The final, and largest barrier on lower Costilla will be removed in 2021.

Vermejo River – The genetically pure, aboriginal RGCT within the upper Vermejo River watershed on Vermejo Park Ranch represent a notable demographic and genetic contribution to overall status of RGCT within the larger Canadian River basin, where 12 remaining populations occupy only 10% of the subspecies historic range in the basin. Multiple fish movement barriers have been built in the upper Vermejo River watershed to facilitate short term conservation of RGCT. These barriers have created four population fragments with restricted upstream fish movement: upper Leandro (RGCT restored above a wooden barrier at ranch/Forest Service boundary in 1997), middle Leandro (culvert barrier near Governors Cabin to facilitate Trojan brook trout study in 2018), Little Vermejo (gabion/shotcrete barrier installed in 1998 to isolate pure RGCT from hybridization), and the mainstem Vermejo River-Ricardo Creek. A fourth, gabion style barrier installed in 1998 on Ricardo Creek failed in the 2007. The upper Leandro and Little Vermejo populations are small, but valuable populations because they have been protected from rainbow trout hybridization events (*as described in Project Background above*). However, isolation management (i.e., above a fish barrier) can have long term consequences for smaller populations (<1000). Stochastic events and inbreeding depression are two major concerns for isolated populations, notwithstanding the threats from non-native competition (brook trout), hybridization (rainbow trout), and habitat degradation that threaten the entire upper Vermejo River.

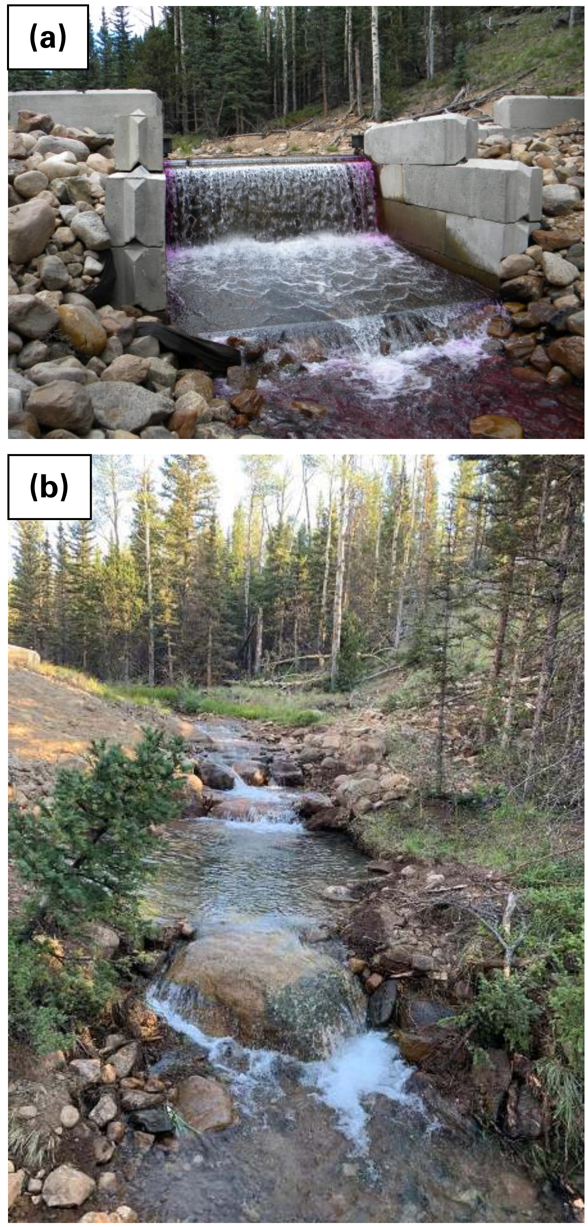


Figure 6.2. (a) Casias Creek barrier in operation during rotenone treatment, August 2011, (b) Casias Creek following barrier removal, August 2020. Note white aspen trunk in both photos.

In 2020, to better understand the impacts of barriers on genetic diversity, the isolated upper Leandro Creek population was compared genetically with the remainder of the upper Vermejo River RGCT. Tissue samples were collected (n=89) from Upper Leandro and Middle Leandro. These samples were compared to the library of upper Vermejo basin genetic samples collected between 2011-2017 (n=312). Importantly, the two Leandro Creek populations tested as genetically pure RGCT. Results further indicated that the isolated upper Leandro RGCT are genetically less diverse than the overall basin and becoming more genetically distant (or distinct). Future management actions could include transfer of fish among populations to enhance overall genetic diversity and to prevent continued genetic drift in isolated subpopulations. Funding from the Western Native Trout Initiative helped support this genetic work.

Las Animas Creek – No monitoring of the RGCT in Las Animas Creek occurred in 2020.

NF Spanish Creek – TBD, along with primary project partners MTFWP and US Forest Service, completed the second year of rotenone treatment in the project area in August (Fig. 6.3). Treatment on the headwater lakes and associated inlet and outlet streams is complete, and the remainder of the project area will be treated for a final time in 2021. Treatment of Willow Swamp on the Flying D Ranch has been challenging but moving forward.

Greenhorn Creek – The University of Montana graduate student funded by TBD successfully completed a second year of demographic and genetic sampling in Greenhorn Creek in 2020. The restored WCT population continues to grow and is reaching carrying capacity. Laboratory and data analyses associated with this project is ongoing.

Green Hollow Creek – No effort was spent capturing brook trout in upper Green Hollow Creek in 2020.

Fig. 6.3. Dye testing to determine streamflow patterns in NF Spanish Creek, August 2020.

7. LESSER PRAIRIE-CHICKEN

(*Tympanuchus pallidicinctus)*

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

STATUS REVIEW

Project Biologists

Grace Ray

Carter Kruse

Project Partners

Administrative

Funding

Threats – Rapid, range-wide decline due to habitat loss and fragmentation.

Background

The lesser prairie-chicken project at the Z Bar represents one of TESF's newest conservation efforts on Turner properties. Beginning in early 2015 we began to manage 32,525 acres to benefit lesser prairie-chickens through a cooperative 10-year agreement with WAFWA. Central to the agreement is habitat restoration, which includes the removal of woody vegetation from the uplands on 1,949 acres, prescribed fire in each pasture at least once every ten years, and a prescribed grazing plan intended to help create the vegetative mosaic required by lesser prairie-chickens. By year two of the project, we had satisfied all required habitat restoration and grazing requirements (Fig. 7.1). In March 2016, 41,000 acres of the Z Bar burned in what ended up being the largest wildfire in Kansas history. Ecologically, the Z Bar largely benefitted from the fire as it served to refresh native grasses, increase ecosystem heterogeneity, and eliminate invasive woody brush and trees from the uplands; all to the benefit of lesser prairie-chickens. Because of this wildfire no prescribed burns were performed in 2016 or 2017.

Over the course of this project lesser prairie-chickens have routinely been observed and sightings at the Z Bar appear to be increasing; however, we have yet to verify that lesser prairie-chickens are reproducing on the ranch.

Fig. 7.1. An upland site on the Z Bar *before* (in 2012) and *after* mechanical removal of eastern red cedar and prescribed fire.

Goal – Restore ~25,000 acres of the Z Bar mixed grass prairie to a condition suitable for lesser prairie-chickens, and to integrate the project into existing bison production and black-tailed prairie dog restoration efforts at the ranch.

Objective – We will increase lesser prairie-chicken numbers at the Z Bar by managing for a diverse landscape mosaic that includes breeding, nesting, and brood rearing habitats within close proximity to each other.

Strategies

- Prescribed fire to improve brood rearing habitat and control woody vegetation. Pastures will be burned at least once every 10 years.
- Mechanical removal of woody vegetation from the uplands to limit avian predation and improve suitable lesser prairie-chicken habitat.
- Using grazing to produce a mosaic of habitats that include lightly grazed pastures with robust standing vegetation, and heavily grazed pastures with minimal standing vegetation.

Supporting Rationale for Objective

The Z Bar once supported a modest lesser prairie-chicken population with at least 2 lek sites on the ranch. The population has since decreased, with only occasional sightings of individuals now reported. The Western Association of Fish and Wildlife Agencies (WAFWA) recommends habitat blocks (i.e., lek complexes) of 21,000 – 25,000 acres to support a viable prairie-chicken population. The 42,500-acre Z Bar has sufficient existing and potential habitat to meet that lek complex requirement.

Activities in 2020 – While lesser prairie-chicken sightings at the Z Bar continue to increase, it is unlikely the ranch supports a breeding population. This assumption is supported by the annual lek surveys that are performed by the TESF, WAFWA, and the TNC over the past six years, which have not detected any leks on the ranch. Having confirmed with relative certainty the Z Bar does not support a breeding population of lesser prairie-chickens we have begun the process of critically evaluating suitable habitat and population trends to determine whether conditions support translocating prairie-chickens to the ranch. A graduate student working through TEI/TESF and Montana State University has been tasked with evaluating the specific habitat suitability of Z Bar Ranch compared to the surrounding areas that do host lesser prairie-chickens and their breeding habitat.

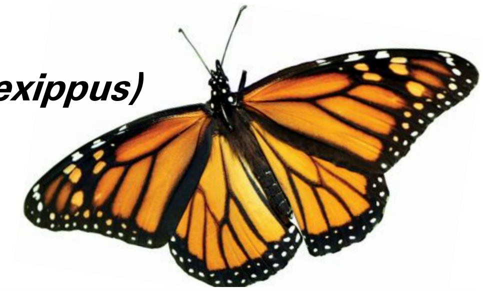
Results from WAFWA's 2020 lesser prairie-chicken habitat surveys indicate the Z Bar continues to make good progress in restoring necessary habitat. For example, in each of the last five years the ranch has surpassed predicted habitat values. There remains, however, one additional habitat component–brood-rearing habitat–which may also be population limiting at the ranch. To remedy this shortcoming, we petitioned and received permission from WAFWA to increase bison grazing in 2019 which, in combination with an increase in prescribed fire, should result in an increase in that specific habitat type. In 2020 we continued to improve on lesser prairie-chicken habitat by utilizing targeting bison grazing and by conducting four prescribed fires averaging approximately 400 acres each in size.

Proposed Future Activities & Considerations

The direction of the lesser prairie-chicken project at the Z Bar hinges on whether we can document reproduction and an increase in the population over the coming years. Existing habitat evaluation metrics suggest the habitat requirements for the species have been met at the Z Bar, yet the population remains low. Our continued effort will work towards determining why the on-ranch chicken populations remains low. Whether due to vegetative composition, vegetative community structure and arrangement, distance from source populations, or a combination of the aforementioned factors, or others. Evaluation of these parameters will be completed by 2022, resultant of the MSU graduate research collaboration with TEI/TESF. This research will help guide next steps for the lesser prairie-chicken project and determine the likelihood of natural repopulation or illuminate the need for managed translocations. In the meantime, TESF/TEI, WAFWA, and our additional project partners continue our diligent efforts in researching and understanding habitat needs of the lesser prairie-chicken by incorporating focused bison grazing, prescribed fire, thorough monitoring of habitat conditions, and a final "cleanup" of the remaining eastern red cedars at the Z Bar Ranch.

8. MONARCH BUTTERFLY (*Danaus plexippus)*

U.S. Fish & Wildlife Service
Listing Status under the Endangered Species Act
STATUS REVIEW



Project Biologist

Magnus McCaffery

Threats – The primary threat to monarch butterflies is habitat loss and pesticides.

Location – Z Bar Ranch, KS; Bad River Ranches, SD; Avalon Plantation, FL; Ladder Ranch, NM

Background

In response to the unprecedented decline of such an iconic insect, TESF teamed up with federal, state, and non-profit partners to initiate multiple monarch butterfly habitat conservation and recovery projects on Turner properties. Central to this effort will be restoring preferred monarch host plants on Turner properties, and adapting management practices to benefit these early successional, disturbance-loving plants.

Beginning in 2015, we began annual milkweed surveys at Avalon, Z Bar, and Bad River to determine species abundance and diversity to guide restoration efforts. Results indicated a robust redring milkweed (*A. variegata*) community but few other species at Avalon, while Z Bar supports the most diverse milkweed community of the Turner properties where nine species were identified–many of which persist in relatively large stands. Both Avalon and the Z Bar support vibrant and robust wildflower communities; a reflection of the sensible use of prescribed fire on those landscapes. Two milkweed species have been documented at Bad River, with showy milkweed being the most common.

We have investigated two principal methods to increase milkweed diversity and abundance: seed plantings and plug plantings, with the latter showing more promise for restoring an extirpated milkweed species. Plug plantings at Avalon and seed plantings at Bad River originated from local ecotype specimens, whereas the seed and plug plantings at the Z Bar and plug plantings at Bad River were regionally sourced.

Partners

Funding

Goal – Restore native milkweed and other wildflowers to benefit monarch butterflies and other native pollinators.

Objective – Increase suitable habitat for monarch butterflies and other native pollinators on Turner properties through milkweed (*Asclepias spp.*) and other native wildflower plantings. Within five years, we aim to reestablish robust, reproducing populations of swamp milkweed (*A. incarnata*) at Z Bar and Avalon to include > 500 plants at four sites on each property. At Bad River we will collect seeds from extant showy milkweed (*A. speciosa*) stands and distribute them in recently disturbed areas. We will also determine if showy milkweed is an effective vegetative barrier to black-tailed prairie dog expansion.

Strategies – We will increase pollinator habitat through milkweed plantings and habitat management. At the Z Bar and Bad River, we will collect local milkweed seeds and broadcast those seeds in unoccupied suitable habitat. At Avalon we will collect swamp milkweed seeds, germinate them in plug pots and plant them in unoccupied suitable habitat.

Supporting Rationale for Objective

Most Turner properties lie within the spring and fall migration routes of the monarch butterfly (Fig. 8.1) and can reasonably be expected to support monarch populations with restoration and conservation of milkweeds and other wildflowers. The Z Bar and the Avalon are particularly well suited to monarch butterfly conservation because both properties support prescribed fire which results in diverse wildflower communities. Both are also located where the first generation of monarchs migrating north from Mexico lay eggs, setting the foundation for the species' multi-generational transnational migration.

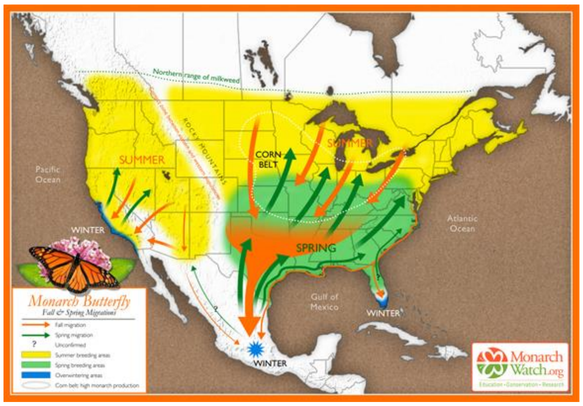


Fig. 8.1. Monarch butterfly migration routes.

All Turner properties have extant populations of milkweed which are beneficial as nectar and pollen sources for native pollinators. However, most of those milkweed populations are sparse and homogenous, and some milkweed species are less desirable than others as host plants for monarch butterflies (Fig. 8.2).

Fig. 8.2. Female tarantula hawk (*Pepsis spp.*) feeding on nectar from a broadleaf milkweed (*A. latifolia*) plant at the Z Bar. While not a highly preferred monarch host plant, broadleaf milkweed is a valuable nectar source for monarchs and other native pollinators.

At Avalon and the Z Bar, a highly preferred host plant for monarchs—swamp milkweed—is largely absent, while at Bad River another preferred host plant—showy milkweed (Fig. 8.3)—exists, but in widely scattered and small stands. Why these two preferred host plants are uncommon—particularly swamp milkweed at Avalon and Z Bar—is unknown although it seems likely that it is a legacy of herbicide use at those properties. With assisted colonization and habitat management we aim to increase the suitability of these properties for monarch butterflies and all native pollinators.

Fig. 8.3. Showy milkweed is ubiquitous throughout the western U.S. and is found on all Turner properties in the Great Plains. Showy milkweed is a preferred monarch host plant, and we are attempting to improve existing stand vigor and establish new stands at the Z Bar and Bad River.

Activities in 2020

Due to travel restrictions associated with the COVID-19 pandemic, we scaled back our milkweed planting and monitoring efforts at Avalon, Bad River, and Z Bar. However, we were able to begin milkweed work at the Ladder Ranch in 2020, where we planted showy and swamp milkweed around the ponds adjacent to Ladder HQ.

9. RIO GRANDE SUCKER / RIO GRANDE CHUB

Rio Grande sucker (*Catostomus plebeius*) & Rio Grande chub (*Gila pandora)*

U.S. Fish & Wildlife Service
Listing Status under the Endangered Species Act
STATUS REVIEW

Colorado Parks & Wildlife
Colorado State Listing Designation
Species of Greatest Conservation Need

New Mexico Department of Game & Fish
New Mexico State Listing Designations
Species of Greatest Conservation Need

Rio Grande sucker (*Catostomus plebeius)*

Colorado Parks & Wildlife
Colorado State Listing Designation
Endangered

Project Biologists

Eric Leinonen

Carter Kruse

Threats – Range-wide declines of RGS and RGC have occurred due to habitat alterations, predation and competition from non-native fishes, loss of genetic variability, and vulnerability to stochastic events. Once common throughout the mainstem Rio Grande River and its tributaries, RGS and RGC are now isolated in a few small, headwater streams, primarily due to mainstem impoundments, diversions and water withdrawals on tributaries, and introduced fishes, and at risk of local extirpations from stochastic events such as wildfire, drought, or destructive high flow events. Historical range for both species is poorly defined, so extent of decline is difficult to enumerate. Recent information suggests that RGS occur at only two sites in CO, and < 25 populations in NM. In their 2013 petition to list RGC under the ESA, WildEarth Guardians suggested this species remained in only 25% of historically occupied habitat in the Rio Grande basin.

Partners

Funding/Management

Funding

Management

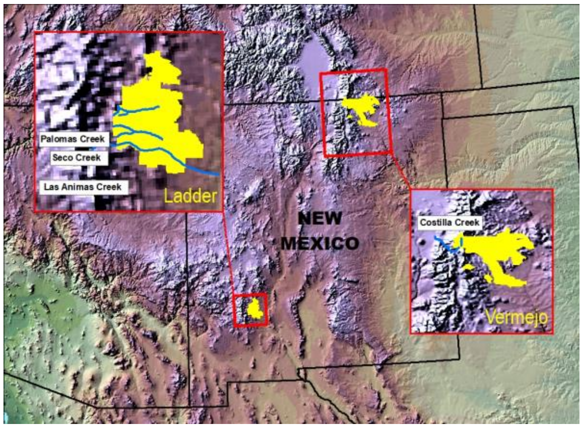
Genetic processing/Data Analysis

THE UNIVERSITY OF NEW MEXICO

Genetic processing/eDNA development

ROCKY MOUNTAIN RESEARCH STATION

Locations



Background

When purchased by the Turner organization in 1992, three streams on the Ladder Ranch – Palomas, Seco, and Las Animas creeks – contained both RGS and RGC as reported in early biodiversity reports. These populations were confirmed by TBD during electrofishing surveys in spring 2003. Although all three streams are tributaries to the Rio Grande River and were historically connected, water diversion, mainstem dams, and non-native fish populations have isolated these populations from each other.

In summer 2003, two separate fires burned approximately 2,266 and 1,817 hectares of the Gila National Forest in the headwaters of North Seco and Palomas creeks, respectively. Although these fires occurred outside of the boundaries of the Ladder Ranch, summer monsoons resulted in a series of ash and sediment flow events that affected RGS and RGC in both drainages. In Seco Creek, RGS and RGC declined 98% and 80%, respectively. Effects in Palomas Creek were similar. The populations recovered relatively quickly and by 2007-08 densities were similar to 2003. This severe population bottleneck event led TBD to partner with UNM to investigate genetic diversity of these isolated RGS populations. Results of that work were published in the journal Conservation Genetics in 2015.

In summer 2013, the Silver Fire burned 138,698 acres of the Gila National Forest, including large portions of the Las Animas and Seco creek headwaters. Subsequent monsoon rains led to several significant ash and debris flows in these two creeks. Palomas Creek was less affected. Fisheries surveys by TBD from 2014-16 confirmed the extirpation of RGS and RGC from Seco Creek, and the loss of RGS and near extirpation (99% decline) of RGC in Las Animas Creek (non-native trout were also extirpated from Las Animas Creek as result of fire associated flow events). 2017 monitoring showed that RGC had begun to recover in Las Animas Creek, but RGS still were not found. RGS or RGC remained absent in Seco Creek; but good numbers of both species were sampled in Palomas Creek. NMDGF approved a TBD proposal in 2017 to translocate RGC and RGS from Palomas Creek back into Seco and Las Animas creeks. Beginning in 2018, modest numbers of RGC and RGS have been collected annually from Palomas Creek and translocated into Animas and Seco Creeks. This effort is ongoing.

In 2016, TBD received a State Wildlife Grant from NMDGF to develop environmental DNA markers for use in detecting RGS and RGC in the environment with a water sample. TBD collected genetic samples from 30 RGC and 17 RGS populations in New Mexico and Colorado and worked with the National Genomic Center for Fish and Wildlife Conservation at the University of Montana, Missoula, to develop and test the eDNA markers. The results of that work were summarized in a Project Completion Report, as well as a draft scientific publication. The field sensitivity trials showed that DNA from a single large chub was detectable in a water sample up to 500 m downstream of the fish location. These results will assist resource managers in efficiently detecting species presence and identifying the current range of RGS and RGC.

Although currently identified as suitable habitat within their historic range, Neither RGS or RGC have ever been sampled in Costilla Creek (tributary to Rio Grande) on Vermejo Park Ranch. It is unknown if the habitat is in fact unsuitable, or if extirpation occurred due to anthropomorphic habitat changes (creation of Costilla Reservoir) and/or predation by an introduced non-native trout population (now restored to native Rio Grande cutthroat trout). Restoration potential of RGC and RGS in Costilla basin will be considered in the coming years, as the RGCT populations become more established within the Costilla system.

Goals

Conserve and restore self-sustaining populations of RGS and RGC on Turner Ranches and surrounding landscapes to enhance the conservation status of both species. Contribute information on RGS and RGC to the scientific community to improve our understanding of these species and their conservation status.

