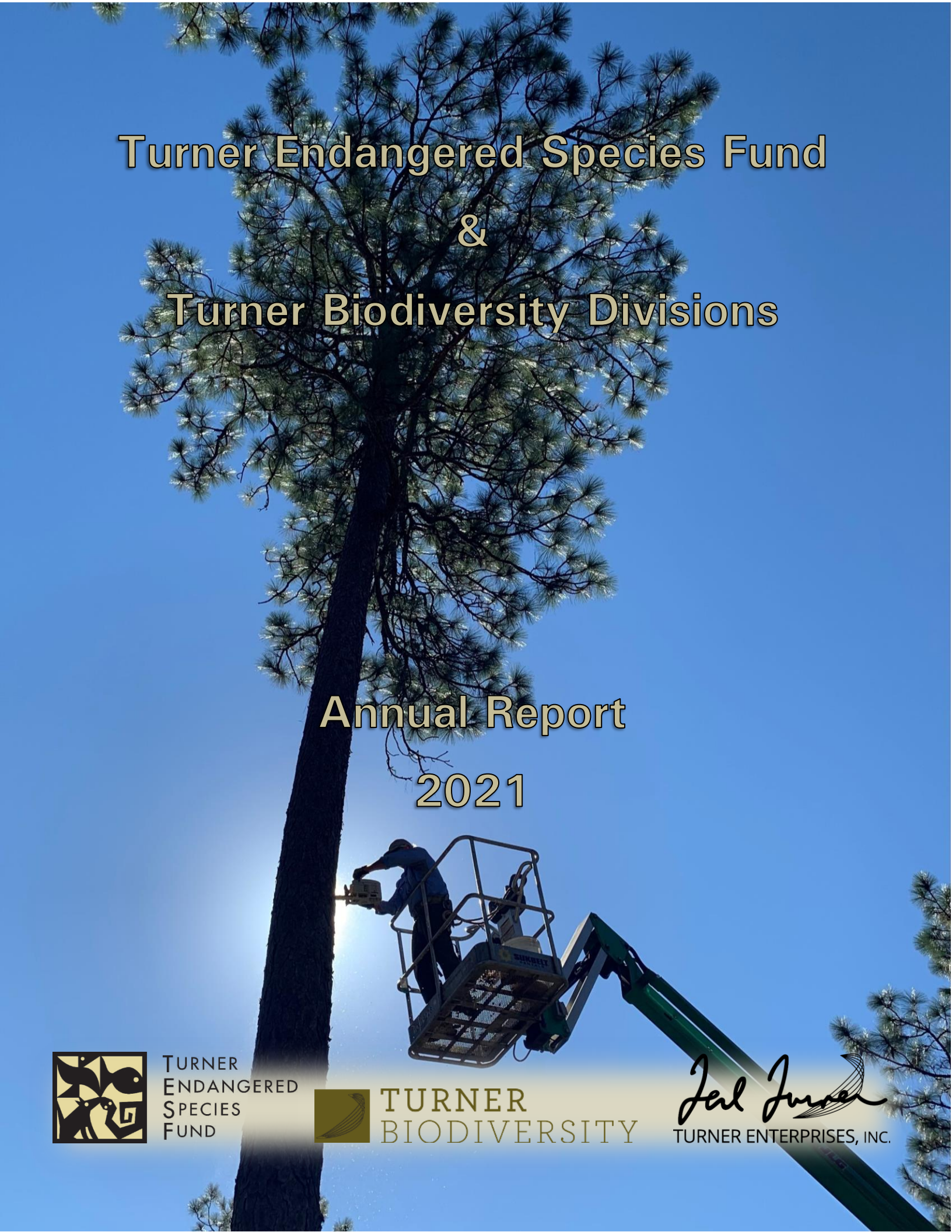
Turner Endangered Species Fund

&

Turner Biodiversity Divisions

Annual Report

2021



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

Turner Endangered Species Fund/Turner Biodiversity Divisions
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Annual Report

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All photos not otherwise marked are TESF/TBD photos.

Cover Photo: Mike Phillips installs an artificial cavity in a longleaf pine tree to encourage red-cockaded woodpecker immigration to the Nonami Plantation in Georgia.

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@tedturner.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@ tedturner.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@ tedturner.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
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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@ tedturner.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@ tedturner.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@ tedturner.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@ tedturner.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.

Scott Hillard
Biologist, TESF

Scott has been involved in the bolson tortoise project since 2006, serving as a consultant, contractor, and, starting in 2013, as a TESF team member.