Objectives

Through 2030, TBD will lead or catalyze restoration or improvement of Rio Grande Chub and Rio Grande Sucker stocks in 100km of stream across appropriate habitat on and adjacent to Turner owned properties. TBD will work with State and Federal partners to advance the overall species conservation and recovery, serve as a model for large-scale conservation efforts on private landscapes, and contribute to conservation science through innovation, implementation and research in the field. Restoration and conservation projects will be implemented in at least 4 sites:

- Las Animas Creek, Ladder Ranch – RGC & RGS
- Seco Creek, Ladder Ranch – RGC & RGS
- Palomas Creek, Ladder Ranch – RGC & RGS
- Costilla Creek, Vermejo Park Ranch – RGC & RGS

Restored populations of RGC will be allopatric and exhibit minimum mean densities of 100 adult RGC (i.e., $\geq$ 90 mm total length) fish per wetted kilometer with successful recruitment (i.e., young of year fish or multiple age/size classes present) at least once every three years.
Restored populations of RGS will be allopatric and exhibit minimum mean densities of 100 adult RGS (i.e., $\geq$ 75mm total length) fish per wetted kilometer with successful recruitment (i.e., young of year fish or multiple age/size classes present) at least once every three years.

Range-wide conservation strategies among management agencies and non-governmental organizations have been finalized for both RGC and RGS. These documents will guide conservation and restoration activities for RGC and RGS across jurisdictional boundaries. Objectives outlined will include: securing and monitoring known populations; seeking opportunities to restore or found new populations, especially over large areas and including private lands; identifying or locating any additional wild populations; coordinating conservation activities among resource agencies and non-governmental organizations; and providing public outreach and technical assistance. These range-wide objectives for RGC/RGS conservation are consistent with the mission of Turner Enterprises and fit within the land management framework on the ranches.

Activities in 2020

TBD was unable to host a seasonal fisheries crew at Ladder Ranch for annual RGC/RGS monitoring given the early challenges of Covid-19. Monitoring efforts did occur in all three creeks but were reduced to spot-surveys throughout Las Animas and Seco Creeks and single pass depletion efforts at two previously established sampling reaches in the Gallinas reach of Palomas Creek. Numerous RGC and RGS were found in Seco Creek. RGS reproduction was documented for the first time since reintroduction in 2018 with the detection of young-of-year (YOY) RGS (Fig. 9.1).

Fig. 9.1. One of many YOY RGS (~35mm) found in Seco Creek.

YOY RGS and RGC were abundant at multiple locations in Seco Creek. No RGS were detected in either the upper or lower reaches of Las Animas creek, despite the 405 individuals transferred into the system in 2018 and 2019. RGC were present throughout the perennial reaches of Las Animas above and below Ladder ranch HQ. Predation pressures from non-native Green Sunfish and crayfish are suspected to be a primary limiting factor for RGS recovery in Lower Las Animas. Extensive habitat and a small population have likely hampered detection of any RGS persisting in Upper Las Animas Creek. The limited sampling in Palomas Creek suggested the RGS population was like previous years, and robust enough to support a collection event for transfer into Las Animas Creek (Fig. 9.2). Collection efforts occurred across 2 km of Palomas creek. Individual RGS were collected from alternating 100 m sections, where only every 10th RGS over 50 mm but under 100 mm in length and every 5th RGS under 50 mm was eligible for collection. Total collection effort yielded 250 RGS gathered for transfer into Animas Creek. Unlike previous years, smaller fish were targeted for collection. No length measurements were made of the transferred fish, but approximately 100 of the 250 RGS were less than 50mm. This collection methodology has been applied all three years of transfer efforts and has minimized impacts on the overall RGS population size structure (Fig. 9.3). Total RGS collected, and transfer destination are detailed in Table 9.1. No RGC were collected from Palomas for transfer in 2020.

Table 9.1. Total RGS translocated between 2018-2020. Palomas negative numbers reflect fish collected for transfer into Seco and Las Animas.

Site	2018	2019	2020	Total
Seco	225	100	0	325
Upper Las Animas	120	130	200	455
Lower Las Animas	100	50	50	200
Palomas	-550	-280	-250	-1080

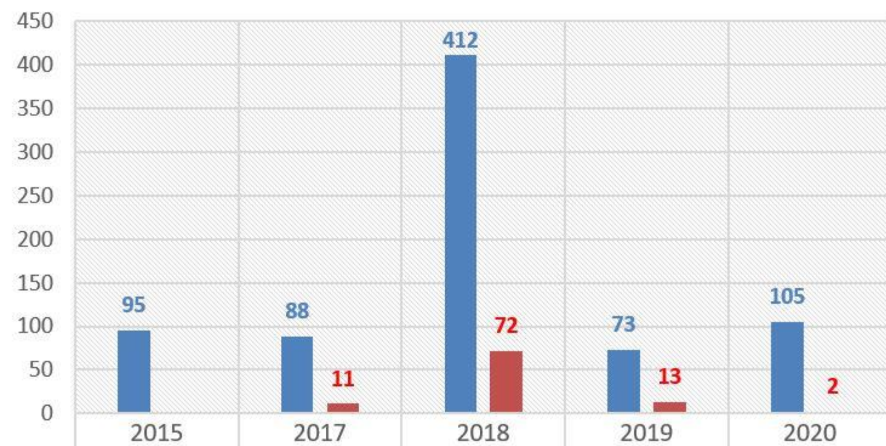


Fig. 9.2: RGS (blue) and RGC (red) population estimates per/100m show RGS numbers have remained stable throughout the past four years. The high number of fish observed in 2018 is somewhat anomalous, and likely a response to ideal annual flow regime and increased habitat from beaver activity within the Galina Springs section of Palomas Creek.

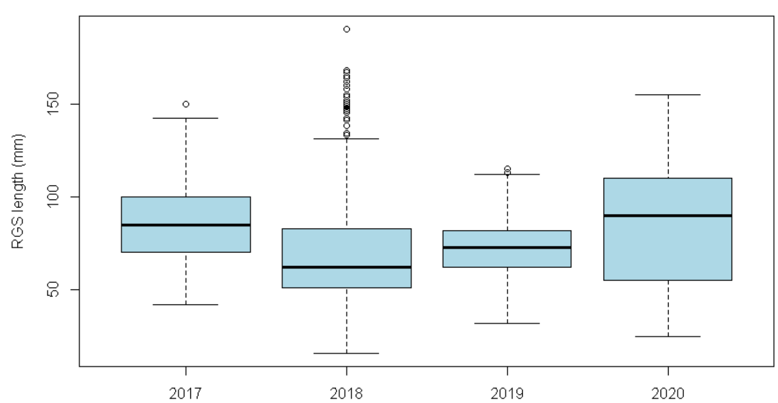


Fig. 9.3: Boxplots presenting the size structure of RGS within the section of Palomas Creek supporting collection efforts for transfer into Seco and Las Animas Creeks.

10. RED-COCKADED WOODPECKER

(Picoides borealis)

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

ENDANGERED

Project Biologists

Greg Hagan

Mike Phillips

Threats – Red-cockaded woodpecker populations are in decline due to habitat destruction and degradation.

Location

Partners

Administrative, Funding

Administrative

Background – RCWs depend on mature pine forests that have longleaf pines averaging 80-120 years old, or loblolly pines averaging 70-100 years old. In the last century, RCWs have declined as pine habitats changed through timber harvest and agriculture. Pine savannah and open forest encompassed over 200 million acres at the time of European colonization, and longleaf pine communities covered 60-92 million of those acres. Today, fewer than 3 million acres remain. RCWs once ranged from Florida to Maryland and New Jersey, west to Texas and Oklahoma, and inland to Missouri, Kentucky, and Tennessee. RCWs are a cooperative breeding species, living in family groups consisting of a breeding pair, which may also include one or two male helpers (females can also become helpers, but do so at a lower rate than males). The limiting habitat requirement for RCWs is the availability of tree cavities, which the birds excavate in live pine trees. RCWs are the only North American woodpecker to excavate cavities in living trees, with the excavation of a new cavity often taking several years to accomplish. A group of cavity trees occupied by a potential breeding group (an adult female and male, with or without helpers) is termed a cluster, and is the metric used to measure RCW populations.

In 1998, we initiated a collaboration with the USFWS to reintroduce RCWs to the Avalon Plantation. This involved translocating 10 birds/year for five successive years to Avalon, and was the first effort by a private landowner, state or federal agency to reintroduce a population of woodpeckers into an area with no remaining extant population.

While the population expanded steadily during the first nine years of the project, during 2007-2009 there were signs that growth was slowing. An assessment of cluster status was undertaken in 2010, where it was determined the population comprised 13 active groups, 2 inactive groups, and 6 abandoned groups (i.e., showing no evidence of RCW activity for 3+ years). An aggressive approach was undertaken to restore the abandoned clusters, establish new recruitment clusters in priority habitat, and cavity tree management. These actions had a positive effect, with the population reaching 20 active groups, 4 inactive groups, and 1 abandoned group by the end of 2018 (Fig. 10.1); the highest number of active clusters on Avalon since project inception.

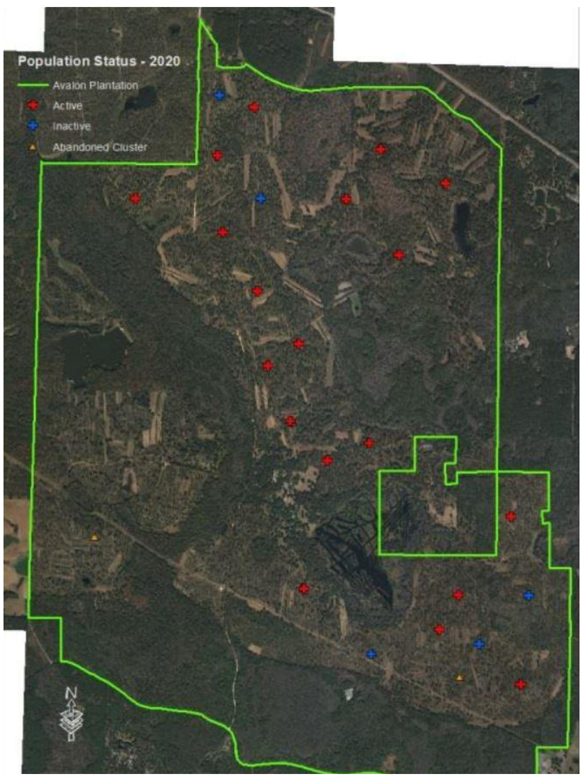


Fig. 10.1. 2020 RCW Cluster Status at the Avalon Plantation.

Goal – Restore red-cockaded woodpeckers to the Avalon Plantation.

Objective – Restore at least 20 breeding groups to the Avalon Plantation that can persist with minimal management. Once this is achieved, Avalon will be available as a donor site for translocations to other recovery sites.

Strategies

- Restoring abandoned clusters (an aggregate of cavity trees) by providing ≥ 4 artificial cavities per abandoned cluster.
- Establishing recruitment clusters by installing ≥ 4 artificial cavities per recruitment cluster.
- Using fire to maintain RCW habitat suitability.
- Pre-burn mowing (2 acres) around all clusters to protect cavity trees from prescribed fire.

Activities in 2020

Cluster Status - Comprehensive cluster surveys were conducted in March, June, August, and October 2020 to ascertain activity status, demographics, and cavity tree composition. A total of 25 RCW clusters were located throughout the property–19 active groups, 4 inactive groups, and 1 abandoned are currently established on the property (Fig. 10.1). While the 2020 population declined by one cluster (2019 = 20 active clusters), the population is doing well overall. For example, numerous new natural cavity trees (active and inactive) were discovered throughout active clusters. This is a positive sign demonstrating Avalon's pine overstory is suitable for the species.

Supplemental Cavities – No supplemental cavities were installed in 2020. All clusters maintained the minimum number of 4 cavity trees.

Cavity Tree management – All clusters and cavity trees were mowed in late January 2020 in advance of the burning season. Cavity trees were marked with pink flagging prior to mowing and the burn season. 40 acres were mowed at active clusters, and 8 acres were mowed at inactive clusters (2 acres/cluster).

Prescribed Fire – Prescribed fire was used to burn approximately 6,000 acres of the Avalon Plantation in March and April 2020. This included 1,500 acres on active clusters and 300 acres on inactive clusters.

Proposed Future Activities & Considerations

In 2020, we developed a 5-year plan (Table 10.1) to expand the RCW program beyond Avalon Proper by developing RCW populations at the Avalon Annex and the Nonami Plantation. We aim to initiate this plan in 2021 with the establishment of three recruitment clusters – with each cluster comprising four artificial cavities in suitable RCW habitat – at both the Avalon Annex sub-unit and the Nonami Plantation.

RCWs can disperse long-distances from natal sites, with reports of between-population dispersal events ranging from 66 km–160 km. Recruitment clusters located on the Annex would be within 11 km of the RCW clusters at Avalon Proper, and would have a good chance of being colonized by dispersers from this population (Fig. 10.2). Recruitments clusters situated at Nonami would be within approximately 30 km of the nearest RCW clusters at the Ichauway Plantation (Fig. 10.3) and would also have the potential to be found and colonized by dispersing RCWs. If recruitment clusters on the Annex and/or Nonami are not naturally colonized by dispersal after two annual dispersal periods (i.e., mid-Oct to mid-Dec. of 2021 and 2022), we would shift to a translocation approach to establish RCWs at the Annex and Nonami.

Table 10.1. Proposed 5-year project implementation schedule:

Timing	Activity
2021: April-September	Identify 6 recruitment cluster sites (3 at Avalon Annex, 3 at Nonami)
2021: Early October	Install artificial cavities to establish 6 exploratory recruitment clusters (3 at Avalon Annex, 3 at Nonami)
2021: Mid-Oct. to Mid-Dec. (1st dispersal)	Monitor recruitment clusters for RCW establishment
2022: Early October	Recruitment cluster maintenance. Establish additional, aggregated recruitment clusters if RCW immigration detected
2022: Mid-Oct. to Mid-Dec. (2nd dispersal)	Monitor recruitment clusters for RCW establishment via dispersal
2023: January	Monitor. If no RCW establishment at recruitment clusters via dispersal, plan translocations
2023-2026: October	If no RCW establishment at recruitment clusters via dispersal, implement annual translocations. Monitor.

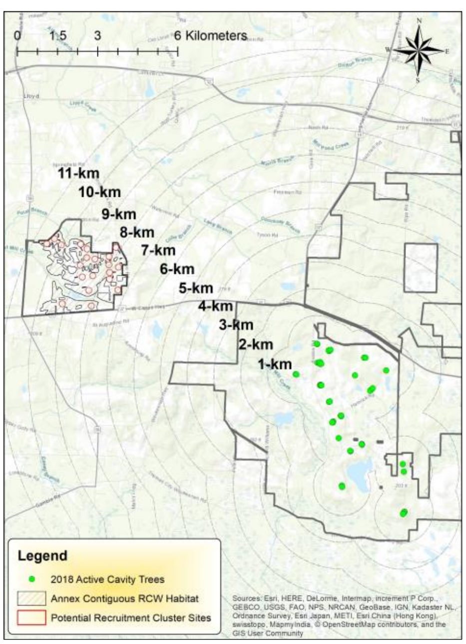


Fig. 10.2. The location of suitable RCW habitat and potential 10-acre recruitment cluster sites relative to active RCW clusters at Avalon Proper. Buffers at 1-km increments from active clusters indicate that recruitment clusters sited on the Annex would be approximately 7 – 11 km of active clusters.

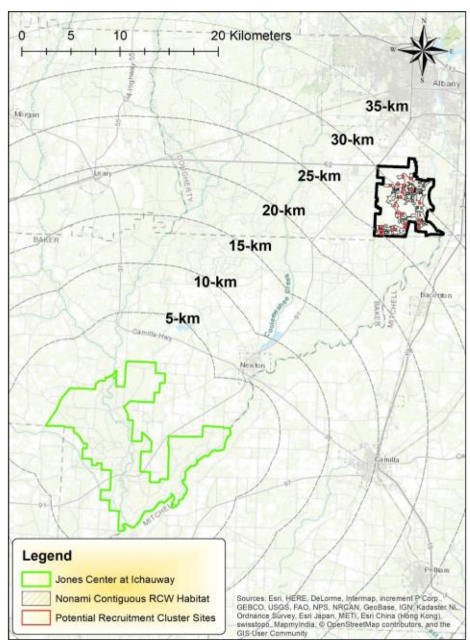


Fig. 10.3. The location of suitable RCW habitat and potential 10-acre recruitment cluster sites relative to the nearest active RCW population at the Jones Center at Ichauway. Buffers at 5-km increments from Ichauway indicate that recruitment clusters sited on the Nonami would be at least 25-km from the nearest active RCW clusters.

11. SANDHILLS WET MEADOW HABITAT

Project Biologist

Carter Kruse

Threats – Loss and modification of Sandhills wet meadow and wetland habitat due to ditching and draining for hay, grazing, and agriculture production. Up to 15-20% of Sandhills wetlands have been lost due to agricultural development and an unknown, but large number of wet meadow habitats have been altered.

Partners

Funding

Funding & Management

Natural Resources
Conservation Service

Background

The Sandhills Region of north-central NE encompasses 19,600 square miles of mixed grass prairie ecosystem. The six Turner Ranches in the Sandhills comprise over 3% of the region. The Sandhills prairies are a vast area of grass covered sand dunes interspersed with interdunal depressions and valley bottoms. Many valley bottoms intersect relatively shallow groundwater gradients, resulting in "wet meadow" habitats that manifest as productive moist grasslands, fens, wetlands, streams, springs, lakes, or ponds, providing and supporting a rich ecological diversity. Approximately 1.2 million acres of wetlands (as example see Fig. 11.1) supporting some 125 species of wetland affiliated birds and a quarter million nesting waterfowl, including most of the Great Plains flock of trumpeter swans, are scattered throughout the region. The area is the second most productive waterfowl region in North America. Sandhills streams are unique in their mostly groundwater origins, lack of tributary network, and flow stability, as surface precipitation readily percolates into the sand and associated shallow groundwater system. Approximately 66% of Ogallala aquifer recharge occurs in the Sandhills.

Fig. 11.1. Classic Sandhill wet meadow and wetland habitat.

Productive wet meadow habitats in the Sandhills are often intensively managed for grazing and haying. Beginning in the early 1900's draining and ditching of wetlands and wet meadows became commonplace as ranchers looked to increase grass production and develop productive hay meadows (Fig. 11.2). Although the Sandhills are relatively intact overall, wet meadow habitats have been disproportionally impacted for production purposes. For example, fens, which are special groundwater-fed, peat-filled wetlands, continue to decline in extent and condition and are considered a critically imperiled habitat. Great Plains fens often support diverse and regionally unique (glacial relict) flora, including prairie white fringed orchid, tall cotton-grass, bog bean, marsh marigold, spike muhly and bog aster.

Fig. 11.2. Example of a ditched wet meadow leading to lower ground water but better (i.e., drier) access for grazing and haying.

A Sandhills Task Force (STF), made up of interested and diverse natural resource and ranching stakeholders, was formed in 1993 with a goal "*to enhance the sandhill wetland-grassland ecosystem in a way that sustains profitable private ranching, wildlife and vegetation diversity, and associated water supplies*" – a goal like the mission of Turner Enterprises, Inc. One general strategy of the STF is to provide technical and financial assistance for improvement and restoration of wetlands, riparian habitat, and upland habitats in the Sandhills. TBD has partnered with STF (and others) on two stream and wetland projects - Gordon Creek at McMurtrey Ranch and Capp Valley at Spikebox Ranch (Fig.11.3). The restoration of three miles of impaired Gordon Creek channel, as well as 300 acres of associated wet meadow habitat, is the largest stream rehabilitation project ever completed in the Sandhills (Fig. 11.4). Several additional wet meadow/wetland projects are under development and consideration, including a continuation of the Gordon Creek project upstream onto the Kime Unit of McMurtrey Ranch, Boardman Creek at McMurtrey Ranch, Sandy Richards Creek on Fawn Lake Ranch, and the upper Snake River project at Deer Creek.

Fig. 11.3. A view of Capp Valley showing one of four ditch "plugs" and resulting water accumulation.

Fig. 11.4. Restored Gordon Creek channel and wetlands on McMurtrey Ranch.

Goal

Restore wet meadow habitat and associated ground water hydrology in the Sandhills ecoregion by reversing the impacts of ditching and draining on streams, wetlands, and fens.

Objectives

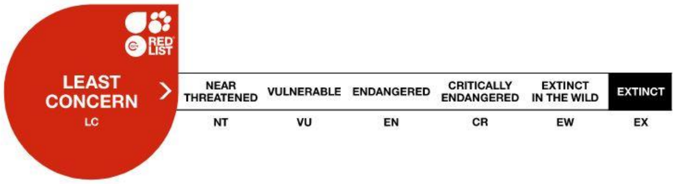
To implement at least ten wet meadow restoration projects, including at least one on each of the six Turner Sandhills ranches, impacting 1,000 acres of wetland, fen, or stream habitat. Projects will be conducted in collaboration with like-minded partners willing to share 40% of the project planning, design, implementation and monitoring costs.

Activities in 2020

In late winter 2020 the Capp Valley Project on Spikebox Ranch was completed. The project installed a culvert grade control structure and ditch plugs to raise the water table and enhance approximately 120 acres of wetland and associated fen habitat in the Capp Valley (Fig.11.3). Due diligence continues on the other potential projects listed above. Conversations are underway with potential project partners regarding cost share and scheduling of projects. The STF and US Fish and Wildlife Service have expressed interest in several of the proposed projects but cannot commit any funding until 2023. TBD staff developed a conceptual design for the Gordon Creek project extension and conducted additional site visits to the Sandy Richards and Boardman creek sites with The Nature Conservancy and NE Game and Parks biologist. A contract with Arrow Survey Group was completed for topographic surveys of the Sandy Richards Phase I and II sites in 2021.

12. WOLVES

(*Canis lupus)*



12a. Mexican Gray Wolf

(*Canis lupus baileyi*)

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

ENDANGERED

Biologists

Cassidi Cobos

Mike Phillips

Threats – Once common throughout portions of Arizona, New Mexico, Texas, and Mexico, human persecution resulted in the extirpation of the Mexican wolf in the wild. Current challenges include political pressures against wolf releases, illegal shootings, and lack of space for population expansion. Additionally, due to the small founder population, diminished genetic diversity appears to be affecting the fecundity and survival of wolves in the wild. Limited pen space in the captive breeding program restricts the size and reproductive output of the captive population.

Detailed Listing Designations

- ESA: Endangered – portions of AZ, NM where this wolf subspecies is known to occur: AZ, NM except for –
  - *Experimental Population, Nonessential:* portion of AZ north of I-10 and south of I-40; portion of NM north of I-10 (in west), north of the NM-TX border (in east), and south of I-40 (see Fig. 12c.1)

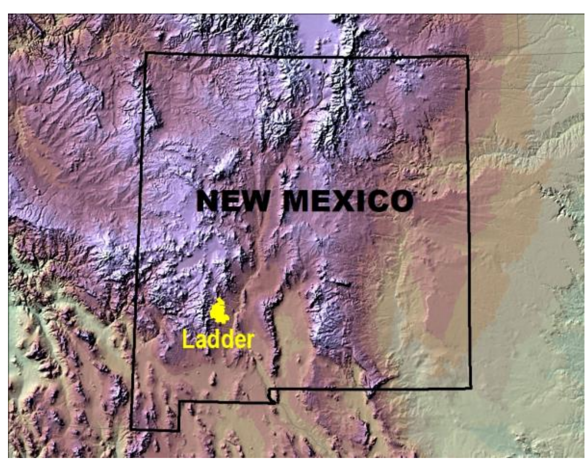
Project Partners

Administrative Funding

Mexican Gray Wolf Species Survival Plan (SSP)

Managed under the Association of Zoos & Aquariums (AZA), the SSP is a collaborative effort amongst zoos, organizations like TESF, USFWS, Mexico's Fish & Wildlife Agencies to coordinate the breeding and management program to ensure long-term sustainability of captive-based animal populations.

Location



Background – Mexican gray wolves (MGW) are a distinct subspecies of gray wolves that roamed most of the southwestern US and portions of Mexico until they were functionally eradicated in the wild through aggressive government-sponsored predator control measures. By the time the Mexican gray wolf was listed as endangered under the ESA in 1976 it was on the verge of extinction. Wildlife biologists captured the last five wolves remaining in the wild and began a captive breeding program. As a result, the subspecies is now secure in captivity.

Reintroductions of MGWs into the Blue Range Wolf Management Area (BRWMA) that spans portions of eastern Arizona and western New Mexico began in 1998, and reintroductions in Mexico began in 2011. About 163 wolves were free-ranging in the BRWMA and ~25 in Mexico in 2019.

Goal – Contribute to recovery of Mexican Gray Wolf populations in the wild in the US and Mexico.

Objective – During the next five years, TESF will continue to support Mexican Gray Wolf recovery by providing a captive facility on the Ladder Ranch that houses up to 25 wolves at any one time, including breeding pairs and wolves transitioning between the wild population and captivity. The Ladder Ranch facility will respond to the needs and overall project goals set by the USFWS and the Species Survival Plan on an annual basis.

Strategies – As a member of the Mexican wolf species survival plan (SSP), we adhere to the management guidelines that standardize captive management in both the US and Mexico. The mission of the SSP is to contribute to Mexican wolf recovery through captive breeding, public education, and research. The SSP uses several criteria to determine the eligibility of a wolf for release. These include: genetic makeup in relation to both captive and wild populations (i.e., "surplus" to the captive community and underrepresented in the wild), reproductive performance, behavior, and physical suitability. It is critically important that release candidates exhibit natural behaviors, especially fear and avoidance of humans. We therefore take steps to prevent socializing or habituating the wolves housed at the LRWMF to minimize conflict with humans once released into the wild. In accordance with SSP recommendations, we reinforce the wolves' natural avoidance behavior to humans by providing as much privacy and as little disturbance as possible. This includes minimizing the length of time an animal is held in captivity and minimizing contact with humans during husbandry and maintenance events (i.e., we feed only once or twice a week, and we spend as little time as possible inside the wolf pens during husbandry and maintenance).

Supporting Rationale for Objectives – The Ladder Ranch has been actively involved in Mexican Gray Wolf recovery since 1997, beginning with construction of the Ladder Ranch wolf management facility (LRWMF). As one of only three pre-release facilities nationwide, the LRWMF plays an important role in the USFWS's implementation of wolf reintroductions to the wild by providing pre-release care and acclimatization for animals eligible for release to the wild. The LRWMF also assists with specific management needs associated with reintroductions in the Blue Range Wolf Recovery Area by serving as a "halfway house" between the wild and traditional holding facilities (zoos and wildlife sanctuaries) for wolves that are removed from the wild for medical reasons or for depredating livestock. The LRWMF is managed collaboratively by TESF and the USFWS. Since we began housing wolves in 1998, over 150 different wolves have passed through the LRWMF facility.

Activities in 2020

Wolves housed at the LRWMF in 2020

A total of 16 different wolves were held at the LRWMF in 2020, with a maximum of 9 at any one time. The studbook identification numbers (and a brief synopsis of the history) of the wolves housed at the Ladder Ranch during 2020 are summarized in Table 12a.1.

Table 12a.1 Wolves housed at the Ladder Ranch Wolf Management Facility in 2020.

Wolf ID	Sex	Birth Date	LRWMF Arrival Date	LRWMF Pen	Eligible for Release/Translocation?	Transferred from	Notes
M1394	M	April 2013	10/18/19	3	Yes	SWMF	Removed from wild 09/19, sent to SWMF. 10/19: sent to LRWMF. Paired with F1633. 2020: pair sent to Cananea, Mexico. Wild release pending.
F1431	F	4/9/15	12/1/17	3	Yes	Wolf Haven	Paired with M1400 for 2018 breeding season (BS); no pups produced. End of 2018, separated from M1400, moved to SWMF and paired with new mate for 2019 BS; no pups produced. In 10/19, separated from mate, reintroduced to M1400 for 2020 BS. Pair released into the wild in Mexico in early 2020.
M1400	M	4/17/15	11/9/17	3 then 2	Yes	EWC	Paired with F1431 for 2018 BS; no pups produced. End of 2018, separated from F1431, introduced to F1633 for 2019 BS; no pups produced. In 10/19, reintroduced to F1431. Pair released into the wild in Mexico in early 2020.
F1633	F	5/11/17	12/18/18	3	Yes	Wolf Haven	F1633 paired with M1400 for 2019 BS; no pups produced. In 10/19, pair split up and F1633 was paired with M1394. The new pair was sent to Cananea, Mexico in 2020 and is scheduled for a wild release.
F1252	F	April 2012	4/24/20	2	No	BRWRA	F1252 was captured in a private trap. USFWS took her into captivity. She was pregnant. Following a USFWS health check cleared her for transport, she was sent to LRWMF. Upon arrival, she was reluctant to leave the crate, and struggled to walk when she did leave it. She was inactive the next morning and afternoon, and by 7pm she was found dead in the pen. Necropsy determined the cause of death to be capture myopathy.
F1959	F	April 2017	4/29/20	3	Yes	SCAR	F1959 was removed from the wild (SCAR) with 4 pups. She was introduced to M1695 for companionship. F1959 and pups seems to have bonded with 1695. Pack released November 5th,2020 in Mexico.
mp1898	M	4/30/20	4/29/20	3	Yes	SCAR	Removed from the wild with F1959. Entered the LRWMF at 3 ½ weeks old. One of 4 pups. Pack released November 5th 2020, in Mexico.
mp1899	M	4/3/20	4/29/20	3	Yes	SCAR	Removed from the wild with F1959. Entered the LRWMF at 3 ½ weeks old. One of 4 pups. Pack released November 5th,2020 in Mexico.
mp2500	M	4/3/20	4/29/20	3	Yes	SCAR	Removed from the wild with F1959. Entered the LRWMF at 3 ½ weeks old. One of 4 pups. Pack released November 5th,2020 in Mexico.
fp2501	F	4/3/20	4/29/20	3	Yes	SCAR	Removed from the wild with F1959. Entered the LRWMF at 3 ½ weeks old. One of 4 pups. Pack released November 5th,2020 in Mexico.
F1674	F	April 2017	5/27/20	1	Yes	SCAR	F1674 was brought in from SCAR with one pup. Another pup was brought in 2 days later. F1674 has been destroying the pen, digging under the skirting, chewing/shredding all trees and ocotillos. She climbs trees and has come very close to jumping out several times. On August 19th, a day after a capture, she dug under the skirting and escaped. She was recaptured on the 27th. Her and fp2553 were transferred to the SWMF.
fp2553	F	4/14/20	5/27/20	1	Yes	SCAR	Part of the Poker pack. 1 of 2 pups captured and brought into the LRWMF. Transferred to SWMF on August 27th with F1674.
fp2554	F	4/14/20	5/29/20	1	Yes	SCAR	Part of the Poker pack. 1 of 2 pups captured and brought to the LRWMF. Found dead in den on July 10,2020. Necropsy conducted but cause of death not determined. Parvo test was negative.
M1695	M	4/14/20	6/10/20	3	Yes, in Mexico	BRWRA	M1695 was brought in for companionship and introduced to the Rose pack. M1695 and F1959 seem to be a bonded pair and he gets along very well with the 4 pups. Pack released November 5th 2020, in Mexico.
M1966	M	5/20/19	12/10/20	3	Yes	SWMF	Reached sexual maturity and separated from family pack.
M1968	M	5/20/19	12/10/20	3	Yes	SWMF	Reached sexual maturity and separated from family pack.

Feedings, Observations, Transfers, and Health Checks

Feedings: Mexican gray wolves held at the LRWMF are fed a combination of foods recommended by the SSP. These are: Mazuri® Exotic Canine Diet (aka "kibble"), Central Nebraska classic canine diet (aka "carnivore logs"), and native prey species. Mazuri® Exotic Canine Diet is a meat-based kibble diet preferred by most zoos that meets the nutrient requirements of all wolf life stages. Carnivore logs are composed predominantly of horsemeat and fortified meat byproducts that are frozen into 5-pound logs. These are protein-rich and also suitable for all life stages. Prey animals (mule deer, oryx, elk, rabbits, and bison) are mainly provided as meat scraps and/or bones salvaged from roadkill or from hunts on the Armendaris and Ladder Ranches and are sporadically fed as supplemental food.

Water: A new water pump was installed in 2019. The water that supplies the wolf pens is first pumped from Animas Creek into a 5,000-gallon holding tank by a pump. Water from the holding tank is then used to fill (by gravity) smaller holding tanks (500 or 2,500 gallons, respectively), which in turn are used to provide water to the wolves in one or two 50-gallon tubs placed in each wolf pen. The 50-gal tubs are cleaned and/or topped off regularly to ensure that all wolves always have access to fresh water. In addition, we occasionally treated the water in the secondary holding tanks with very dilute bleach (>1:2,000, which is the dilution used to treat well-water for human consumption) to prevent algal growth.

Observations: We observed animals from the blind on a regular basis to monitor their overall health, behavior, and wellbeing (Fig. 12a.1). In addition, we observed daily (or twice daily) from the blind when wolves first arrived at the facility, during the breeding season, and around putative whelping times. Informal observations took place during scheduled feedings, where we obtained a visual of animals in the facility and checked for signs of injury or illness. In addition, we made regular use of trail cameras to get close-up views of individual wolves.

Figure 12a.1 M1968 enjoying the snow.

Health Checks: All wolves received thorough health checks, vaccinations, and anti-parasite medication before arriving at the LRWMF (Fig. 12a.2). Similarly, all wolves leaving the LRWMF in 2020 received deworming and anti-parasite medication (ivermectin, revolution, and/or praziquantel) before their departure from the facility and received vaccinations as warranted. The goal is to perform health checks and update vaccinations for each wolf once a year (usually done during the cooler months).

Fig. 12a.2. Cassidi Cobos with a Rose pup during health checks.

Oral ivermectin treatment for heartworm prevention: In mid-September 2016, following the recommendation of USFWS veterinarian, Dr. Susan Dicks, we started a regimen of once-a-month oral ivermectin treatment of all wolves to prevent heartworm. We followed the protocol developed for and approved by the MGW SSP. Briefly, full-strength ivermectin is first diluted 1:250 with propylene glycol. For every 10 lbs. of wolf, 1 ml of the diluted ivermectin is then mixed with thawed canine logs (for example, for a wolf weighing 60 lbs., we would mix 6 ml of diluted ivermectin into one log). The wolves are fed the medicated wolf log on a regular feeding day, followed by the remaining amount of untreated food on the following day.

Breeding season: No breeding pairs were at LRWMF during breeding season in 2020.

Births in 2020

There were no pups born at the Ladder Ranch Wolf Management Facility in 2020. However, six, 3-week-old puppies were brought into the facility from the wild. Four pups from the Rose Pack and two pups from the Poker Pack. Both packs were removed from the San Carlos Reservation.

Deaths in 2020

There were two deaths at the LRWMF during the reporting period. F1252 died within 24 hours of arriving at the facility on April 24, 2020. She had been caught in a private trap in the wild and had spent a good amount of time in the trap before USFWS removed her. She was also pregnant at the time. She was cleared for transport by USFWS veterinarian Dr. Susan Dicks. She arrived at the LRWMF late that night. F1252 slowly and somewhat reluctantly emerged from the crate, looking sore and disheveled. She very slowly moved away from the crate, deeper into the enclosure, and settled at the bottom end of the pen. During observations the next morning, F1252 didn't move much and when she attempted to walk her back legs seemed to struggle to keep her up and she laid back down. Water was placed near her midday, but she never moved much from there during subsequent observations. During evening observations, she laid motionless under a tree. Closer inspection revealed that she was not breathing and had passed away. There was no evidence of a struggle, and no wounds or injuries were detectable. We transferred the carcass to USFWS law enforcement the following day. Necropsy results, and the results of the investigation into the cause of death, revealed capture myopa thy.

On July 10th, 2020, one of the Poker pups f2554, was found deceased in a den in their pen. She was seen on camera the day before and seemed fine. The carcass was collected and handed over to USFWS for a necropsy. Unfortunately, the carcass was too mummified for a proper necropsy. Several tests for parvo were performed and came back negative. A rattlesnake had been seen in the pen several days before and it is believed she was bitten but this can't be confirmed.

Releases

Four groups were transferred to Mexico for release in 2020. M1400, F1431, M1394, and F1633 were transferred to Mexico on January 9th. M1400 and F1431 went directly to a release site. M1394 and F1633 went to Cananea to hopefully breed and be released with pups.

On November 5th, 2020, the Rose Pack, F1959, M1695, M1898, M1899, M2500, and F2501 were transferred to Mexico and went directly for release.

Escape

On August 20th, 2020, when going to feed, we discovered that F1674 had dug out of the pen (Fig. 12a.3). Her pup was still in the pen and F1674 could be heard howling down the canyon. USFWS and the State were immediately notified. The following day USFWS and NMDG&F sent personal down and recapture efforts began. Cameras were set and she was seen coming back to the pen at night visiting her pup. Traps were set all around the pen. F1674 was finally recaptured on August 27th. Both F1674 and F2553 were transferred to the Albuquerque BioPark to get check out by a veterinarian and then moved to the Sevilleta the following day. F1674 has since been paired up with a male and all 3 animals were released in Mexico.

Fig. 12a.3. Area were F1674 dug out.

Off-site Activities and Outreach

We participated in a spectrum of wolf-related activities during the reporting period including organizing captures at the LRWMF and participating in captures and health checks at the evilleta Wolf Management Facility (SWMF), conducting breeding observations at the LRWMF and the SWMF, wolf transfers to and from other US wolf holding facilities or the BRWMA.

Proposed Future Activities and Considerations

As one of only three pre-release facilities in the country, and the facility closest to the wild BRWMA population, the SWMF, and Mexico, the LRWMF plays an important role as a transitional facility for wolves that are being transferred between captivity and the wild. This includes wild wolves that need to be moved to captivity due to livestock depredations, as well as releases of captive-bred wolves to support the wild population.

Cross-fostering is a technique in which very young pups (less than 10 days old, i.e., before they can see or hear) from genetically desirable captive wolf pairings are swapped or introduced to denning wild wolf parents. This technique eliminates concerns of captive-born wolves habituating to humans because pups are introduced to the wild prior to their being able to perceive sights and sounds. Cross-fostering has been used successfully to increase the genetic diversity of red wolves in North Carolina (Waddell et al., 2002), and has also been tested in European gray wolves (Scharis and Amundin, 2015). Moreover, it has been used successfully in 2014, 2017, and 2018 to place captive born MGW pups into the den of a wild wolf pack that was known to rear young that avoid conflict with humans (USFWS, 2015, 2017).

Because the Mexican wolf holding facilities are currently at capacity, not all captive wolves are allowed to breed. In turn, this means that not all wolf-holding facilities participate in the breeding program. Breeding pairs are carefully chosen using several criteria, including genetics, compatibility, and need. Mexican gray wolves produce pups only once a year: they generally breed in February or March and whelp 2-6 pups in April or May.

In this way, we will continue our strong support of the USFWS-led efforts to recover the MGW in the Southwest. In 2020, we plan to continue to serve as caretakers of important wolves, participate in hands-on activities (captures, health checks, transfers, surveys, etc.) and mandatory training sessions, and participate in SSP-related management activities (for example, annual meetings).

12b. Rocky Mountain Gray Wolf

(***Canis lupus***)

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

DELISTED: Northern Rocky Mountain Distinct Population Segment (MT, ID, WY, WA (east), UT (north)

Montana Fish, Wildlife & Parks

Montana State Listing Designation

Species in Need of Management

Biologists

Val Asher

Mike Phillips

Threats – Wolves are a polarizing issue, thus limiting expansion of the species current range.

Location

Background – In 2000, we assigned our wolf biologist to assist the USFWS and later MTFWP, with wolf recovery in Montana. We remain the only private organization ever permitted under the ESA to assist the USFWS with wolf recovery and it was a notable achievement for us to be involved for over 9 years with the daily implementation of recovery and management. With delisting imminent, we shifted our focus in 2010 to wolves on the Flying D. Wolves first established themselves on the ranch in 2002. In 2011, they were at their highest numbers before splitting into two packs. Both packs made use of the entire ranch (over 113,000 acres) and the bordering forest. Both bison and elk numbers are monitored by the Flying D ranch manager and Montana Hunting Company. In addition to understanding wolves and their effects on ranched bison and wild elk, we have participated in two ongoing studies on the ranch. Both anthrax (*B. anthracis*) and brucellosis (*Brucella abortus*) affect ungulates and potentially carnivores through scavenging.

Goal – Understand the ecology of wolves on the Flying D ranch and inform recovery efforts throughout the species' historical range.

Objective – Over the next five years we will locate and identify predator-killed prey and analyze wolf scats to determine predation characteristics of the wolf population on the Flying D ranch. All carcasses will be evaluated for cause of death, body condition and any predisposition to predation by classifying femur marrow and boiling leg bones and jaws to identify arthritis or injuries. During this time, we will monitor the Flying D's wolf population and will work cooperatively with the Flying D ranch manager and Montana Hunting Company to track bison herd health, herd size and the resident elk and deer population. Knowledge of these dynamics and the practicality of living with wolves on a working landscape will be shared by conducting tours for visiting guests.

Supporting Rationale for Objective

Uncertainty over the ecosystem impacts of wolves fosters intolerance for wolves in the west. An abundant prey base on the Flying D allowed the ranch to support what was once the largest pack in MT (24 individuals in 2011), before it split into two packs. The ranch practices an ecologically sustainable management style which also benefits the persistence of large carnivores. We can maintain a healthy wolf population on the ranch by understanding food habits, prey health and the effects wolves have on ranch activities.

Activities in 2020

Wolf population

The Beartrap pack produced five black pups this year (Fig. 12b.1). Using Montana Fish, Wildlife and Parks (MFWP) criteria where final counts end Dec. 31, 2019, our highest visual count at the end of the year was sixteen individuals. The VHF collar on wolf 032F is no longer working The GPS collar on wolf 039F continues to work but the VHF portion of that collar is not functioning properly. We will be applying to obtain a collaring permit from MFWP in 2021. The Beartrap pack uses the entire ranch and occasionally travels through neighboring properties to the north. At least three wolves were legally harvested in 2020.

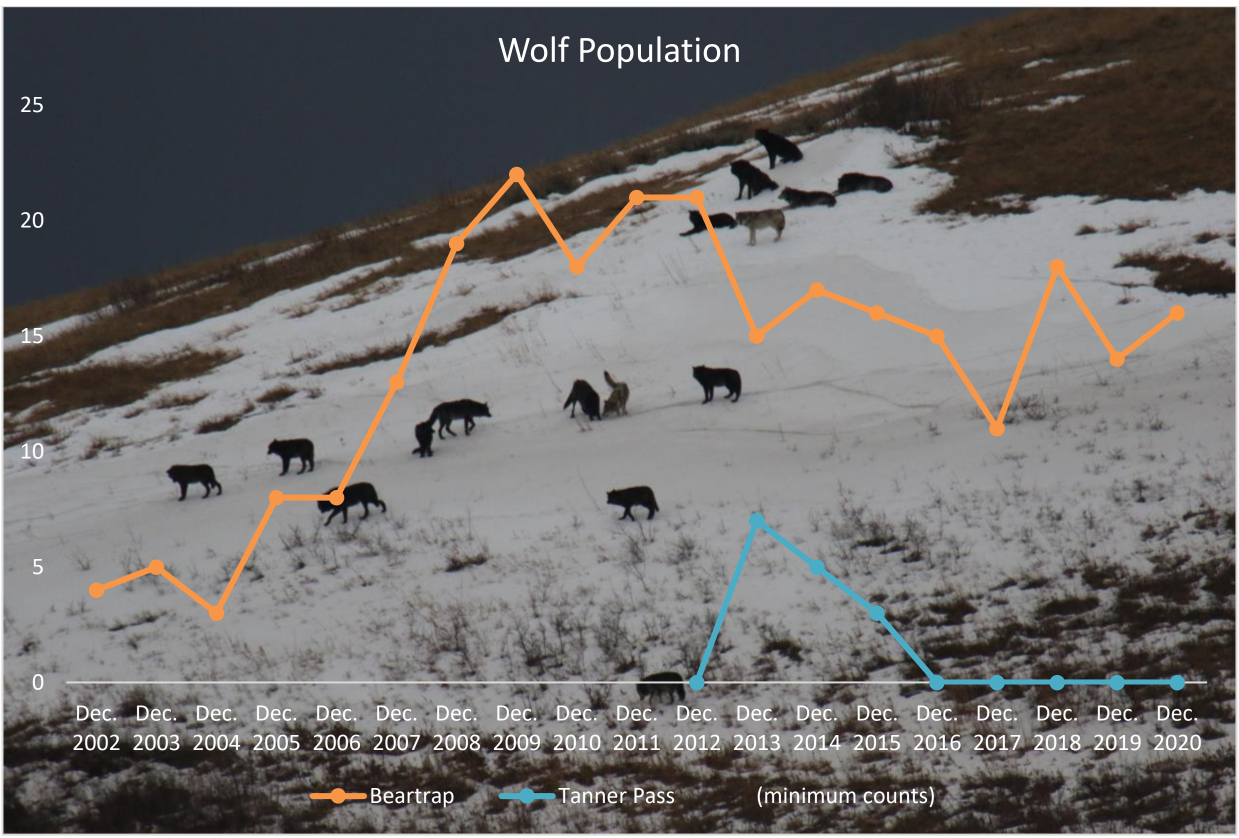


Fig. 12b.1. Minimum number of wolves in the Beartrap and Tanner Pass packs from 2002 to 2020.