Scott holds a B.Sc. in Systematics and Ecology from the University of Kansas in 1989 and earned his M.Sc. degree from Colorado State University in 1996.

Hunter Prude
Senior Biological Technician, TBD

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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@ tedturner.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.

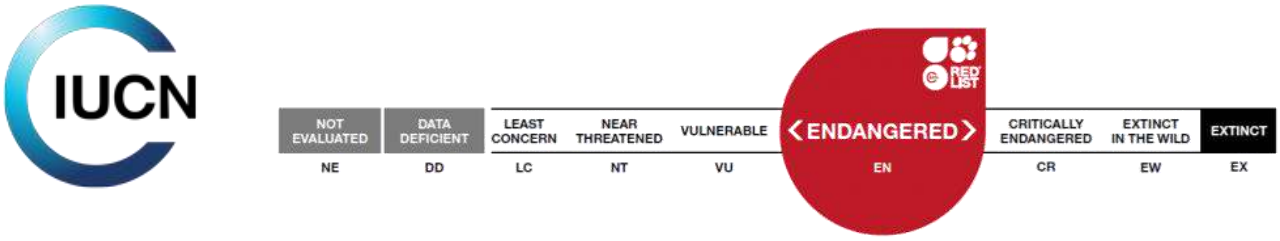
Acknowledgements

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.

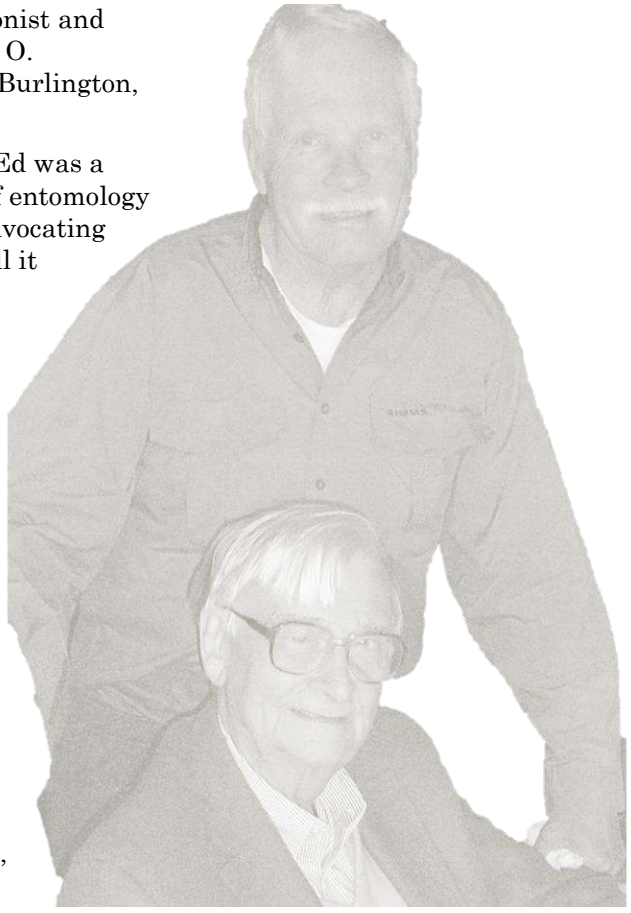
Inclusion of ICUN Red List Category

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.



In Memoriam



Harvard biology professor, esteemed conservationist and two-time Pulitzer Prize-winning author Edward O. Wilson passed away on December 26th, 2021, in Burlington, Massachusetts. He was 92.

Widely regarded as the "father of biodiversity," Ed was a leader in the field of myrmecology, the branch of entomology focused on ants, and he spent much of his life advocating for protecting the planet and the species that call it home. His skillful writing enabled him to popularize his ideas, earning him a place in history among the most celebrated conservation figures, including Henry David Thoreau, John Muir, Aldo Leopold and Jane Goodall.

In announcing his death on the E.O. Wilson Biodiversity Foundation website, Paula J. Ehrlich, the foundation's CEO and president, said in a statement:

"Ed's holy grail was the sheer delight of the pursuit of knowledge. A relentless synthesizer of ideas, his courageous scientific focus and poetic voice transformed our way of understanding ourselves and our planet…His gift was a deep belief in people and our shared human resolve to save the natural world."

Ed studied biology at the University of Alabama, before earning a doctorate from Harvard University in 1955. The following year he joined the Harvard faculty, where he remained for four decades. From his retirement to his death, Ed held the position of professor emeritus.