Food habits

Of the 1,485 carcasses investigated since monitoring began in 2010, 498 were documented as predator kills. 354 were attributed to wolves, with the remainder categorized as coyote (100), mountain lion (13), bobcat (2), bear (9), and 19 as unknown predator.

Bison are the dominant ungulates on the Flying D, numbering around 3300-5400 individuals. With a bison population almost twice as large as that of elk, we assume that encounter rates between bison and wolves are higher than between elk and wolves. However, wolves are more successful at killing elk, or are actively selecting elk to prey upon (Fig. 12b.2).

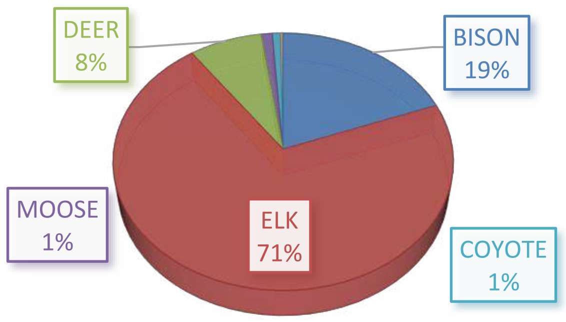


Fig. 12b.2. Percentage of wolf kills by prey species.

Prey Vulnerabilities

A generalization of wolf-prey systems is that wolves tend to select prey that are disadvantaged (e.g., young, old, sick/injured). Environmental traps, maternal behavior and herd health also influence predation risk.

We evaluated predisposition to predation using femur marrow of wolf-killed elk and deer. We also examined leg bones for arthritis or abnormalities. The femur marrow has been used as a standard for evaluating bone marrow fat content, as this is one of the last fat resources the body utilizes. Healthy bone marrow is white, firm, and waxy to the touch. In a state of malnutrition or disease the marrow is red, solid and slightly fatty to the touch. In an advanced starvation, the bone marrow is red to yellow, gelatinous and wet to the touch due to the high-water content. Femur marrows of prey species were collected and categorized as "white/waxy", "red/firm" or "red/gelatinous" (Fig. 12b.3).

Marrow was collected from 291 wolf killed ungulates showing 72% in marginal to poor health condition.

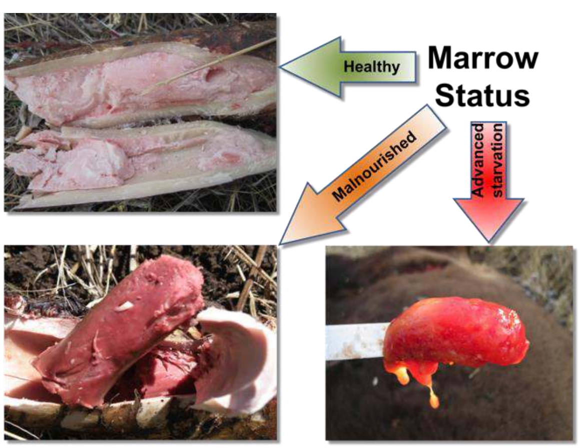


Fig. 12b.3. Femur marrow helps determine the condition of prey species.

A second dramatic vulnerability has been disfigured/injured hooves and legs. Of the 468 elk carcasses investigated of varying cause of death, 48 (10%) had visible deformities. Interestingly, 35 (73%) were killed by wolves (Fig. 12b.4). Wolves have an acute ability to recognize even the slightest lameness and it would make sense that they would test these individuals over one that shows heartiness. Once legs have been boiled, we can see in more detail the calcification and arthritis that has developed (Fig. 12b.5)

Fig. 12b.4. Examples of elk legs with visible and varying deformities.

Fig. 12b.5. Abnormal front left hoof from bull elk and normal front right from same individual.

More data is needed to determine if this is related to injury or other causes. In addition, we have begun to collect and boil legs from all elk found regardless of visible injury to the hoof or legs to determine if there are any differences between predator kills and elk that die from other causes. We plan to compile and finalize this data early 2022.

Education

Information dissemination is important as we learn more about wolves on the ranch. In 2019, we conducted 7 tours and talks on the Flying D totaling ~120 since 2010. In 2020, we participated in a short mini documentary about wolves on the Flying D; https://mountainjournal.org/how-ted-turner-gets-along-with-one-of-largest-wild-wolf-packs-on-earth. We also share our population estimates with MTFWP. Finally, we continue to produce monthly and annual reports on wolf activities and food habits.

Proposed Future Activities and Considerations – With the deployed GPS collar, we are learning how often the Beartrap pack leaves the ranch, (Fig. 12b.6), and measuring the success of finding carcasses using cluster data. Of the 5,202 locations received since the collar was deployed in August 2018, we learned this female, (SW039), has been off the ranch 6% of the time. The majority of these off-ranch events have taken place in the winter months. When combining 2016/2017 pre-GPS carcass numbers we found 147 carcasses, 39 of those were wolf kills. When combining 2019/2020 data using GPS cluster data, we found 272 carcasses, 65 of those wolf kills. Other factors may contribute to the discrepancy, and we will do a more thorough analysis of cluster success when the GPS collar falls off May of 2022.

Bear Hair Snag study: Asher has proposed a hair snag study in 2021 to understand the population size and distribution of both black bear and grizzly bear on the Flying D Ranch.

Parasites in Bull Elk: Asher will continue to send in samples of sick bull elk, opportunistically, that are suffering from hair loss. To date, the mite, "Psoroptes sp." have been found in Flying D bull elk. More samples need to be collected to determine if there is an underlying cause for this vulnerability. We are also collecting teeth for cementum analysis to properly determine age class.

Flying D Aerial survey: Asher will conduct winter ungulate counts and fall classification.

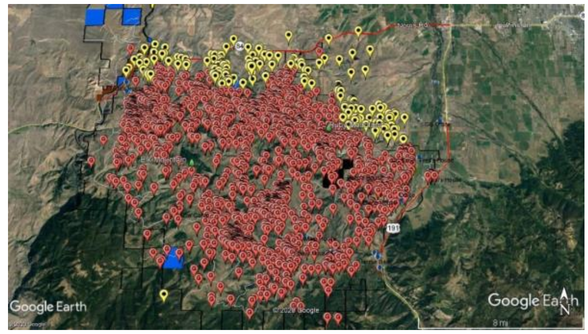


Fig. 12b.6. Red balloons show locations of the collared female (SW039) on the Flying D. Yellow balloons indicate locations north of the FDR boundary (August 2018-December 2020).

Publications in Prep or Review in 2020

Ungulate Use of Locally Infectious Zones (LIZs) in a Re-Emerging Anthrax Risk Area Morgan A. Walker1,2, Maria Uribasterra, **Valpa Asher**, José Miguel Ponciano, Sadie J. Ryan2,5, Jason K. Blackburn.

Factors Influencing Scavenger Guilds and Scavenging Efficiency in Southwest Montana Morgan A. Walker, Maria Uribasterra, **Valpa Asher**, Wayne M. Getz, Sadie J. Ryan. Jose Miguel Ponciano, Jason K. Blackburn.

Sex Specific Elk Resource Selection During the Anthrax Risk Period. Anni Yang, Kelly M. Proffitt, **Valpa Asher**, Sadie J. Ryan, Jason K. Blackburn.

12c. Rocky Mountain Wolf Project

(*Canis lupus*)

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

ENDANGERED

Detailed Listing Designations (see Fig. 12c.1)

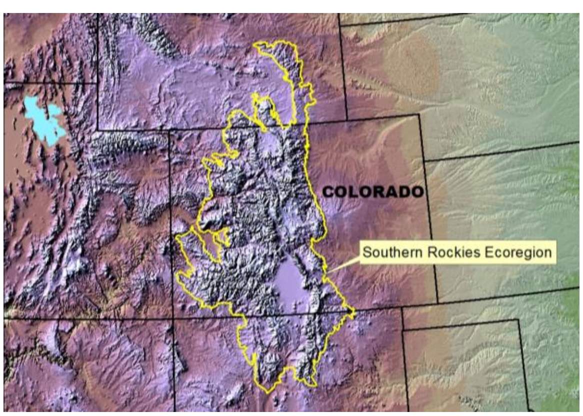
- ***ESA Endangered:*** AL, AR, CA, CO, CT, DE, FL, GA, IA, IN, IL, KS, KY, LA, MA, MD, ME, MI, MO, MS, NC, ND, NE, NH, NJ, NV, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WI, WV. Parts of AZ, NM, OR, UT, WA: (1) North AZ (north of I-40); (2) North NM (north of I-40); (3) West OR (west of Hwy 395, Hwy 78 north of Burns Junction, west of Hwy 95 south of Burns Junction); (4) Most of UT (south and west of Hwy 84, south of Hwy 80 from Echo to UT/WY border); (5) West WA (west of Hwy 97, Hwy 17 north of Mesa, west of Hwy 395 south of Mesa).
- ***ESA Delisted:*** Northern Rocky Mountain Distinct Population Segment (MT, ID, WY, eastern WA and OR, north-central UT.

Biologist

Mike Phillips

Threats – Wolf recovery is a divisive issue in the U.S., limiting the species' distribution to about 15% of historical range.

Location – Western Colorado portion of the Southern Rockies Ecoregion (SRE)



Science Advisory Team – E.O. Wilson, Barry Noon, Joel Berger, Kevin Crooks, Phil Cafaro, Marc Bekoff, Joanna Lambert, Mike Phillips, Dave Mech, Rolf Peterson, Doug Smith, John Vucetich, Phil Hedrick, Rich Reading, Bob Wayne, Bridgett vonHoldt, Ed Bangs, Carter Niemeyer, Diana Tomback, Andrew Gulliford.

Project Partners – The Rocky Mountain Wolf Project (RMWP) is a coalition of individuals and organizations dedicated to returning wolves to the public wild lands of western Colorado. Active supporters of the RMWP include:

ROCKY MOUNTAIN WILD
International Wolf Center — Teaching the World about Wolves
Endangered Species Coalition
NRDC Natural Resources Defense Council
Frances Seebe Trust
WILD Foundation
Colorado Wolf & Wildlife Center — Conservation · Education · Preservation
WildEarth Guardians
Living with Wolves
Western Wildlife Conservancy
Wolves of the Rockies
Wildlands Network
Center for Biological Diversity
Defenders of Wildlife
Western Watersheds Project
Project Coyote — Fostering Coexistence
Sierra Club Colorado
Captain Planet Foundation

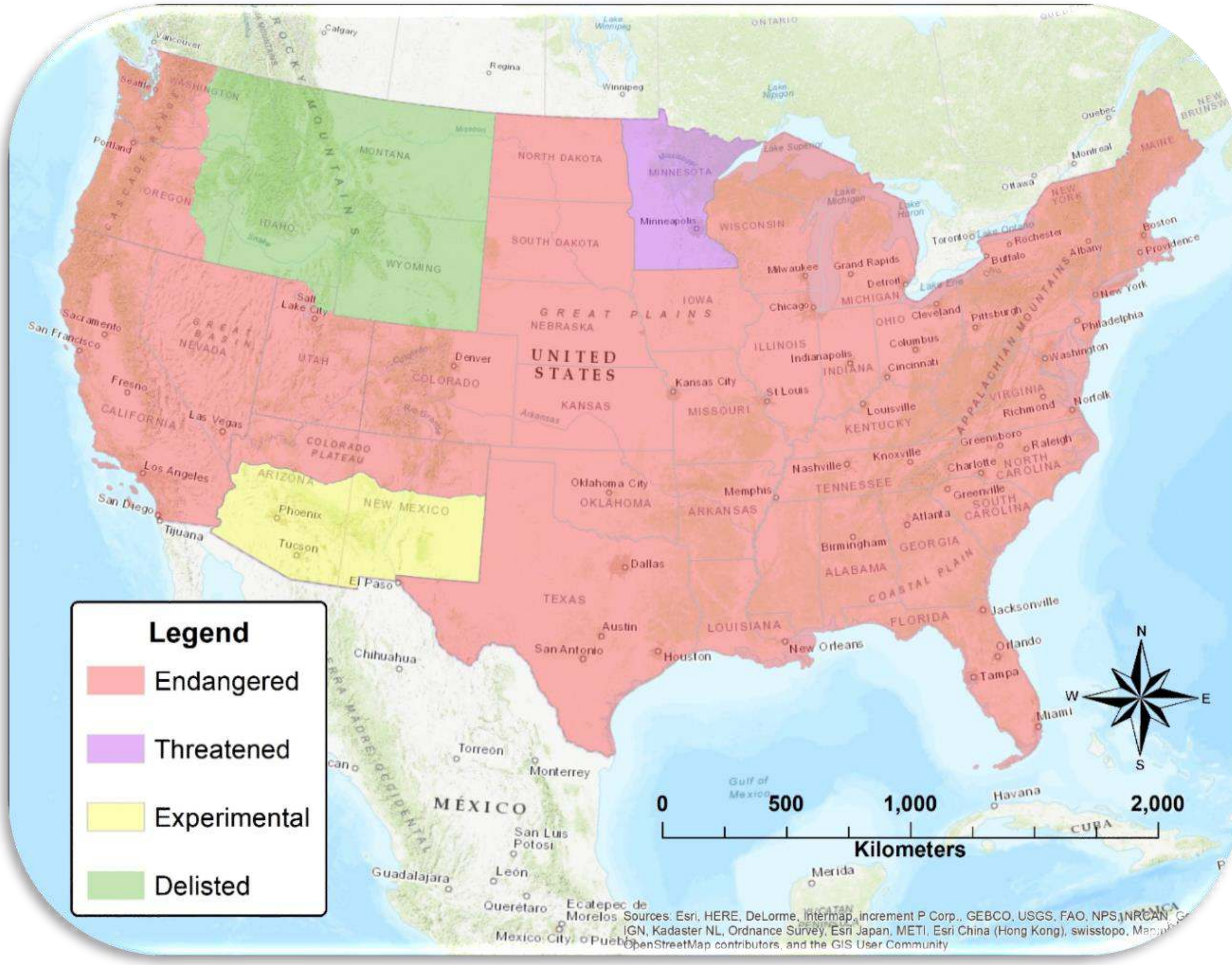
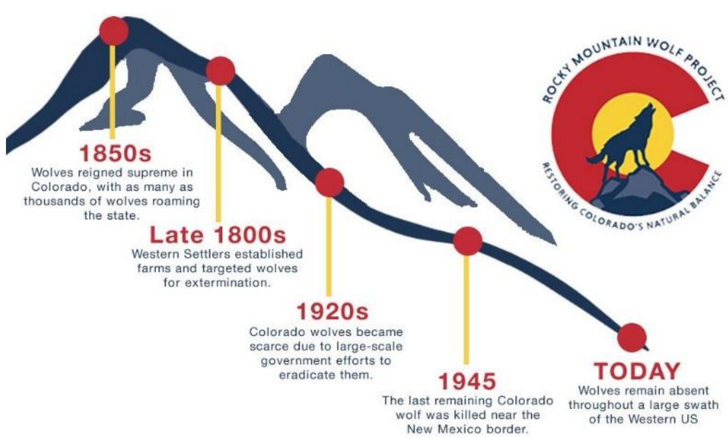


Fig. 12c.1. Listing status of *C. lupus* in the conterminous United States.

Background – Wolves historically occurred throughout the U.S., with the species common in Colorado up to the mid-1800s. With human expansion, wolves were exterminated until Colorado's last wolf was killed in 1945 near the New Mexico border.



Over the last few decades wolves have returned to parts of their historical range, with re-establishment in Minnesota, Michigan, Wisconsin, Montana, Idaho, and northwestern Wyoming. Wolf packs are also beginning to gain a foothold in Washington and Oregon.

Despite an improved conservation status, wolf recovery is not complete. No convincing argument about wolf recovery can be put forth without a discussion of restoration to the SRE. Why? Because of widespread public support for the notion, because no other region in the U.S. offers the same expanse of suitable public land not already occupied by the species, and because of the ESA's recovery mandate.

Successful wolf restoration in the northern Rocky Mountains and Great Lake states underscores the practicality of accomplishing the same in the SRE. This is bolstered by research that showing the SRE's great capacity to support wolf numbers and distributions that would satisfy the spirit and intent of the federal and Colorado endangered species acts.

The SRE is the best remaining area for gray wolf restoration in the U.S. It stretches from central Wyoming, through western Colorado, and into north-central New Mexico (Fig. 12c.2). The Colorado portion of the SRE includes over 17 million acres of public lands with abundant native prey. This is more public land than is available to wolves in the Yellowstone area and central Idaho. This prodigious public land base coupled with robust ungulate populations make western Colorado a motherlode of opportunity for wolf restoration. A viable, self-sustaining, wolf population there would: 1) have at least 250 adult wolves, 2) exhibit stable or increasing population trends over 8 years, 3) be naturally connected with wolf populations elsewhere at a rate not less than 0.5 genetically effective migrants per generation averaged over a period of two successive generations (i.e., eight successive years), and 4) be monitored and managed per a science-based conservation plan implemented by Colorado Parks and Wildlife.

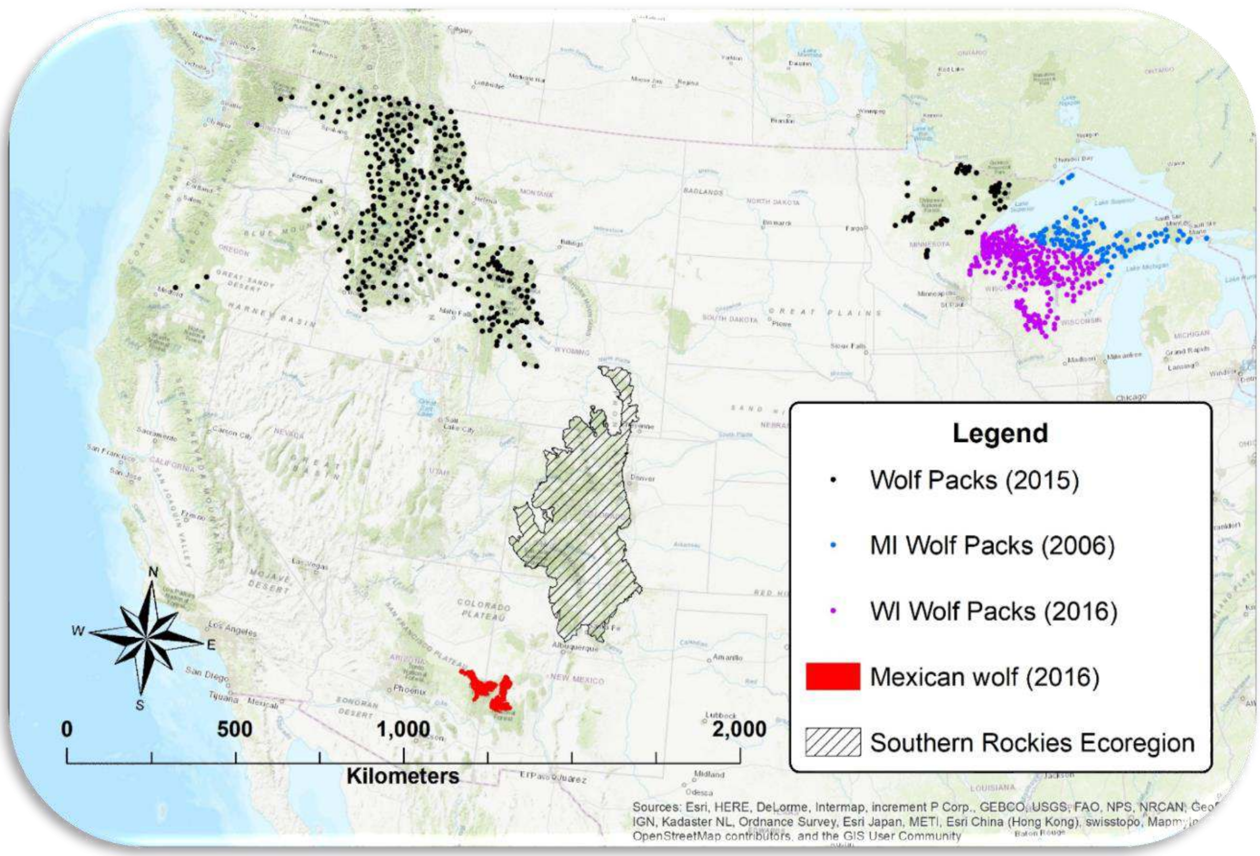


Fig. 12c.2. Distribution of wolf packs, estimated during the period 2006-2016, in the conterminous U.S. relative to the Southern Rockies Ecoregion. Wolf pack locations were obtained from relevant state gray wolf annual reports and georeferenced using ArcGIS 10.0. Michigan (MI) wolf packs represent 2006 data, Wisconsin (WI) pack locations and home ranges for Mexican wolves were recorded in 2016. All other locations in Minnesota, Montana, Wyoming, Washington, and Oregon were georeferenced from pack data collected in 2015. It is estimated that for the wolf packs portrayed, there are approximately 4,000 individual wolves in Great Lakes region, 1,500 individuals in Northern Rocky Mountains, and about 113 Mexican wolves.

Two studies have estimated the SRE's wolf carrying capacity to be between 1,000 to 2,000 wolves, and the public has been found to be supportive of restoring wolves to the area. A 2001 poll revealed that 71% of Coloradans supported restoration (Fig. 12c.3), with widespread majority support among various demographic groups. A more recent poll of 600 Colorado voters in 2014 revealed continued support for wolf restoration (Fig. 12c.4). Overall, the findings suggested a high degree of social tolerance for wolf reintroduction in Colorado across the state.

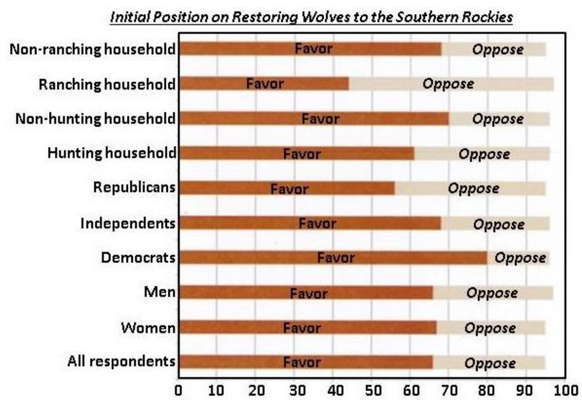


Fig. 12c.3. Results of a 2001 public opinion survey revealed widespread support for restoring wolves to the Southern Rockies. Source: Decision Research, 2001.

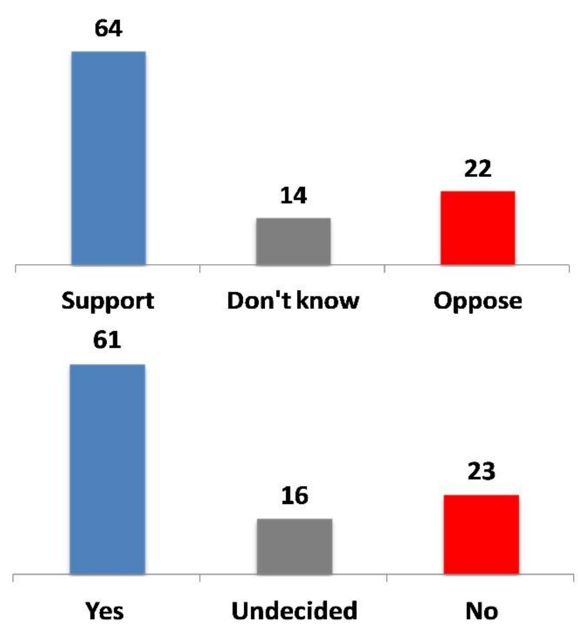


Fig. 12c.4. Results of a 2014 poll measuring support and opposition for reestablishing wolves in western Colorado (top panel), and support (yes) or opposition (no) for a combined wolf restoration ballot measure (bottom panel).

Western Colorado is a vast area of high quality and secure habitat that is mostly located on public land managed for natural resources. Restoring the gray wolf there represents an outstanding opportunity to advance recovery of the species throughout a significant portion of its historical range, as mandated by the federal ESA.

From an ecological perspective restoring wolves to western Colorado would provide nature with grist for recreating a wolf population that stretches from the Arctic to Mexico. Nowhere else in the world has greater potential to achieve large carnivore conservation across such a vast landscape. when considering such a vision, wolf biologist Dr. L. D. Mech concluded:

> *"Ultimately then, this restoration could connect the entire North American wolf population from Minnesota, Wisconsin, and Michigan through Canada and Alaska, down the Rocky Mountains and into Mexico. It would be difficult to overestimate the biological and conservation value of this achievement."*

The work of the RMWP seeks to educate Coloradans, as well as the broader public of the U.S., of the ecological implications of restoring the evolutionary potential of wolves and reestablishing their role as a keystone species throughout the Rocky Mountain west. Evolutionary and ecological restoration of the species will be hindered if wolf recovery remains limited to the northern Rocky Mountain and the Great Lakes states. Wolf reintroductions to western Colorado would represent an important step for restoring the species to a significant portion of its historical range and would pave the way towards species recovery.

By 2013 it was clear that the USFWS did not intend to advance wolf restoration to the area based on the agency's only authority to do so – the federal ESA mandate. Consequently, a non-federal approach is needed.

Goal – Provide the public with science-based information about restoring gray wolves to the SRE of western Colorado.

Objective – RMWP will engage in public education and outreach, as well as broad-based coalition building, to catalyze gray wolf restoration to the SRE of western Colorado. This will advance species recovery and serve as a conservation model for restoring other wide-ranging, controversial species.

Activities in 2020

TESF was instrumental in giving rise to, and maintaining, RMWP as a 501(c)(3) educational organization focused on disseminating science-based information about wolf restoration. In 2019 another organization dedicated to wolf restoration, the Rocky Mountain Wolf Action Fund (RMWAF), was formed as a 501(c)(4) political operation. RMWAF focused on passage of citizen-initiated Proposition 114 (Prop 114; Fig. 12c.5) in 2020. With electioneering activities by RMWAF dominating Colorado's wildlife conservation landscape during 2020, RMWP went into stand-by mode for the year. But given the obvious relevance to RMWP's past and future work, below we report on RMWAF's accomplishments during the year.

On January 6, 2020, the Elections Division at the Colorado Secretary of State's (SOS) office announced that RMWAF had qualified Proposed Initiative 107 (I-107, "Restoration of Gray Wolves") for the 2020 general election ballot. As a statewide initiative, qualifying I-107 required the collection of at least 5% of the total number of votes cast for all candidates for the office of SOS during the previous general election. For I-107 the qualifying number of signatures was 124,632. In response, RMWAF submitted 215,370 signatures. After reviewing 5% of those, the SOS affirmed that at least 124,632 were valid and qualified I-107 for the ballot. Upon qualification, I-107 was renamed by the SOS as Prop 114 (Appendix 12c.1).

Despite polling data previously collected by RMWP that showed overwhelming support for wolf restoration, the election on Prop 114 was extremely close. When the Colorado Secretary of State certified the outcome Prop 114 had passed with 50.91% of the votes (Fig. 12c.6). Concerning the win, "yes" votes were logged in every county in the state. Indeed, > 120,000 "yes" votes came from Colorado's rural counties. This indicates support for the gray wolf in areas with suitable habitat and bodes well for its future after reintroductions.

Passage of Prop 114 (Fig. 12c.5) resulted in the enactment of a new state law, specifically Colorado Revised Statute 33-2-105.8 (Appendix 12c.2), that calls for restoration of a viable population through reintroductions that must begin by December 31, 2023. Never in history has a wolf restoration mandate been established through a vote of the people.

For the election to be as close as recorded required many people to vote "no" who support restoration. Why would they do that? RMWAF has offered several reasons:

(i) The COVID-19 pandemic impacted the state's economy, leading some wolf supporters to conclude the restoration was an expense that could not be afforded.

(ii) The presence of a few wolves in northwestern Colorado in early 2020, and then purportedly one pup that summer, led wolf supporters to mistakenly believe that reintroductions were unnecessary.

(iii) The killing of three wolves in northwestern Colorado or southern Wyoming in mid-summer 2020 allowed wolf supporters to conclude that rural Colorado was too hostile, and that wolves deserved better.

(iv) The USFWS's announcement, just before the election, that gray wolves would be removed from the federal list of threatened and endangered species led some wolf supporters to conclude that wolves were doing well enough to no longer be a conservation issue.

(v) RMWAF was outspent 2:1 on advertising by opponents to Prop 114 which cemented the significance of the points (i) through (iii) above.

COLORADO ELECTION RESULTS
Proposition 114

Shall there be a change to the Colorado Revised Statutes concerning the restoration of gray wolves through their reintroduction on designated lands in Colorado located west of the continental divide, and, in connection therewith, requiring the Colorado parks and wildlife commission, after holding statewide hearings and using scientific data, to implement a plan to restore and manage gray wolves; prohibiting the commission from imposing any land, water, or resource use restrictions on private landowners to further the plan; and requiring the commission to fairly compensate owners for losses of livestock caused by gray wolves?

Counties Reporting 64/64
Total Votes (Percentage Votes)

Y
Yes/For: **1,590,299 (50.91%)**

N
No/Against: **1,533,313 (49.09%)**

Total Votes Cast: 3,123,612

Fig. 12c.5. Results of Prop 114 from 2020 General Election.

Despite the closeness of the outcome, immediately following the election RMWAF emphasized to all concerned that a win is a win. The organization noted that with support from Governor Polis and members of the Colorado state legislature, adherence to C.R.S. 33-2-105.8 would ensure that reintroductions begin by December 2023 which is the first and crucial step to restoration of a viable population of wolves.

With restoration now mandated by state law, there is a notable need for science-based educational efforts that focus on co-existing with wolves through conflict resolution. RMWP intends to re-engage in 2021 and beyond to satisfy that need.

Publication

Phillips, M. & Edward R. 2021. A Quarter Century to Make History: The Wolf's Return to Colorado. International Wolf. Spring 2021: 16-18 (see Appendix 12c.3).

Appendices

Appendix 12c.1. State of Colorado press release, and associated Statement of Sufficiency, announcing the qualification of the gray wolf restoration initiative for the 2020 General Election ballot.

News Release

Media contact
Steve Hurlbert
303-860-6903
steve.hurlbert@sos.state.co.us

State of Colorado Department of State
1700 Broadway
Suite 250
Denver, CO 80290

Jena Griswold
Secretary of State

Jenny Flanagan
Deputy Secretary of State

"Restoration of Gray Wolves" Initiative Qualifies For 2020 Ballot

Denver, January 6, 2020 – The Elections Division at the Colorado Secretary of State's office announced today that Proposed Initiative 107 ("Restoration of Gray Wolves") has qualified for the 2020 General Election ballot.

The "Restoration of Gray Wolves" Initiative is a statewide initiative and therefore requires at least 5% of the total number of votes cast for all candidates for the office of secretary of state at the previous general election, which in this case is 124,632. This requirement is outlined by Article V, Section 1 (3) of the Colorado constitution. After reviewing a 5% sample of the 215,370 submitted signatures, the projected number of valid signatures is greater than 110% of the total number required.

STATE OF COLORADO
Department of State
1700 Broadway
Suite 200
Denver, CO 80290

Jena Griswold
Secretary of State

Jenny Flanagan
Deputy Secretary of State

STATEMENT OF SUFFICIENCY

2019-2020 Proposed Initiative #107 "Restoration of Gray Wolves"

January 6, 2020

On December 10, 2019, the proponents and designated representatives of 2019-2020 Proposed Initiative #107 ("Restoration of Gray Wolves") submitted 215,370 petition signatures to the Secretary of State's office. After reviewing a five-percent random sample of the submitted signatures, the Secretary of State's office projected the number of valid signatures to be greater than 110 percent of the total number of signatures required for placement on the ballot.

Random sample verification summary:

Total number of qualified signatures submitted	215,370
5% of qualified signatures submitted (random sample)	10,769
Total number of entries accepted (valid) from the random sample	6,967
Total number of entries rejected (invalid) from the random sample	3,802
Number of projected valid signatures from the random sample	139,333
Total number of signatures required for placement on ballot	124,632
Projected percentage of required valid signatures	**111.80%**

Because the random sample verification established that the projected number of valid signatures totals 111.80 percent of the amount required for placement on the ballot, 2019-2020 Proposed Initiative #107 is sufficient and will be certified to the 2020 general election ballot.

Dated this 6th Day of January, 2020.

Jenny Flanagan
Colorado Deputy Secretary of State

Main Number (303) 894-2200
TDD (303) 869-4867
Fax (303) 869-4861
Web Site www.sos.state.co.us
E-mail elections@sos.state.co.us

Appendix 12c.2. Colorado Revised Statute 33-2-105.8 that requires restoration of a viable wolf population in Colorado

C.R.S. 33-2-105.8

33-2-105.8. Reintroduction of gray wolves on designated lands west of the continental divide - public input in commission development of restoration plan - compensation to owners of livestock - definitions

(1) The voters of Colorado find and declare that:

(a) Historically, wolves were an essential part of the wild habitat of Colorado but were exterminated and have been functionally extinct for seventy-five years in the state;

(b) The gray wolf is listed as an endangered species on the commission's list of endangered or threatened species;

(c) Once restored to Colorado, gray wolves will help restore a critical balance in nature; and

(d) Restoration of the gray wolf to the state must be designed to resolve conflicts with persons engaged in ranching and farming in this state.

(2) Notwithstanding any provision of state law to the contrary, including section 33-2-105.5 (2), and in order to restore gray wolves to the state, the commission shall:

(a) Develop a plan to restore and manage gray wolves in Colorado, using the best scientific data available;

(b) Hold statewide hearings to acquire information to be considered in developing such plan, including scientific, economic, and social considerations pertaining to such restoration;

(c) Periodically obtain public input to update such plan;

(d) Take the steps necessary to begin reintroductions of gray wolves by December 31, 2023, only on designated lands; and

(e) Oversee gray wolf restoration and management, including the distribution of state funds that are made available to:

(I) Assist owners of livestock in preventing and resolving conflicts between gray wolves and livestock; and

(II) Pay fair compensation to owners of livestock for any losses of livestock caused by gray wolves, as verified pursuant to the claim procedures authorized by sections 33-3-107 to 33-3-110 and, to the extent they are available, from moneys in the wildlife cash fund as provided in section 33-3-107 (2.5).

(3) (a) The commission's plan must comply with section 33-2-105.7 (2), (3), and (4) and must include:

(I) The selection of donor populations of gray wolves;

(II) The places, manner, and scheduling of reintroductions of gray wolves by the division, with such reintroductions being restricted to designated lands;

(III) Details for the restoration and management of gray wolves, including actions necessary or beneficial for establishing and maintaining a self-sustaining population, as authorized by section 33-2-104; and

(IV) Methodologies for determining when the gray wolf population is sustaining itself successfully and when to remove the gray wolf from the list of endangered or threatened species, as provided for in section 33-2-105 (2).

(b) The commission shall not impose any land, water, or resource use restrictions on private landowners in furtherance of the plan.

(4) In furtherance of this section and the expressed intent of voters, the general assembly:

(a) Shall make such appropriations as are necessary to fund the programs authorized and obligations, including fair compensation for livestock losses that are authorized by this section but cannot be paid from moneys in the wildlife cash fund, imposed by this section; and

(b) May adopt such other legislation as will facilitate the implementation of the restoration of gray wolves to Colorado.

(5) As used in this section, unless the context otherwise requires:

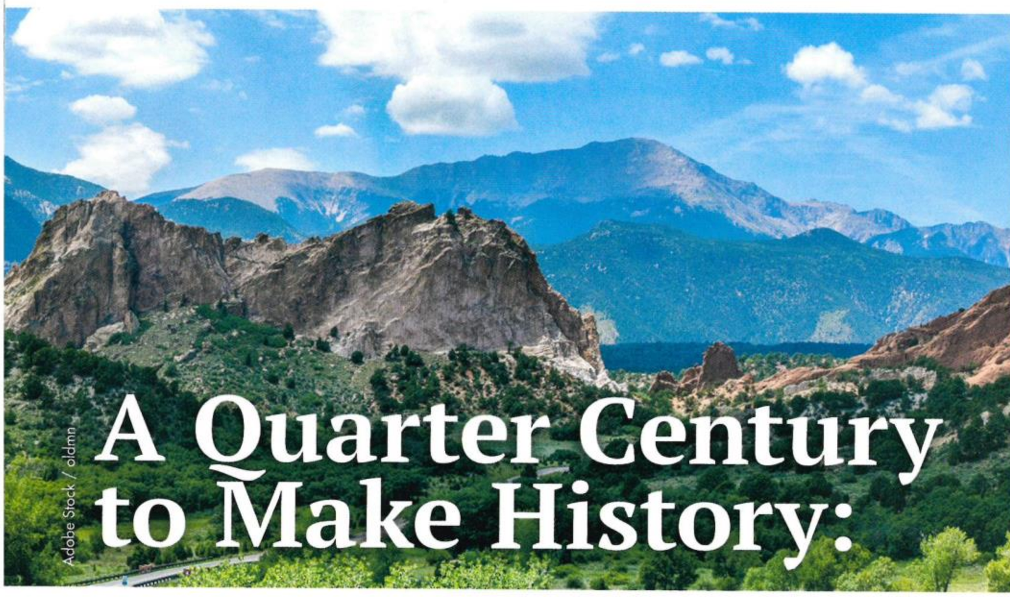
(a) "Designated lands" means those lands west of the continental divide in Colorado that the commission determines are consistent with its plan to restore and manage gray wolves.

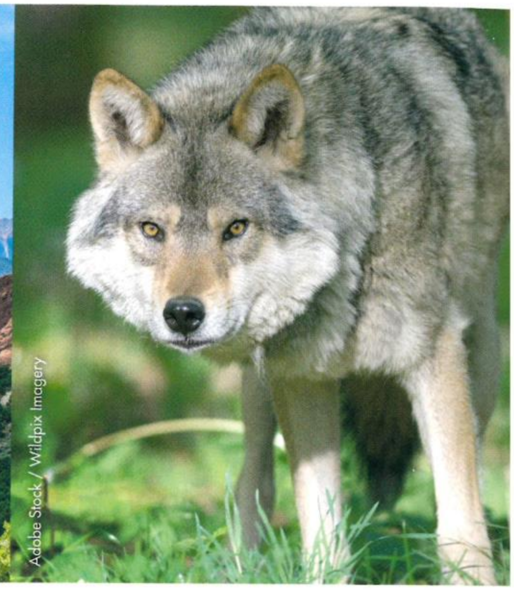
(b) "Gray wolf" means nongame wildlife of the species canis lupus.

(c) "Livestock" means cattle, horses, mules, burros, sheep, lambs, swine, llama, alpaca, and goats.

(d) "Restore" or "restoration" means any reintroduction, as provided for in section 33-2-105.7 (1)(a), as well as post-release management of the gray wolf in a manner that fosters the species' capacity to sustain itself successfully.

Appendix 12c.3. Article published in *International Wolf* magazine, summarizing the work of the RMWP and RMWAF.





A Quarter Century to Make History: The Wolf's Return to Colorado

Views expressed here are those of the authors and are provided to offer information and further discussion on the Rocky Mountain Wolf Project.

To no avail.

That was the outcome of 25 years (1993 to 2018) of hard work, good science, and professional activism to convince the U.S. Fish and Wildlife Service (USFWS) to restore the gray wolf to western Colorado under the Endangered Species Act. Similar efforts at the state level met a comparable fate.

Western Colorado is vast, encompassing more than 17 million acres of federal public wildlands—lands managed for conservation—that support abundant native prey. The region could easily support a robust, self-sustaining wolf population that would serve as the arch-stone connecting the species from the High Arctic to northern Mexico. Nowhere else in the world does such an opportunity exist to connect a large carnivore's distribution across a continent

Inexplicably, the USFWS never applied professional scrutiny to the possibility of restoring wolves to Colorado, and by 2013, institutional disinterest in the idea was the agency's official and resolute policy. Faced with federal stonewalling, wolf advocates returned to pushing for engagement at the state level.

In 2004, Colorado's Division of Wildlife had empaneled the Wolf Working Group, a stakeholder group tasked with providing recommendations to the agency regarding management and, arguably, recovery of wolves. Although overrepresentation of livestock interests on the working group scuttled support for reintroduction, the final report voiced a desire for wolves to "roam freely, wherever they find sufficient habitat and prey." Nonetheless, active restoration efforts gained no traction.

Carpe Diem

Given that advocates had spent more than 20 years building the scientific case for wolves in the Southern Rockies and had done their due diligence with the federal and state agencies, only one option remained to effect recovery in the region: direct democracy. To advance that future, advocates created the Rocky Mountain Wolf Project (RMWP) in 2014 and the Rocky Mountain Wolf Action Fund (RMWAF) in 2019. The RMWP coalition engages Coloradans about co-existing with wolves, disseminating science-based information to cultivate enthusiasm for the species. RMWAF was a political organization committed solely to securing passage of a 2020 ballot proposition to reintroduce wolves.

Adobe Stock / Quattrophotography

By MIKE PHILLIPS & ROB EDWARD

Advocates were aware of longstanding, widespread support for returning wolves to Colorado (greater than 70 percent in multiple polls). Buoyed by that support and sufficient private funds, RMWP succeeded in engaging Coloradans about wolves, while RMWAF focused on developing a wolf restoration ballot proposal. Drafting a legally sound, strategically sensible bill is no small task, but wolf advocates ultimately produced draft legislation that would prove to be a watershed event in wildlife conservation.

The measure establishes wolf restoration as an aspirational goal, leaving the details to the technical expertise of state biologists. It requires Colorado's Parks & Wildlife Commission to develop a plan to restore and manage wolves based on public input received during statewide hearings and the best available scientific, economic and social considerations; begin reintroductions by December 31, 2023; and assist ranchers in preventing and resolving conflicts involving wolves and livestock. The proposal further mandates the Colorado General Assembly to make necessary appropriations to fund wolf restoration and adopt other legislation, if needed, to facilitate restoration.

Never Giving Up

By early summer 2019, the Colorado secretary of state had certified the proposal submitted by RMWAF for petitioning and christened the measure Initiative 107. Colorado law required citizens to gather—within a breathtakingly brief period of six months—124,632 valid signatures in support.

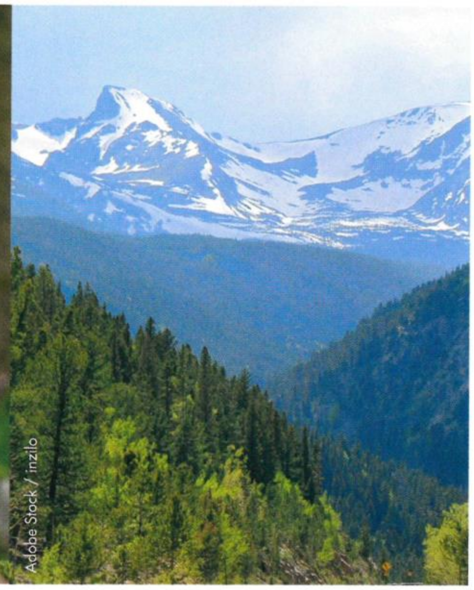
> "Never doubt that a small group of thoughtful, committed, citizens can change the world. Indeed, it is the only thing that ever has."
>
> —Margaret Mead

Through summer and fall, volunteers and paid petitioners collected signatures from Coloradans of all stripes. By the December 5 deadline, RMWAF submitted a whopping 215,370 signatures—far more than needed for validation. In early January 2020, the Secretary of State certified Initiative 107 for the ballot and renamed the measure to Proposition 114.