In addition to hundreds of technical papers, Ed authored more than 30 books, making the New York Times bestseller list and winning the Pulitzer Prize for general nonfiction, first in 1979 for "On Human Nature" and again in 1991 for "The Ants."

Most recently, Ed championed the Half-Earth Project — a movement to protect half the planet's land and sea to manage sufficient habitat to reverse the species extinction crisis and ensure the long-term health of our world. Laura Turner Seydel and Mike Phillip serve on Wilson's Half-Earth Council.

Ed was a friend of Ted's and an admirer of TESF. He was a north star for guiding efforts to cherish and protect the living world. Navigating the future without him will be difficult. But his written words are durable and inspiring, and chart a clear path. It is altogether fitting that we lean on them as never before.

"There can be no purpose more inspiriting than to begin the age of restoration, reweaving the wondrous diversity of life that still surrounds us." E. O. Wilson

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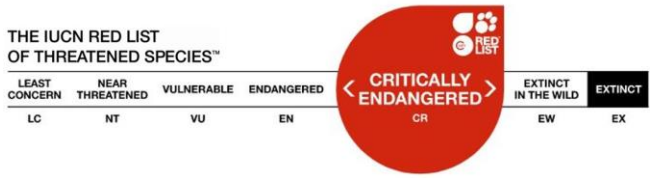
1. AMERICAN BURYING BEETLE

(*Nicrophorus americanus)*



U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

THREATENED

Nebraska Game & Parks

Nebraska Non-game & Endangered Species Conservation Act

THREATENED

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

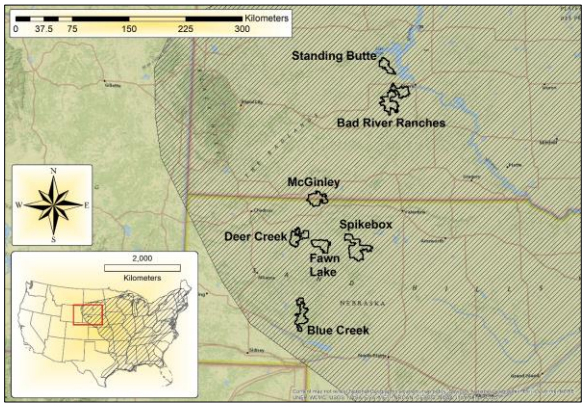


Fig. 1.1. Turner properties (Black polygons) in South Dakota and Nebraska that are within the historical range (hatched area) of the ABB

Partners

NEBRASKA GAME & 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 15 years of survey data carried out across their historical range, 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 2021

TESF and TBD biologists conducted ABB presence/absence surveys on Deer Creek Ranch (Fig. 1.2) 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 Fig. 1.2 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.

Trap Setting Procedure

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.

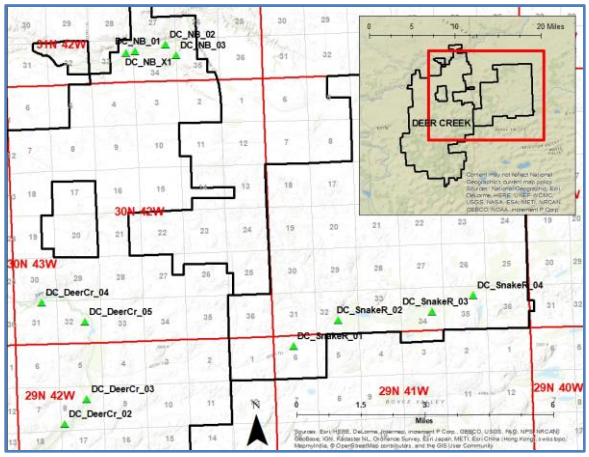


Fig. 1.2. Township, Range, Section information and ABB trap locations on Deer Creek Ranch

Trap Checking Procedure

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.