The success of the petition gathering triggered an effort by state legislators (see link below) to craft legislation that would have been even more robust than Prop 114. Dubbed SB 121, the bill appeared to have enough support in the Colorado Senate and House of Representatives to ensure passage. After Governor Jared Polis signaled his inclination to sign the bill, and just as it was about to have a first hearing, the coronavirus pandemic struck, scuttling all "non-essential" legislation for the session.

Undaunted, RMWAF refocused attention on developing a statewide campaign to pass Prop 114. Two formidable political coalitions immediately formed in opposition—one allied with ranching interests and one allied with both ranchers and hunters. While both were effective at casting Prop 114 in a negative light, and while they effectively outspent the bill's proponents nearly three-to-one in the last weeks of the campaign, the opposition came up short.

On November 3, 2020, with more than three million votes cast, Prop 114 passed by 1 percent. Specifically, 1,590,299 Coloradans voted yes, and 1,533,313 voted no. Passage marked the first time in history that citizens anywhere had used direct democracy to instigate restoration of an endangered species.



Despite the small margin of victory, every county in the state registered significant, if not majority, support. More than 120,000 affirmative votes came from Colorado's lightly populated rural counties—support that should bode well for wolves once reintroduction begins.

If support in rural counties is encouraging, support from the state administration charged with implementing Prop 114 is vital. By early 2021, Colorado's Governor Polis indicated his intention to exercise good governance by dutifully achieving the planning and reintroduction mandates of Prop 114. With a willing administration, completion of the planning process—including public hearings—within 12 to 18 months is achievable and sets the stage for completion of several, if not all, reintroductions well before the end of 2023. The release of 40 to 60 wolves should guarantee a viable population.

Forever Vigilant

The scientists, conservation professionals and citizen volunteers who worked so hard to ensure successful wolf reintroduction in Colorado remain at the ready. Now they will help assure faithful execution of the mandate of Prop 114. Thereafter, they will breathe life into a permanent wolf management paradigm that emphasizes peaceful coexistence with wolves. In support of that mission, as it was dissolved the Rocky Mountain Wolf Action Fund donated its remaining campaign assets to the Rocky Mountain Wolf Project (www.rockymountainwolfproject.org).

Working together, Coloradans of diverse backgrounds and interests will leverage science to build understanding and trust, to the benefit of wolves in Colorado and throughout the Rocky Mountains. Prop 114 was an audacious act of hope, and that hope will now allow wolves to go about their work, bringing balance to Colorado's wildlands and vitality to her elk and deer herds. Most notably, this reintroduction program will serve as a reminder of the wondrous diversity of life on earth—and our undeniable capacity to restore it. ■

Reference

"Colorado Politics.com" article on Colorado SB121: https://www.coloradopolitics.com/news/sen-kerry-donovan-introduces-wolf-reintroduction-bill/article_53977a64-3f06-11ea-8ba3-fb200f3491b6.html

Mike Phillips is the executive director of the Turner Endangered Species Fund, an experienced wolf restoration biologist, term-limited Montana state senator, and co-founder and advisor to the Rocky Mountain Wolf Project and Rocky Mountain Wolf Action Fund.

Rob Edward has advocated for wolf restoration in Colorado since 1994. He now serves as a strategic advisor to the Rocky Mountain Wolf Project. He is a co-founder of the Rocky Mountain Wolf Action Fund and served as the board president from the organization's founding in 2019 and throughout the successful 2020 campaign for Proposition 114.

13. DESERT BIGHORN SHEEP

(*Ovis canadensis nelsonii)*

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

NOT LISTED

New Mexico Department of Game & Fish

New Mexico State Listing Designations

DELISTED

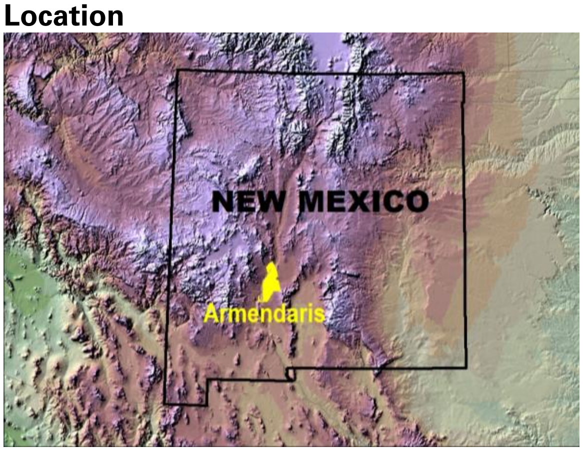
Biologists

Charles "Hunter" Prude

Carter Kruse

Threats – Desert bighorn sheep ("sheep") were listed as an endangered species in New Mexico in 1980 when fewer than 70 remained statewide. Declines were attributed to disease (transmitted from domestic sheep), overhunting, and habitat changes. Early restoration efforts were hampered by mountain lion predation. With concerted management by NMDGF, including captive breeding, translocation, and mountain lion control, sheep populations recovered sufficiently to down-list the species in 2009, and delist in 2011. The project described herein was integral to the delisting process.

Location



Partners

Funding/ Research — *Research* — *Funding* — *Funding/ Management/ Research*

Background

It is unknown whether the Fra Cristobal Mountain Range on the Armendaris Ranch ever supported native sheep; however, habitat was deemed suitable to support sheep. In a collaborative restoration effort TESF and NMDGF introduced 37 sheep from the NMDGF captive Red Rock population into the Fra Cristobal Mountains in 1995. An additional seven rams were added to the population in 1997. From 1995-2014, 50 mountain lions were captured and removed in the Fra Cristobal mountains. This intensive mountain lion control helped the sheep population to grow to a minimum count of 154 individuals in 2010, and 272 by 2017, including 138 ewes (Table 13.1; population estimate of 300-350 sheep after adjusting for survey sightability), constituting the largest sheep population in the state at that time. Growth of and emigration by the Fra Cristobal population resulted in a new sheep population in the neighboring Caballo Mountains by 2006, which now includes over 200 individuals (2019 survey). With successful establishment of the Fra Cristobal sheep population, collaborative efforts have shifted from recovery (e.g., introductions, intensive monitoring, and intensive predator control) to management and sport harvest of the population. Since delisting in 2011, over 50 mature rams have been harvested on the Fra Cristobal Mountains through a public-private partnership with NMDGF. Perhaps more importantly, 79 sheep have been transplanted from the Fra Cristobal's to support sheep restoration and recovery elsewhere in New Mexico.

In 2014, predator control transitioned from the lethal removal of all known mountain lions within the Fra Cristobal mountains to a less invasive strategy of removing only those lions that are documented to kill multiple sheep. Mountain lions are captured, collared, and prey selection is monitored with GPS point cluster analyses. Once a mountain lion is documented to have killed three ewes or five total sheep it is subject to removal. Since that time, 8 of 23 collared lions using the mountains have been removed due to predation on sheep (see Table 13.2). Substantial information on lion prey selection and diet has been gathered since 2014.

In late 2017 and continuing into 2018 we documented suspicious mortalities of four collared sheep (3 ewes/1 ram). These sheep were part of a group of 30 ewes and rams that were collared in 2016 for a research project assessing sheep survey techniques. Histopathological analysis of blood and tissue samples collected from the collared sheep mortalities and from hunter harvested rams revealed that *Mycoplasma ovipneumoniae*, a bacterium that can cause pneumonia in sheep, was present in the Fra population. The strain of mycoplasma identified suggests it was carried to the Fra population from the San Andreas Mountain range. Based on information from collared sheep, it is estimated that a minimum 15% of the Fra Cristobal sheep population perished due to disease exposure in 2018, hence the lower population counts in 2018, 2019, and 2020 (Table 13.1). Disease is always a management concern with sheep, and we will continue work with NMDGF to monitor and investigate any suspected disease-caused morbidity or mortality of wildlife within the Fra habitat area.

Goal – Establish a self-sustaining desert bighorn sheep population in the Fra Cristobal Mountains (Armendaris Ranch) that contributes to improving conservation status of the species in NM.

Objectives

We will work cooperatively with the NMDGF to maintain a desert bighorn sheep population in the Fra Cristobal Mountains that exceeds 300 desert bighorn sheep and includes at least 120 adult ewes. Ideally, 15-20 adult ewes will be translocated from the Fra Cristobal population every 2-4 years to restore, improve, or maintain other populations of sheep in New Mexico. The Fra Cristobal population will support hunter harvest of 4-8 mature rams annually. All mountain lions observed in the Fra Cristobal Mountains will be captured, collared with a GPS transmitter, and tracked to identify habitat use and prey composition. We will work to develop sustainable alternatives to the current targeted mountain lion management in the Fra Cristobal Mountains by 2025.

Activities in 2020

We assisted NMDGF with one helicopter sheep survey in December 2020. A minimum count of 112 sheep were observed during the survey (Table 13.1; population estimate of 150-172 sheep). We continued disease monitoring in 2020 by testing hunter harvested rams and some lion killed sheep for disease exposure. None of the sheep sampled tested positive for *M. ovipneumoniae* infection. However, the Fra population may be experiencing reduced fecundity and recruitment as secondary effects of the 2017-2018 disease event. NMDGF identified the strain of *M. ovi* present in the Fra Cristobal population as the Kofa strain, which was likely transferred to New Mexico with sheep that were translocated from the Kofa National Wildlife Refuge to the San Andres mountains on White Sands Missile Range. The *M. ovi* bacteria can be spread between bighorn populations by transient sheep moving between mountain ranges. By the end of 2019, it was likely that sheep populations in the San Andres, Fra Cristobal, Caballo, Ladrone, and Sacramento Mountain ranges in New Mexico had been exposed to *M. ovi* bacteria.

We detected two new (not previously captured or known) lions using the Fra Cristobal mountains. We captured and collared two new lions: both were males (ARM15, ARM16). We recaptured one female lion (ARF06) twice to exchange collars; once using hounds along the Rio Grande River but her collar malfunctioned and stopped transmitting data so she was recaptured again in a snare within the Fra Cristobal Mountains. Male lion ARM15 was one of ARF06's two kittens born in 2019 and was incidentally captured in traps set to capture ARF06. ARM15 was killed and eaten by ARF06 not long after he was collared. One male lion (ARM16) was removed for bighorn sheep depredation. Lion predation on bighorn sheep decreased slightly from 16 kills documented in 2019 to 10 kills in 2020.

From 2014 through 2020, more than 100,000 GPS point locations have been collected from collared mountain lions. Since 2014, TBD staff have investigated approximately 1,507 GPS clusters, or potential lion kill or feeding sites. Of these, 958 were determined to be kill locations. Diet composition for the mountain lions using the Fra Cristobal Mountains and surrounding habitat is diverse, with 32 different prey species documented (Fig. 13.1). Prey species range in size from common carp (*Cyprinus carpio*, $n = 50$) to gemsbok (*Oryx gazella*, $n = 100$). Approximately 45% of the combined confirmed lion diet is composed of smaller prey items that weigh less than 15 kg, however mule deer (*Odocoileus hemionus*, $n = 253$) are the most utilized prey species comprising approximately 26% of the total kills. Predation of oryx increased from 35 total kills from 2014 – 2018, to 75 total kills by the end of 2019, and then 100 total kills by the end of 2020. The increase in oryx predation is likely due to the population expanding and becoming more abundant on the landscape. Desert bighorn sheep comprise approximately 5% (by number) of the diet composition with 58 documented kills to date. Bighorn rams ($n = 21$) and lambs ($n = 21$) are killed by lions more than ewes ($n = 14$). Lion predation on bighorn sheep increases during the lambing season, February through May.

The principal biologist on this project, Charles "Hunter" Prude, successfully defended his Master's Thesis titled "Influence of Habitat Heterogeneity and Water Sources on Kill Site Locations and Puma Prey Composition" in 2020 (New Mexico State University) and was promoted to a Wildlife Biologist position with Turner Biodiversity.

Table 13.1. Fra Cristobal desert bighorn sheep minimum population counts derived from aerial or ground surveys conducted by NMDGF and TEI staff from 2011-2020. Survey sightability is estimated to be around 78%.

Date	Total	Ewes	Y. Ewe	Lambs	Unk	CI	CII	CIII	CIV	Total Rams	Survey Type & [Time in hours]
05/2011	190	68	7	27		25	20	18	25	88	AG[3.8]
05/2012	72	26	-	24	10	2	6	-	4	12	G[8]
05/2013	111	53g	6	26	5	6	4	10	1	22	G[17]
10/2013	201	76	16	24	3-4	18	31	14	18	81	A[6.1]
05/2015	193	72	8	31	1	15	21	28	17	81	AG[5.4]
10/2015	221	108	10	34	1	10	22	14	22	68	AG[5.4]
12/2016	263	110	-	68	2	2	39	28	13	83	AG[5.3]
05/2017	272	138	7	40	-	14	32	31	10	87	A[5.7]
10/2017	242	112	14	27	-	15	30	36	8	89	A[?]
09/2018	78	41	2	9	-	2	4	8	5	26	G[13]
10/2018	179	75	-	25	-	-	-	-	2	79	A[?]
12/2019	134	52	5	12	-	-	-	-	9	65	A[?]
12/2020	112	54	-	26		4	9	12	7	32	A[?]

KEY:	Y. Ewe = Yearling Ewe
CI = Class I Ram (2-4 years old)	Unk = Unidentified age/sex
CII = Class II Ram (4-6 years old)	A = Aerial Survey
CIII = Class III Ram (6-8 years old)	G = Ground Survey
CIV = Class IV Ram (8-16 years old)	AG = Combined Aerial and Ground Survey

Table 13.2. The status of mountain lions captured and collared 2014-2020.

Animal ID[1]	Capture Date(s)	Current Status/Comments	Confirmed Desert Bighorn Sheep Kills
AR-M01/BM3	6/6/2014	Dead - hunter harvested 1/3/2016. Killed in San Marcial area.	5 prior to collar malfunction on 10/28/2014
AR-M02	6/15/2015	Dead - killed by other lion on 6/30/2015. May have been killed by AR-F02.	
AR-M03	9/28/2015	Presumed Dead - AR-F03 kitten, VHF collar only, collar confirmed to have fallen off.	
AR-M04	10/17/2015, recaptured on 12/09/2015	Dead - complications during NMDGF relocation attempt on 12/09/2015. Was using urban interface prior to recapture.	
AR-M05	11/15/2015, recaptured 5/3/2016 and 10/2/2016	Dead - removed due to DBS depredation on 3/20/17. Snared and euthanized on last kill. AR-F01 was mother.	1 CI ram, 1 ewe, 5 lamb
AR-M06	10/16/2016	Dead - removed due to DBS predation on 3/27/17. Tracked and shot.	1 ewe, 1 ram, 2 lamb
AR-M07	11/11/2016; recaptured 2/08/2017; recaptured 11/01/17; recaptured 11/8/2018	Dead - hunter harvested 3/14/2019 along Rio Grande near Bernardo, NM (+34.489188, -106.796454)	2 lambs
AR-M08	2/14/2017	Dead - died of unknown causes 2/24/2107. Carcass found on BDA +33.85303, -106.85861	
AR-M09	3/27/2017	Presumed Alive - not using Fra Cristobals; using river corridor and eastern plains, including WSMR, collar malfunction on 4/30/2020 no longer sending data	
AR-M10	9/22/2017	Dead - removed due to DBS depredation on 11-15-17. Killed by shooter.	3 ewe, 1 juvenile
AR-M11	6/26/2018; recaptured 9/26/2018	Dead - removed due to DBS depredation on 09-26-18. Killed in snare.	3 ewe/lamb, 2 CII ram
AR-M12	1/19/2019	Dead - removed due to DBS depredation by NMDGF contractor in Caballo Mountains on 7/4/2019	3 lamb, 2 CII ram, 1 CIII ram
AR-M13	3/10/2019; recaptured 6/5/2019	Dead - removed for DBS depredation on 8/13/2019. Killed by shooter.	2 ram, 3 ewe, 4 lamb
AR-M14	4/27/2019, recaptured 10/28/2019; 3/27/2020	Alive. Recaptured on 3/27/2020. Collar exchanged	1 CII, 2 CIII ram
AR-M15	2/14/2020	Dead - killed and eaten by another lion at +33.54370, -107.08510 on 3/27/2020	
AR-M16	4/20/2020	Dead - removed due to DBS depredation on 8/31/2020. Killed in snare.	3 CIII ram, 2 ewe, 4 lamb
AR-F01	3/6/2014, recaptured 2/6/2015	Unknown - recollared on 2/6/2015, collar malfunction, collar dropped off 2/16/2016.	
AR-F02	7/1/2015	Dead - died of unknown causes 12/31/2015. Found under water.	
AR-F03	8/12/2015, recaptured 6/6/2016	Dead - malnourishment and intestinal worms	
AR-F04	10/23/2015	Presumed alive - VHF collar only, captured on camera in Jornada Lava Cave on 6/13/2018. Not collecting location or kill data.	
AR-F05	11/15/2015; recaptured 03/21/2017	Dead - hunter harvested near San Marcial 4/28/2017. AR-F01 was mother.	
AR-F06	10/12/2018; recaptured 3/14/2020; recaptured 12/2/2020	Alive - using Fra Cristobals and riparian corridor; recaptured with hounds 3/15/2020 at +33.558751, -107.073138; Collar malfunction on 3/17/2020, recaptured in Fras on 12/20/2020	1 ewe
AR-F07	10/29/2019; recaptured 11/17/2019	Alive - incidentaly recaptured at powerline on 11/17/2019	

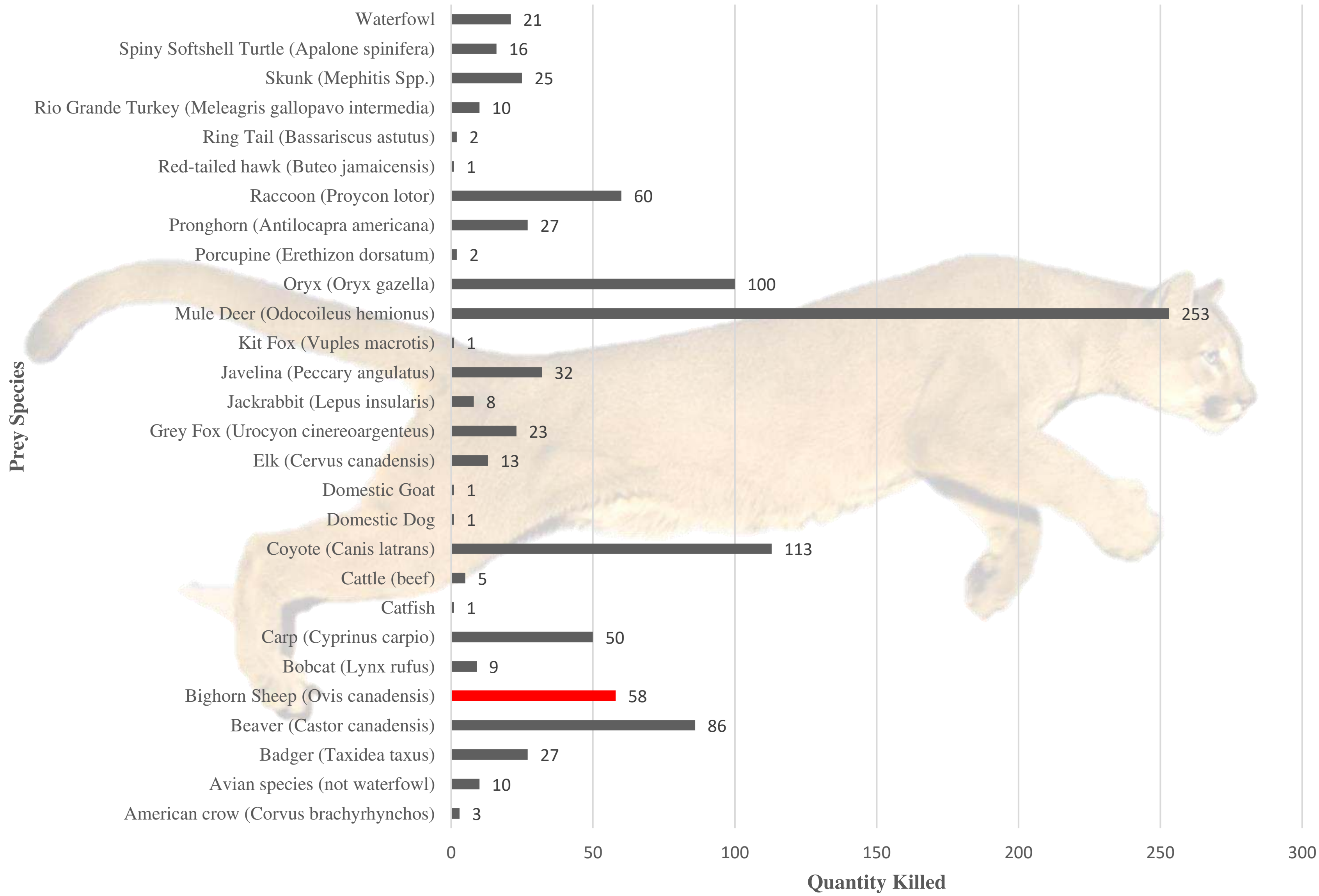


Fig. 13.1. Documented collared mountain lion kills on the Armendaris Ranch and surrounding habitat from 2014 – 2020.

14. BLOWOUT PENSTEMON

(*Penstemon haydenii S. Watson*)

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

ENDANGERED

Nebraska Game & Parks

Nebraska State Listing Designation

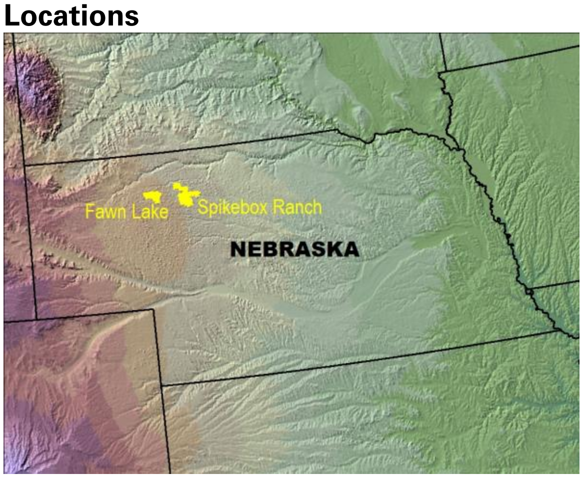
ENDANGERED

Project Biologists

Grace Ray

Carter Kruse

Locations



Project Partners

Funding ($10,000)

Funding ($5,000)

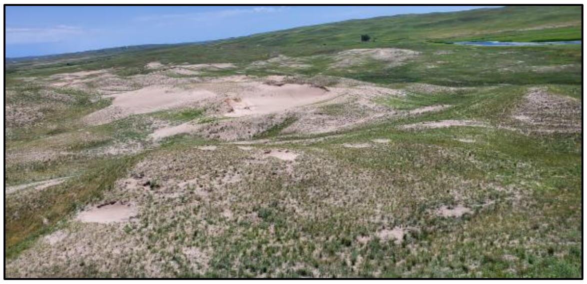
Funding ($3,670)

Background – Since the blowout penstemon was listed, the number of acres of suitable blowout habitat has continued to decline due to fire suppression and changes in grazing management practices. Numerous penstemon reintroduction projects have taken place across the Sandhills with minimal success, as the acreages dedicated to projects are rarely large enough to support sustainable populations for the long term. Although populations associated with public lands projects are generally more successful, there remains an inherent lack of suitable penstemon habitat large enough to sustain fluctuating populations. Turner Ranches in the Sandhills have a unique ability to utilize bison grazing to promote penstemon habitat on a scale large enough to support yearly population fluctuations as well as provide the acreage necessary for promoting genetic variation and sustainable reproduction. Promotion of penstemon habitat essentially requires "overgrazing" an area to promote sand dune blowout and migration. The Spikebox Ranch has worked with TBD to implement this effort. No other private landowner in the Sandhills has been willing to experiment with decreasing range condition to benefit penstemon.

Goal – To work with state and federal partners to implement the largest (in acreage) blowout penstemon reintroduction project to date, with the goal of achieving a naturally reproducing and self-sustaining population that contributes to the recovery and potential downlisting/delisting of the species.

Objective – TEI and our project partners will utilize focused bison grazing on a Sandhills prairie pasture to create >800 acres of ideal habitat (i.e., sand dune blowout and migration) for penstemon reintroduction. Once the desired habitat is achieved, approximately

5,000 seedlings and >10 pounds of seed will be dispersed throughout the pasture. Due to the short-lived nature of the species and the understanding that populations fluctuate drastically on a year-to-year basis, penstemon populations remaining above a minimum population threshold of >300 plants will be considered a stable population.



Aerial view of active penstemon habitat.

Blowout associated species thriving in restored penstemon habitat.

Spikebox penstemon grown from seed (left) vs. penstemon transplant (right).

Activities in 2020

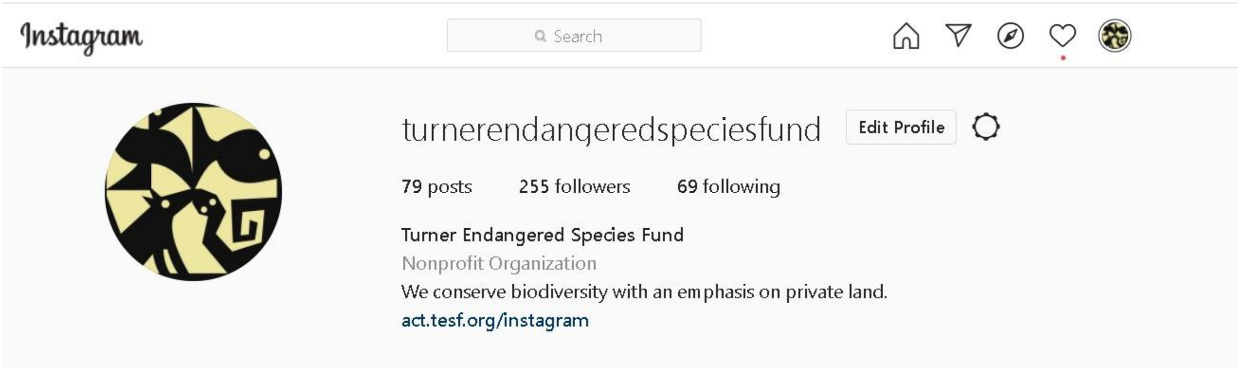
Timely bison grazing of the Spikebox project pasture continued throughout 2020. Project partners planted approximately 1,750 penstemon seedlings in late May of 2020 and yearly vegetation monitoring took place in June. Contract agreements were finalized in 2020 making Fawn Lake Ranch the second site of the largest blowout penstemon reintroduction project to date. Fawn Lake Ranch employees completed fence and well construction in early 2020, and baseline vegetation monitoring of the additional 277-acre penstemon occurred in June.

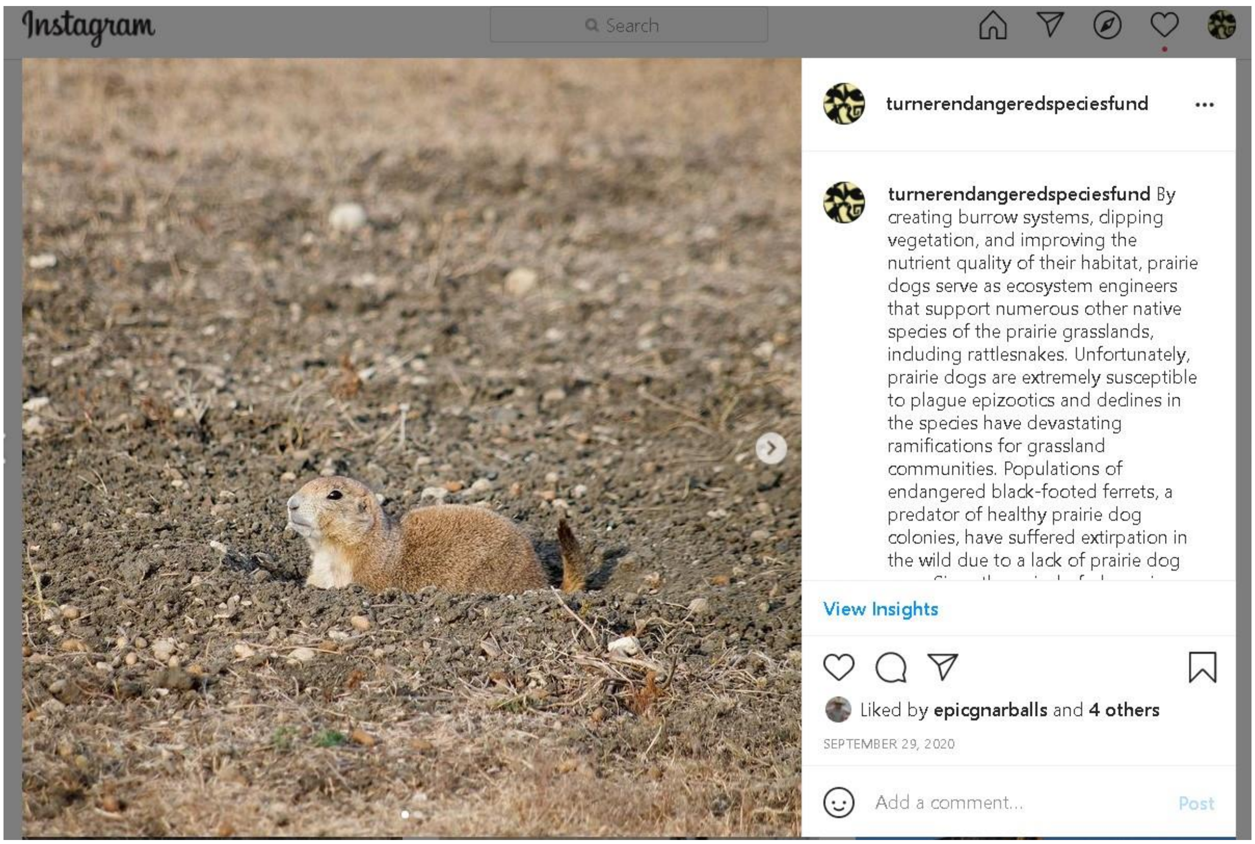
Future Activities – TEI and our project partners will continue to monitor the Spikebox and Fawn Lake penstemon pastures for habitat progress. Seedling and seed growth will be monitored in 2021 to show rate of success in the Spikebox pasture. The Fawn Lake project will begin its implementation of a bison grazing prescription in 2021, with a focus on creating suitable penstemon habitat for at least 2 years before approximately 5 pounds of penstemon seed will be dispersed through the project site. This project has had great success in its very early stages, and TEI/TBD and partners are looking forward to the projected expansion of activities in 2021, as we move closer towards our goal of delisting the blowout penstemon.

Landscape view: grazed and ungrazed comparison.

PUBLIC OUTREACH

Selected Instagram Posts from 2020






Instagram
Search
turnerendangeredspeciesfund
turnerendangeredspeciesfund Bighorn rams spar while drinking water at one of the rain catchments in the Fra Cristobal Mountains on the Armendaris Ranch in New Mexico. Sometimes one good bump deserves another.
#savingspecies #wildlifeconservation #bighornsheep
39w
johnrseydel Wow!!! So beautiful
39w 1 like Reply
theworldtraveler2018 😮😍
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84 views
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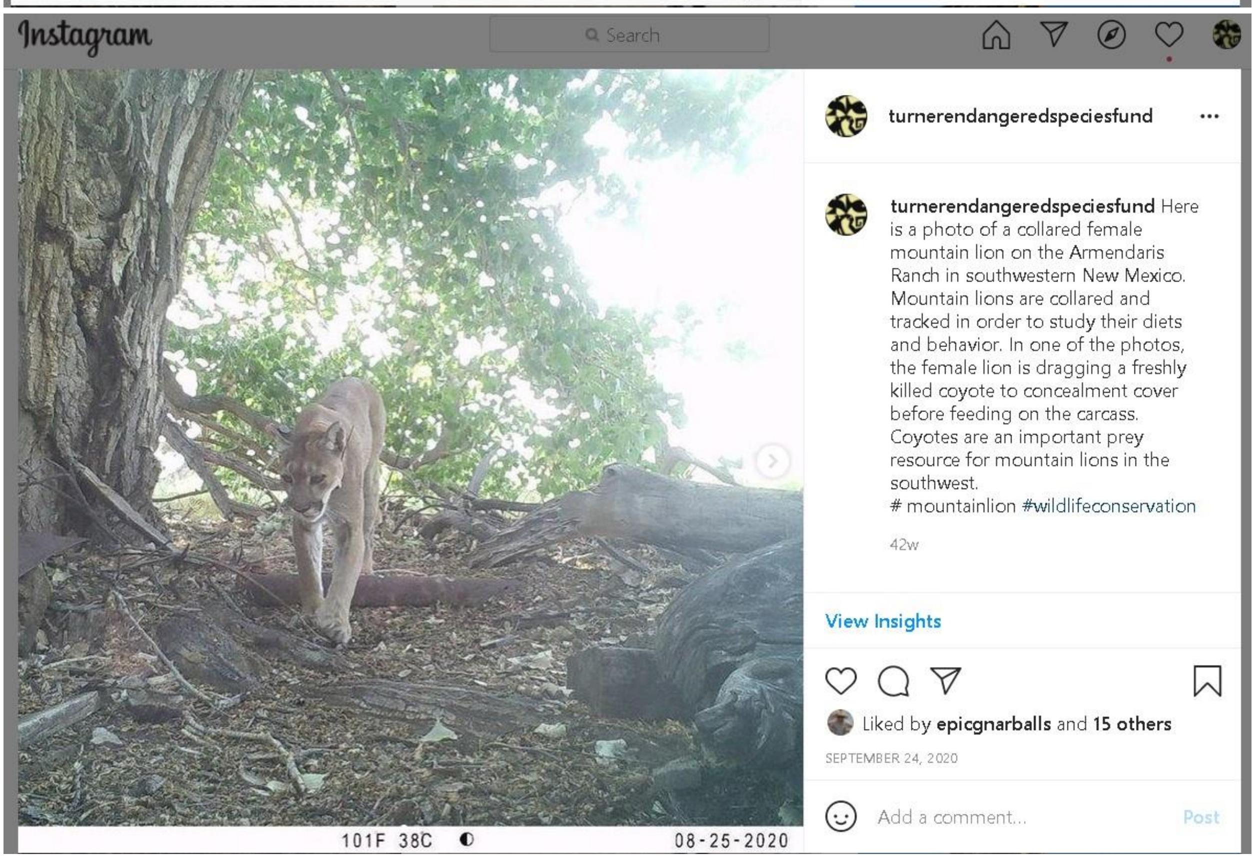
Instagram
Search
turnerendangeredspeciesfund
turnerendangeredspeciesfund Here is a photo of a collared female mountain lion on the Armendaris Ranch in southwestern New Mexico. Mountain lions are collared and tracked in order to study their diets and behavior. In one of the photos, the female lion is dragging a freshly killed coyote to concealment cover before feeding on the carcass. Coyotes are an important prey resource for mountain lions in the southwest.
mountainlion #wildlifeconservation
42w
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SEPTEMBER 24, 2020
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Post
101F 38C
08-25-2020

Instagram

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turnerendangeredspeciesfund ...

turnerendangeredspeciesfund For years now, TESF has been assisting with recovery of the species. Since inception in 1997 TESF has been dedicated to arresting the extinction crisis by advancing reintroduction projects for imperiled plants, birds, fishes, mammals, reptiles, and amphibians.
#blowoutpenstemon
#imperiledplants

45w

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Liked by **cheneylikethevp** and **10 others**

AUGUST 31, 2020

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turnerendangeredspeciesfund A threatened Chiricahua leopard frog sunning its self on an artificial island in a stock tank. Stock tanks on the Ladder Ranch not only provide water for livestock and wildlife but are great refugia for frogs.
wildlifeconservation # ladderranch
#Chiricahualeopardfrog

39w

rhondaproc ❤️

38w Reply

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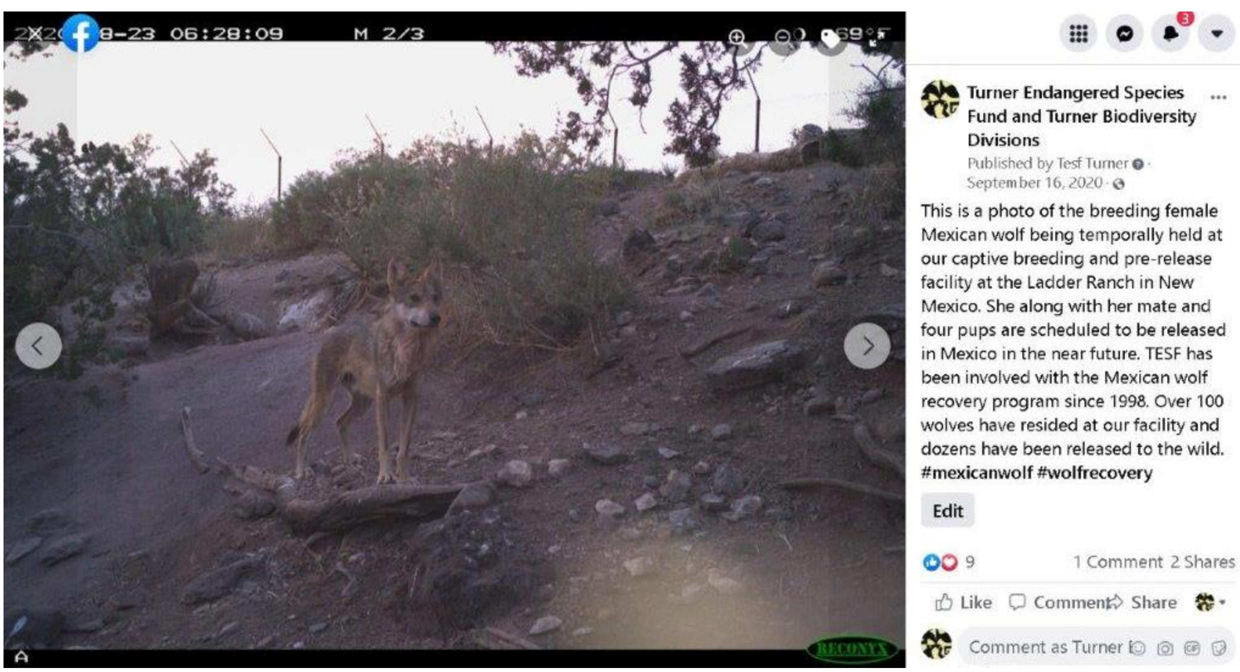

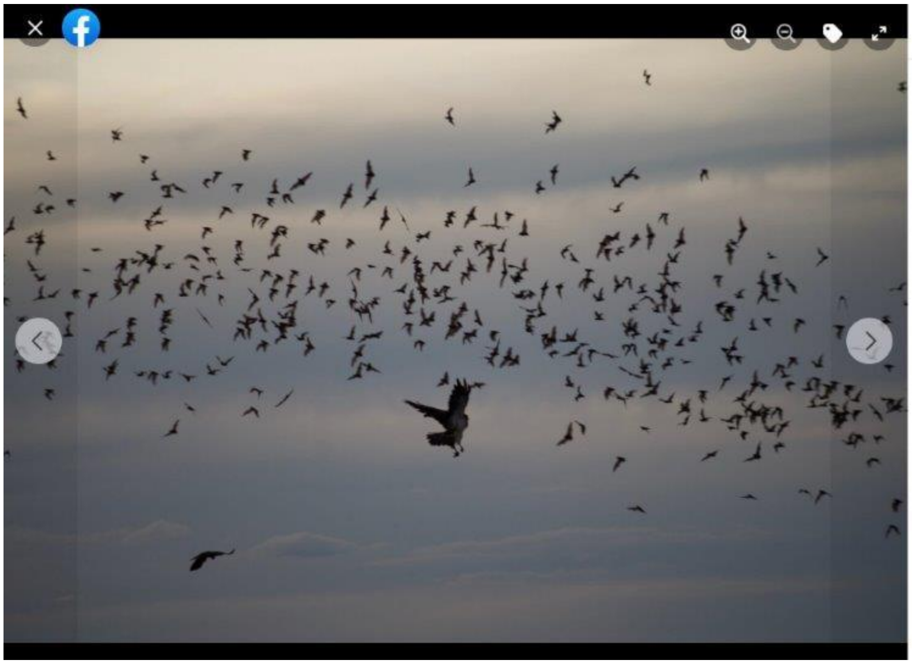

Turner Endangered Species Fund and Turner Biodiversity Divisions
Published by Tesf Turner · August 27, 2020

Swainson's hawks congregate for a predictable meal during the summer months at the Jornada bat caves on Ted Turner's Armendaris Ranch in New Mexico. These caves are the second largest lava tubes in North America and provide habitat for eight bat species. The migratory population of Mexican free-tailed bats at Jornada is the largest in New Mexico, and the fifth largest in North America. Like all Turner ranches, the Armendaris is a hot spot for biodiversity.
#swainsonshawk #ar... See More

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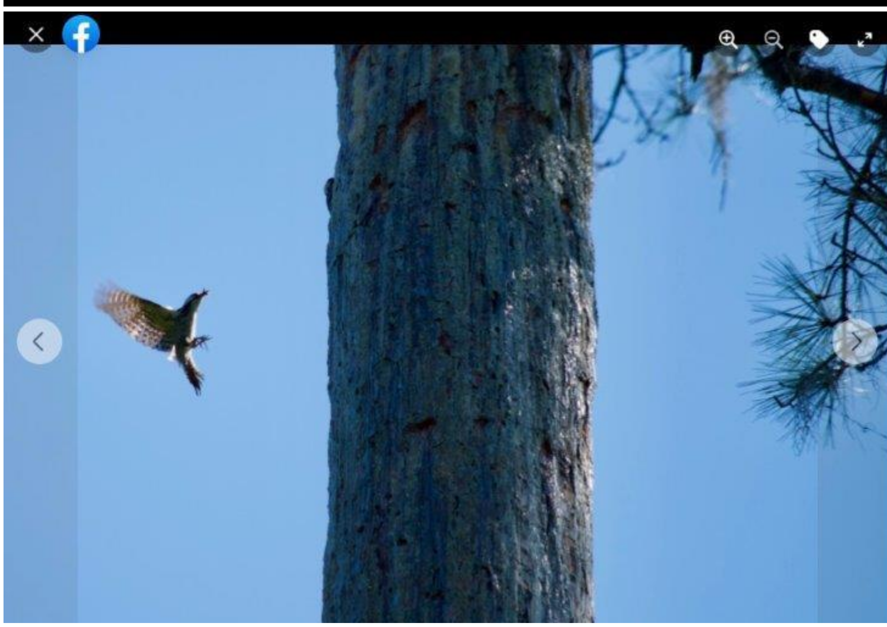

Turner Endangered Species Fund and Turner Biodiversity Divisions
Published by Cheney Gardner Holbrook · March 25, 2020

As of December 2019, Ted Turner's Avalon Plantation in Florida continues to support 20 active clusters of red-cockaded woodpeckers, the second straight year TESF achieved this significant milestone and fulfilled our goal of sustaining population growth.