Processing Time

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

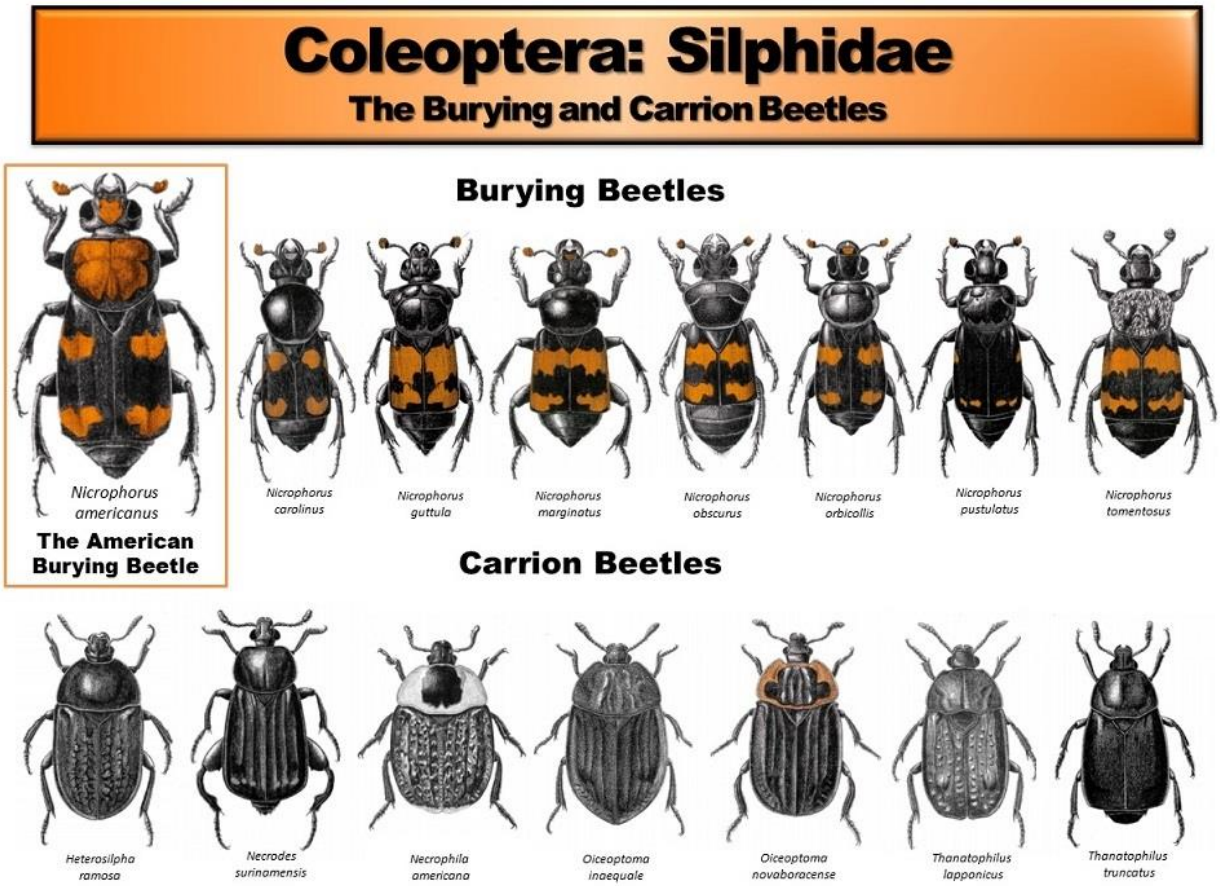


Fig. 1.3. Silphidae species that may be captured and recorded during ABB surveys

Identification and Processing

1. All captured Silphidae species were identified (Fig. 1.3), 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. ABB captures require the following additional information:
   - ***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. 1.4).
   - ***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. 1.4). 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.

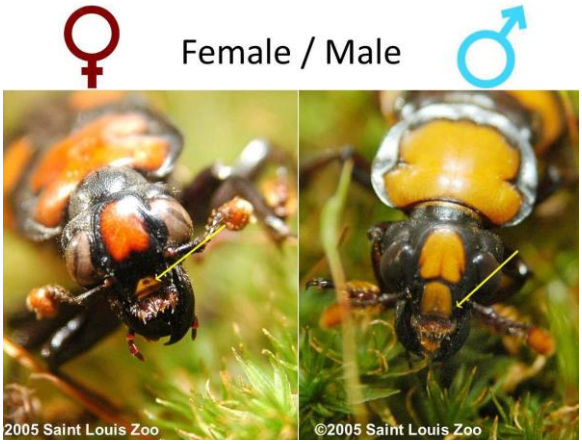


Fig. 1.4. Gender and age characteristics for ABBs. The gender of ABBs is distinguishable by orange-red marking located between the frons and mandibles (indicated by arrows) on the head. These markings are rectangular on males and triangular on females. *Left image*: This female is darker in hue and appears 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

Capture Results

During the trapping period (June 24-26, 2021) on the Deer Creek Ranch, we had no ABB captures. In all we captured 7 *Nicrophorus* species: *N. carolinus, N. guttula, N. marginatus, N. obscurus, N. orbicollis, N. pustulatus,* and *N. tomentosus* (see summary of captures in Table 1.1).

Proposed Future Activities and Considerations

We will continue to implement burying beetle surveys on Turner's South Dakota and Nebraska properties to identify extant ABB populations as well as evaluate *Nicrophoros* species diversity on these ranches.

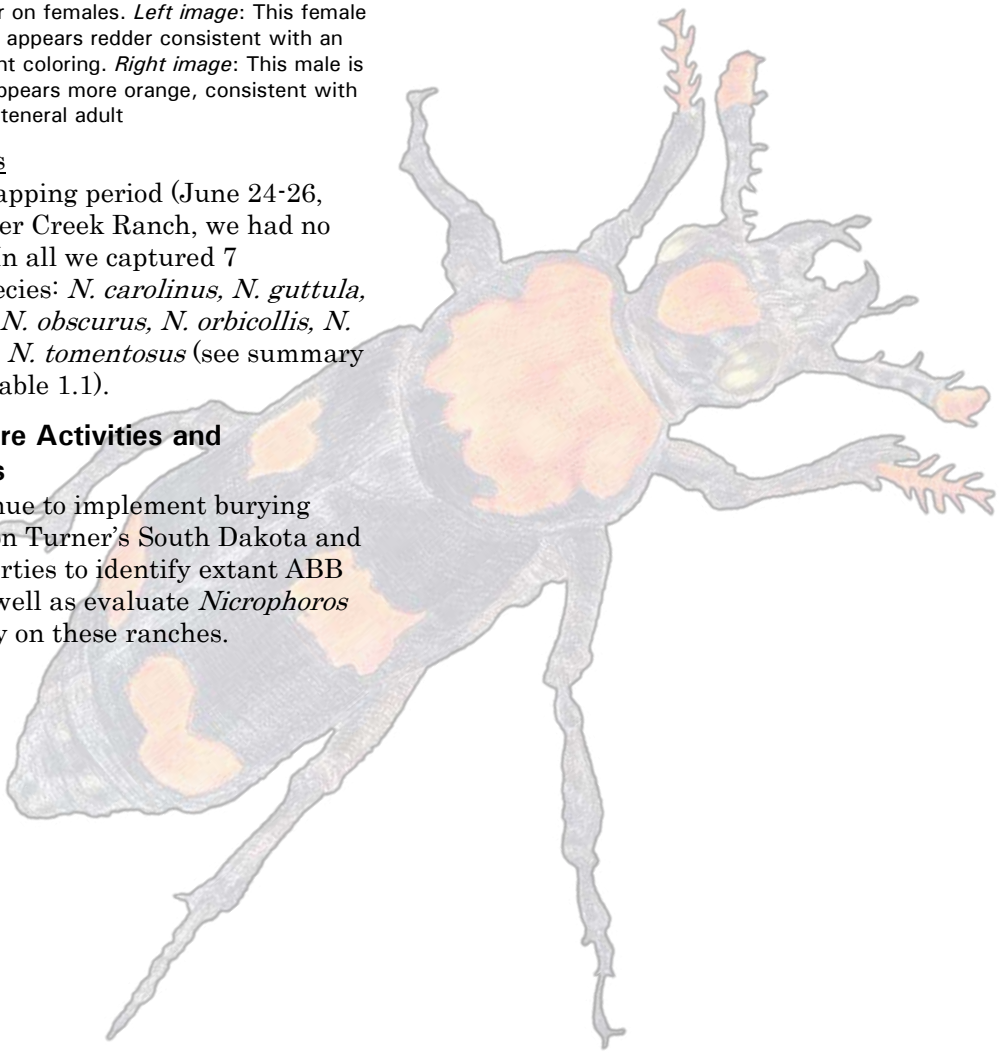


Table 1.1: Summary of *Nicrophorus* captures at Deer Creek Ranch

	Number of Captures During Trap Night (TN)																							
	N. carolinus			*N. guttula*			*N. marginatus*			*N. obscurus*			*N. orbicollis*			*N. pustulatus*			*N. tomentosus*			UTM Coordinates		
Trap Site	TN1	TN2	TN3	TN1	TN2	TN3	TN1	TN2	TN3	TN1	TN2	TN3	TN1	TN2	TN3	TN1	TN2	TN3	TN1	TN2	TN3	Zone	X	Y
DeerCr_01	4	28	-	0	0	-	0	10	-	0	2	-	0	0	-	0	0	-	0	0	-	13	721785	4707944
DeerCr_02	8	12	0	0	0	0	5	10	0	5	1	0	0	0	0	0	0	0	0	0	0	13	723468	4709143
DeerCr_03	7	6	0	0	0	0	8	10	0	1	0	0	0	0	0	0	0	0	0	0	0	13	724294	4710073
DeerCr_04	31	5	-	0	0	-	11	6	-	0	4	-	0	0	-	0	0	-	1	2	-	13	722590	4713705
DeerCr_05	19	7	-	0	0	-	3	0	-	7	0	-	0	0	-	0	0	-	0	0		13	724222	4712983
SnakeR_01	0	26	0	0	0	0	3	32	0	40	2	1	0	0	0	0	0	0	0	1	0	13	732063	4712066
SnakeR_02	1	36	0	0	0	0	0	35	1	2	2	2	3	1	0	0	0	0	0	0	0	13	733734	4713033
SnakeR_03	0	33	-	0	0	-	3	33	-	1	4	-	0	0	-	0	1	-	1	0	-	13	737268	4713362
SnakeR_04	1	49	-	0	0	-	5	20	-	3	3	-	1	0	-	1	0	-	0	0	-	13	738819	4713968
NB_01	4	0	0	1	0	0	6	0	0	1	0	0	3	0	7	0	0	0	5	2	0	13	726110	4723103
NB_02	3	0	0	1	1	0	1	0	1	1	0	0	8	15	8	0	0	0	2	12	0	13	727249	4723103
NB_03	3	-	-	0	-	-	2	-	-	1	-	-	0	-	-	1	-	-	1	-	-	13	727657	4722968
NB_X1	-	0	0	-	0	0	-	0	0	-	1	0	-	9	6	-	0	0	-	1	0	13	725760	4723037

2. ARCTIC GRAYLING

(*Thymallus arcticus)*

Biologists

Eric Leinonen

Carter Kruse

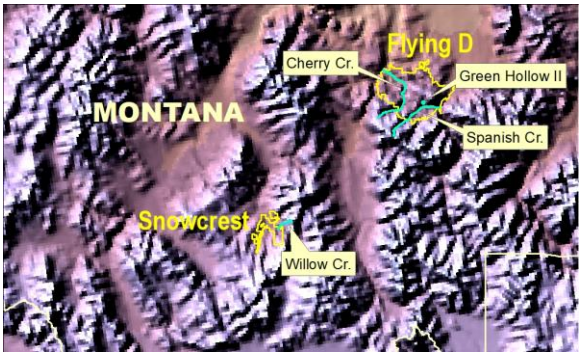
Threats – Arctic grayling are widespread throughout drainages of the Arctic and northern Pacific oceans. However distinct populations in Michigan (now extinct) and southwestern Montana have declined significantly due to competition from non-native trout and habitat alterations, especially from water 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 (Fig. 2.1). The wild born offspring from 2012-15 resulted in an overpopulation of grayling in the brood pond and decreased 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, more than 2,000 adult grayling have been moved following the spring spawn (Fig. 2.2). These fish have unrestricted passage 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) (Fig. 2.3). Fish from this population likely have and will continue to escape downstream, 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.

Fig. 2.1. Aerial view of fish barrier, inlet channel (to Green Hollow II), and bypass pipe system. Note the lighter colored gravel substrate to the right of diversion pipes that was deposited below the barrier in 2011

Fig 2.2. Schooling grayling after transfer to lower Green Hollow Creek from Green Hollow Reservoir II

Fig. 2.3. Male arctic grayling staging to spawn in the stream between Green Hollow Reservoirs I and II

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 177,000 fertilized eggs have been stocked into lower Cherry Creek using remote stream-side incubation (RSI) devices from 2016-21. RSI's improve hatching success and allow newly hatched grayling to volitionally leave the incubator and enter the stream habitat. Table 2.1 details recent 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.

Activities in 2021

TBD prepared for the annual spring grayling spawn at Green Hollow II by netting and holding several hundred grayling in early May. A total of 210 female fish were captured, with 188 spawned on May 13th, and produced an estimated 360,448 eggs for grayling restoration in southwest Montana (Table 2.1). Average female size was 10.5 inches. By these three metrics, TBD met all stated objectives for Green Hollow brood management. Following the egg take, 250 grayling captured for the spawning effort were moved into lower Green Hollow Creek. Later in May, MT FWP added 200 Big Hole River lineage grayling to maintain genetic diversity and quality of the Green Hollow brood.