#birds #woodpeckers #inspiration

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4

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Total Page Likes

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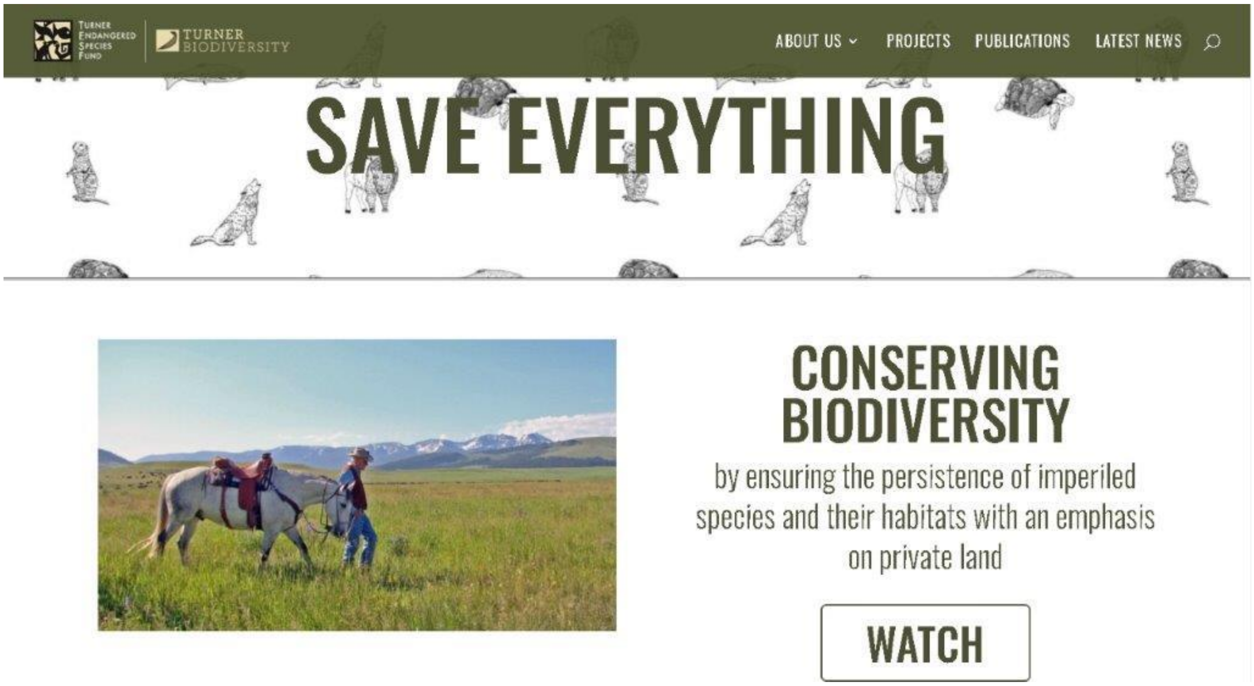

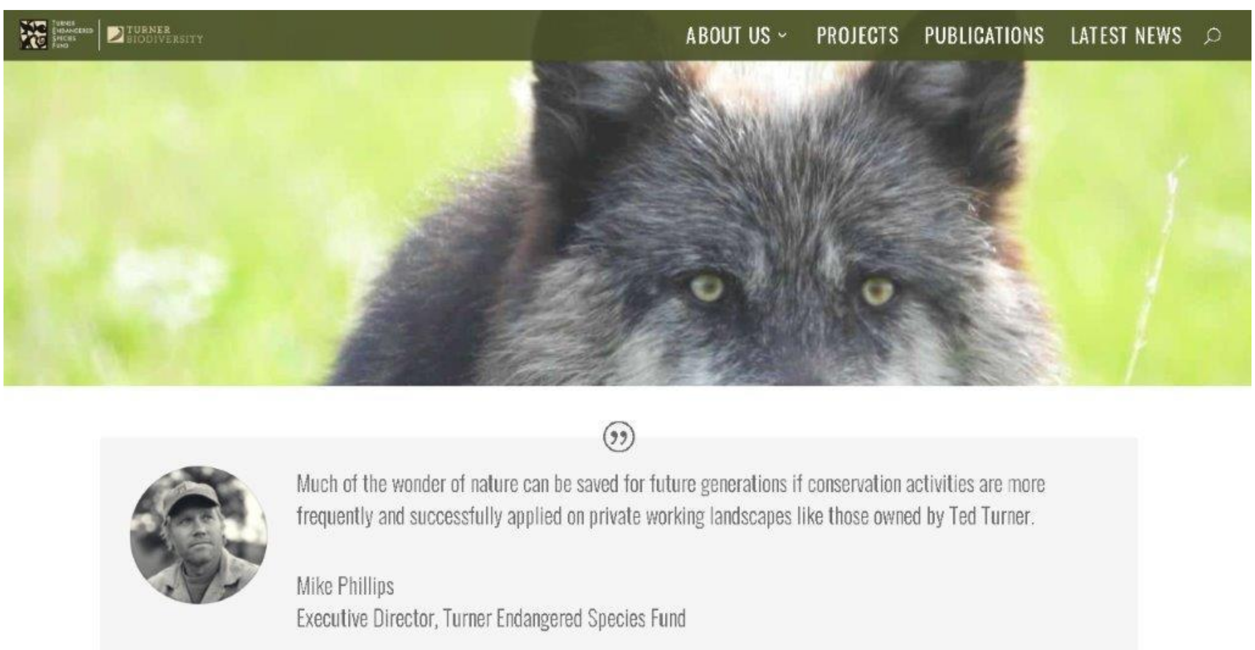

NEWSROOM

Mexican wolves released near Chihuahua, Mexico.

On November 5, two adult Mexican wolves and four pups were released in suitable habitat near Nuevo Casas Grandes, Chihuahua, Mexico. Prior to release the wolves had been removed from the San Carlos Apache Reservation in Arizona and placed for a few months at the...

A prescribed burn at our Z Bar Ranch in Kansas.

A 2020 prescribed fire treatment on the mixed grass prairie at our Z Bar Ranch in Kansas controls eastern redcedar encroachment and restores prairie health for lesser prairie chickens.

A Chiricahua leopard frog soaks up some sun in a stock tank at the Ladder Ranch.

A threatened Chiricahua leopard frog sunning its self on an artificial island in a stock tank. Stock tanks on the Ladder Ranch not only provide water for livestock and wildlife but are great refugia for frogs.

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NEWSROOM

TESF is proud to advance the future for prairie dogs, one of the world's greatest underdogs.

TESF manages prairie dogs on several Turner properties to provide habitat for the endangered black-footed ferret. Prairie dogs also complement Turner's bison herds as these species have co-evolved over thousands of years and constitute a grazing association: bison...

Female Mexican wolf at the Ladder Ranch captive breeding facility.

This is a photo of a breeding female Mexican wolf being temporally held at our captive breeding and pre-release facility at the Ladder Ranch in New Mexico. She along with her mate and four pups are scheduled to be released in Mexico in the near future. TESF has been...

Healthy westslope cutthroat trout on the Flying D Ranch.

A healthy westslope cutthroat trout from Cherry Creek on the Flying D Ranch in Montana. Turner Biodiversity restored these native trout to upper Cherry Creek in a decade long project that concluded in 2010. The population is now regularly monitored to assess health...

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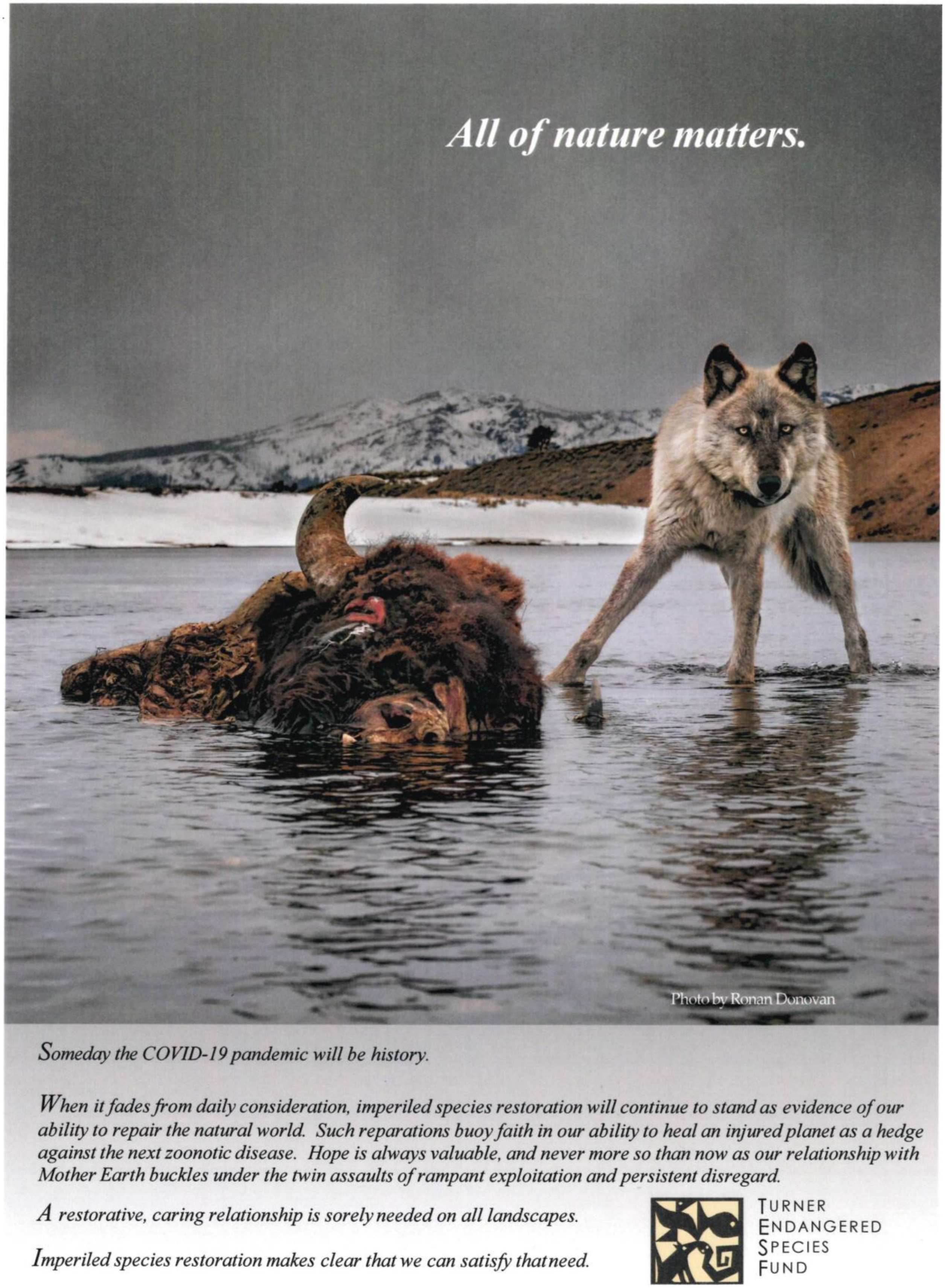
2020 Advertisements

Ad placed in Volume 3(1) of The Tortoise magazine, a publication of the Turtle Conservancy.



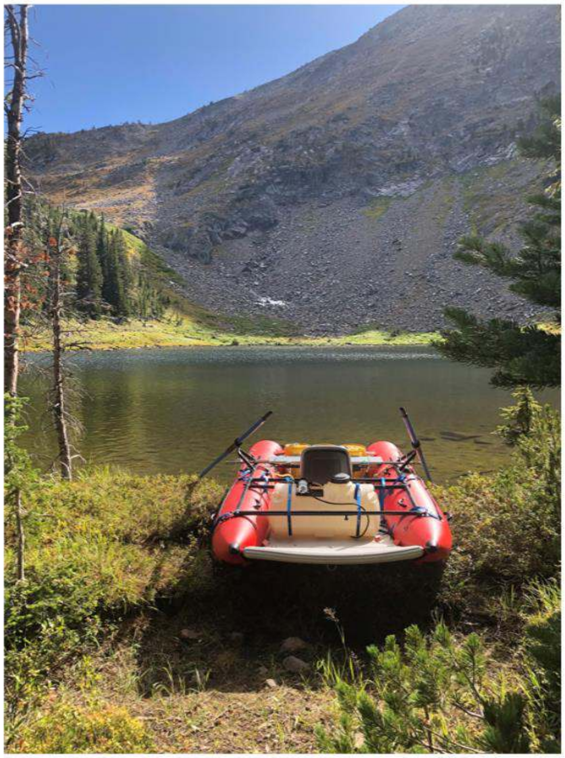
FIELD GALLERY

First ABB capture at Spikebox (Credit: Eric Leinonen)

Two-thirds of the planet's captive black-footed ferret population lives at the USFWS National Black-Footed Ferret Conservation Center in Colorado. It's these captive-bred animals that we aim to restore to Turner prairie ecosystems (Credit: Magnus McCaffery)

Ecotour on the Z Bar (although grass in the foreground is invasive) (Credit: Grace Ray)

Bethany Zerbe learning how to draw blood on a pup (Credit: Cassidi Cobos)



Chiquita Lake, NF Spanish drainage
(Credit: Carter Kruse)

Western burrowing owls depend on prairie dog colonies for nesting and brood rearing, food, and escape from predators (Credit: Magnus McCaffery)

Prairie dog burrows create shelter for a host of other species, including prairie rattlesnakes (Credit: Magnus McCaffery)

A perfectly set, and aesthetically pleasing, pitfall trap
(Credit: Magnus McCaffery)

A bison calf wanders through a prairie dog colony at Bad River Ranches (Credit: Magnus McCaffery)

Baiting a pitfall trap with an odorous ripened rat
(Credit: Eric Leinonen)

Annual penstemon monitoring
(Credit: Grace Ray)

Vegetation monitoring by horseback on the Snowcrest
(Credit: Grace Ray)

Not good American burying beetle trapping weather: A hailstorm blows in at Spikebox (Credit: Magnus McCaffery)

A creep of juvenile tortoises in the Ladder headstart pen
(Credit: Chris Wiese)

PUBLICATIONS/PRESENTATIONS

Forrester, A., Rohde, M., Harner, M., **Kruse, C.**, & Geluso, K. (2020). Ornate Box Turtles (*Terrapene ornata*) copulating in water: an incidental observation or ancestral behavior. Transactions of the Nebraska Academy of Sciences 40, 19–23.

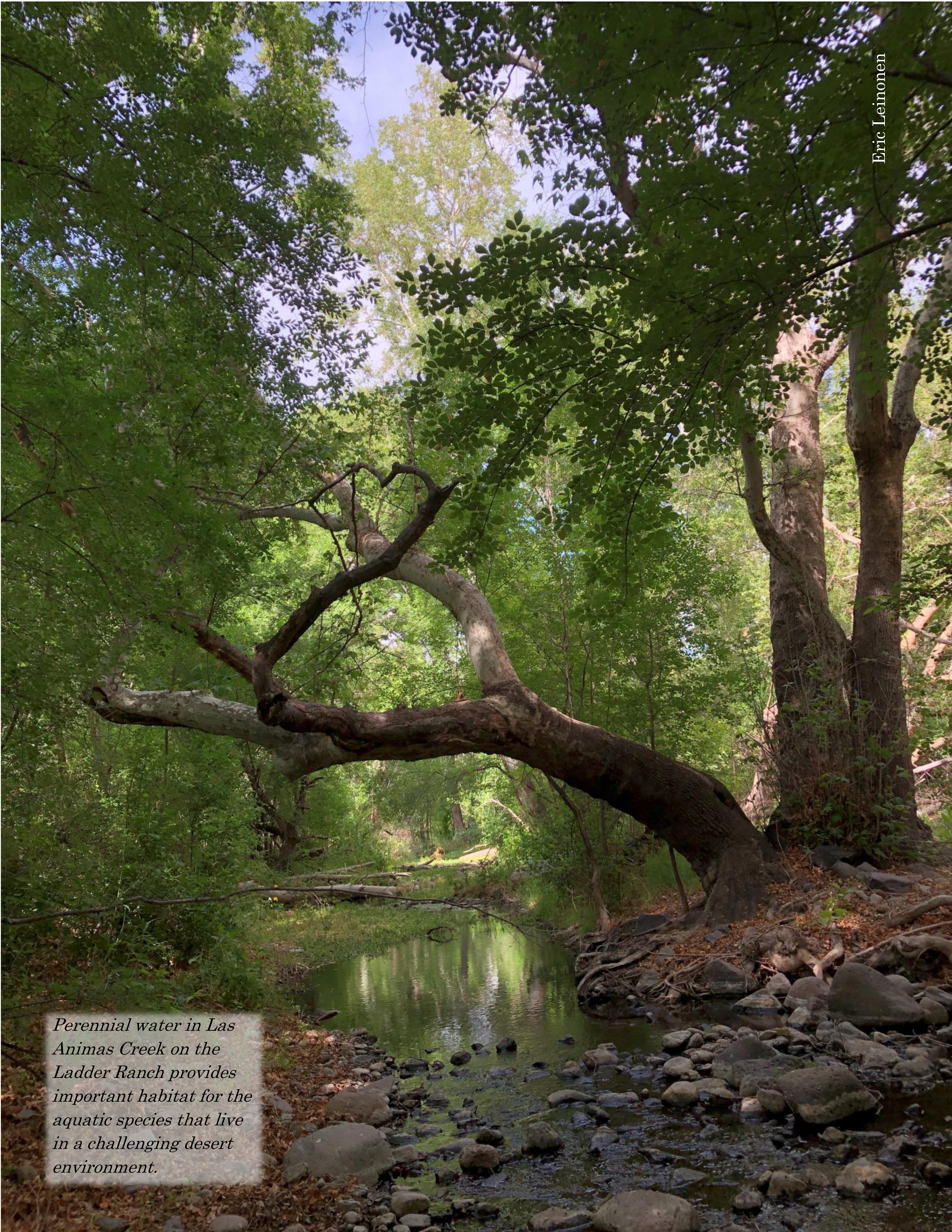
Geluso, K., **Kruse, C.**, & Harner, M. (2020). Wetland edge trampled by American Bison (*Bos bison*) used as basking site for Painted Turtles (*Chrysemys picta*). Transactions of the Nebraska Academy of Sciences and Affiliated Societies. 527.

Phillips, M.K. 2020. Politics, Science, and the Biodiversity Crisis. Invited banquet presentation, Annual Meeting South Dakota Chapter of The Wildlife Society, Oacoma, SD, February 27, 2020.

Prude, C. H. (2020). Influence of Habitat Heterogeneity and Water Sources on Kill Site Locations and Puma Prey Compositions. M.S. thesis, New Mexico State University.

ACRONYMS & ABBREVIATIONS

ABB = American Burying Beetle
ACES = Aspen Center for Environmental Studies
ACRA = Ash Creek Restoration Area
AFS = American Fisheries Society
ATP = Armendaris Truett Pen
AZ = Arizona
AZA = Association of Zoos and Aquariums
Bd = *Batrachochytrium dendrobatidis*
BFFRIT = Black-Footed Ferret Recovery Implementation Team
BKT = Brook trout
BLM = Bureau of Land Management
BRR = Bad River Ranches
BRWMA = Blue Range Wolf Management Area
BRWRA = Blue Range Wolf Recovery Area
CA = Conservation Area
CCAA = Candidate Conservation Agreement with Assurances
CLF = Chiricahua leopard frog
CO = Colorado
CPW = Colorado Parks and Wildlife
CSS = Chupadera springsnail
CSU = Colorado State University
CT = Cedar Tank
CZ = Conservation Zone
DEA = Draft Environmental Assessment
DNR = Department of Natural Resources
DPS = Distinct Population Segment
EA = Environmental Assessment
eDNA = Environmental DNA
EHD = Epizootic Hemorrhagic Disease
ESA = Endangered Species Act
EWC = Endangered Wolf Center
FL = Florida
FWC = Florida Fish and Wildlife Conservation Commission
GA = Georgia
GADNR = Georgia Department of Natural Resources
GIS = Geographic Information Systems
GLI = Global Landowners Initiative
GPS = Global Positioning System
ID = Idaho
ISU = Idaho State University
ITP = Incidental Take Permit
IUCN = International Union for the Conservation of Nature and Natural Resources
KDWPT = Kansas Department of Wildlife, Parks, and Tourism
KS = Kansas
LBP = Ladder Big Pen
LDZG = Living Desert Zoo and Gardens State Park in Carlsbad, NM
LHS = Ladder Headstart Pen
LRWMF = Ladder Ranch Wolf Management Facility
LTDS = Line Transect Distance Sampling
MGW = Mexican Gray Wolf
MOU = Memorandum of Understanding
MI = Michigan
MN = Minnesota
MSU = Montana State University
MT = Montana
MT FF = Montana Future Fisheries
MTFWP = Montana Fish Wildlife & Parks
MTTF = Montana Trout Foundation
MVP = Minimum Viable Population
NAFWS = Native American Fish and Wildlife Society
NE = Nebraska
NGPC = Nebraska Game and Parks Commission
NF = North Fork
NFWF = National Fish and Wildlife Foundation
NGO = Non-Governmental Organization
NM = New Mexico
NMDGF = New Mexico Department of Game & Fish
NMSU = New Mexico State University
NRCS = National Resources Conservation Service
NWE = Northwestern Energy
NWR = National Wildlife Refuge
OCIC = Orianne Center for Indigo Conservation
ODWC = Oklahoma Department of Wildlife Conservation
OR = Oregon
PIT = Passive Integrated Transponder
PLF = Plains leopard frog
RCW = Red-cockaded woodpecker
RGCT = Rio Grande cutthroat trout
RGC = Rio Grande chub
RGS = Rio Grande sucker
RMWAF = Rocky Mountain Wolf Action Fund
RMWP = Rocky Mountain Wolf Project
RSI = Remote Streamside Incubation
RU = Recovery Unit
SCAR = San Carlos Apache Reservation
SD = South Dakota
SDGFP = South Dakota Game, Fish and Parks
SF = South Fork
SFGT = Saving Florida's Gopher Tortoises
SGCN = Species of Greatest Conservation Need
SHA = Safe Harbor Agreement
SPV = Sylvatic Plague Vaccine
SRE = Southern Rockies Ecoregion
SSC = Species Survival Commission
SSP = Species Survival Plan
STF = Sandhills Task Force
SWMF = Sevilleta Wolf Management Facility
TBD = Turner Biodiversity Divisions
TEI = Turner Enterprises, Inc.
TIE = Turner Institute of EcoAgriculture
TNC = The Nature Conservancy
TESF = Turner Endangered Species Fund
TTR = Ted Turner Reserves
TU = Trout Unlimited
TX = Texas
UNM = University of New Mexico
U.S. = United States
USFS = U.S. Forest Service
USFWS = U.S. Fish & Wildlife Service
UT = Utah
VPR = Vermejo Park Ranch
WAFWA = Western Association of Fish and Wildlife Agencies
WCT = Westslope cutthroat trout
WA = Washington
WI = Wisconsin
WLA = Western Landowners Alliance
WMA = Wildlife Management Area
WNS = White-nose syndrome
WNTI = Western Native Trout Initiative
WPM = Western pearlshell mussel
WWF = World Wildlife Fund
WY = Wyoming
YOY = Young-of-year



Eric Leinonen

Perennial water in Las Animas Creek on the Ladder Ranch provides important habitat for the aquatic species that live in a challenging desert environment.