TBD staff introduced 42,000 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 2021 (Fig. 2.4). The RSI's were placed in a controlled flow environment (i.e., irrigation ditch) rather than in the stream in order to provide the hatching grayling a higher chance of short-term survival once they leave the RSI's (Fig. 2.5). After flowing in the ditch for some distance below the RSI's, the water and newly hatched grayling were diverted back into the creek.

Fig 2.4. Eyed grayling eggs ready to be placed into the RSI's. Eyed eggs have been held in a fish hatchery long enough (about 10 days) for the eye of the fish embryo to develop. This is the best time to place the eggs in the incubators

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
2021	188	*360,448*	1,917	250	42,000
TOTAL		***1,962,290***		**2,045**	**177,000**

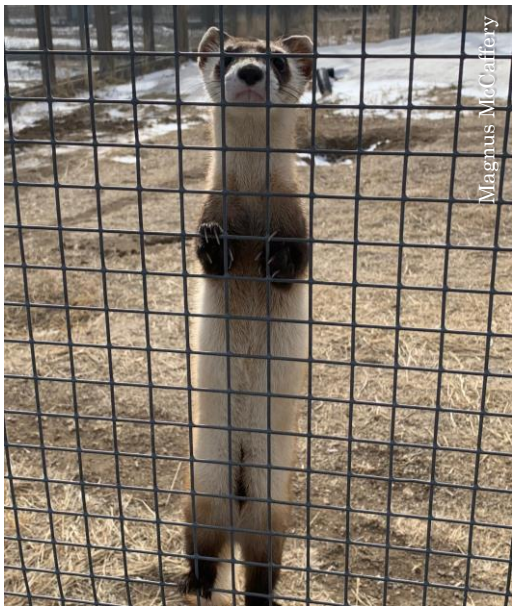
Fig 2.5. Remote streamside incubators (RSI's) with grayling eggs placed in an irrigation ditch alongside lower Cherry Creek. This slower water environment (as opposed to the creek) in the spring has the potential to increase survival of the newly hatched fish

Modest electrofishing monitoring efforts in the spring and fall of 2021 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. Monitoring efforts for Grayling will increase in 2022, as following several years of successful releases detection of adult grayling is more plausible.

In 2021, as part of the North Fork Spanish Creek native cutthroat trout restoration project (see cutthroat trout project summary), MTFWP stocked arctic grayling into Chiquita Lake, a headwater lake (to NF Spanish Creek) on Custer Gallatin National Forest lands. As this population grows, grayling should inevitably move downstream and occupy, sympatrically with cutthroat trout, available habitat in the North Fork Spanish Creek watershed, including waters found on the Flying D Ranch.

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;

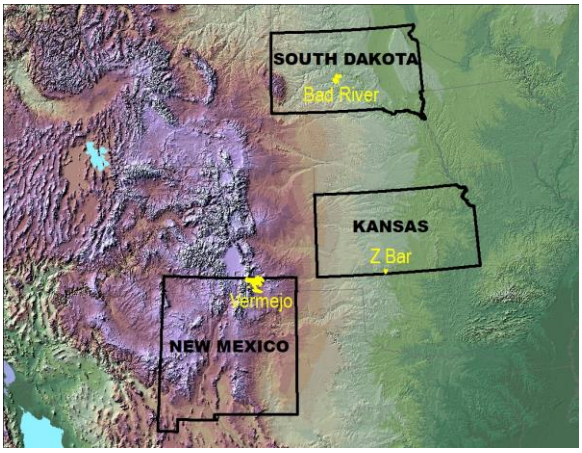
Protected Furbearer

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 one of the most endangered mammals in North America and are the only ferret species native to the continent. As an obligate predator of prairie dogs (*Cynomys* spp.), the historical range of black-footed ferrets (Fig. 3.1) coincided closely with thriving prairie dog colonies (Fig. 3.2), from southern Canada to northern Mexico.

Fig. 3.1. Historical black-footed ferret range prior to the 20th Century

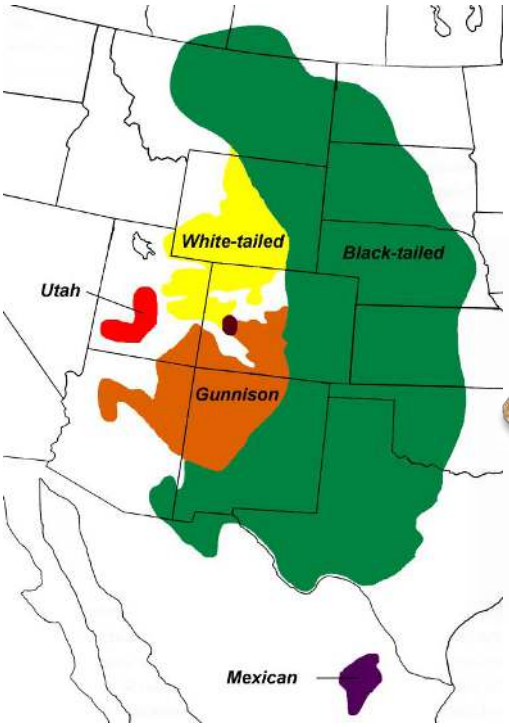


Fig 3.2. Historical distribution of prairie dog species native to the grasslands of North America

A FATE CLOSELY TIED TO ITS PREY

During the first half of the 20th century, widespread prairie dog eradication efforts on farms and ranches, along with predator control campaigns, decimated not only prairie dog populations but also the black-footed ferrets that depended on them. Conversion of native prairies to farmland also gravely impacted both species. In 1967 black-footed ferrets were placed on the U.S. Endangered Species List, and in 1979 the species was considered to be extinct. However, in 1981 a population was discovered in Meeteetse, WY (Fig. 3.3) after a rancher's dog dropped the body of a black-footed ferret on the porch of his owner's home.

Fig. 3.3. Last surviving black-footed ferret population (red dot) found in Meeteetse WY in 1981 (dashed red line indicates historical range)

A obligate carnivore of prairie dogs, the black-footed ferret preys upon the prairie dog to survive. Not only do they hunt prairie dogs for food, but they also overtake prairie dog burrows and use them for shelter. This reliance has led to several challenges for Black-footed ferrets, including exposure to introduced disease

KEY EVENTS IN THE BLACK-FOOTED FERRET CONSERVATION TIMELINE

Decline of black-footed ferrets tied to reductions of prairie dogs, due to:

1880s – 1920s: *Conversion of native range to cropland*

1918 – 1972: *Large-scape prairie dog poisoning*

1940s – Present: *Disease (sylvatic plague)*

1960s – Present: *Unregulated recreational shooting*

1967: Black-footed ferrets declared extinct in the wild

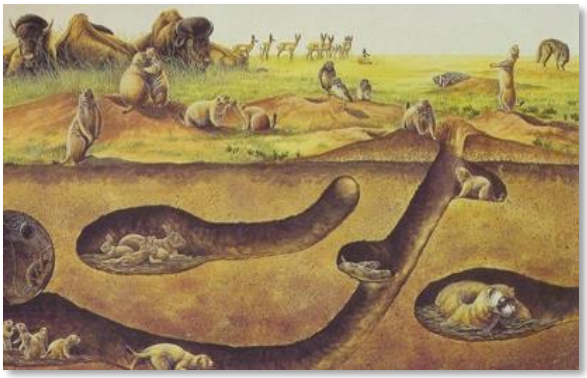
1981: Black-footed ferrets rediscovered in Meeteetse, WY

1984: Meeteetse population peaked at 129 individuals, then decimated by plague

1985 – 1987: The last 18 individuals captured from Meeteetse for captive breeding

RECOVERING A SPECIES

Following the 1981 rediscovery of black-footed ferrets, the location of the remnant Meeteetse population was pinpointed, and a conservation and monitoring program initiated. In 1984, the number of individuals in this population peaked at 129 before being decimated by plague. Between 1985 and 1987, the last 18 black-footed ferrets surviving at Meeteetse were captured so they could be bred in captivity to build up their numbers (although only 7 of these individuals ultimately became the captive founder population; Fig. 3.4). This effort evolved into a coalition of federal, state, tribal and nonprofit partners, led by the U.S. Fish and Wildlife Service to try to save the species. Ferrets are captively bred at five zoos as well as the Service's National Black-Footed Ferret Conservation Center (which houses 60-70% of all captive ferrets) in Colorado. To date, participating centers have produced over 9,000 ferrets, maintaining a captive population of 250–350 breeding adults.



Prairie dogs are a keystone species in North American native grasslands: their mound-building encourages grass development and renewal of topsoil, which can be crucial for soil quality and agriculture. They are a critical component of the food chain, contributing to the diet of many animals such as the black-footed ferret, swift fox, golden eagle, red tailed hawk, American badger, and coyote. Other species, such as the golden-mantled ground squirrels, mountain plover, and burrowing owls, also rely on prairie dog burrows for nesting areas. Grazers, such as plains bison, pronghorn, and mule deer have shown a proclivity for grazing on the same land used by prairie dogs

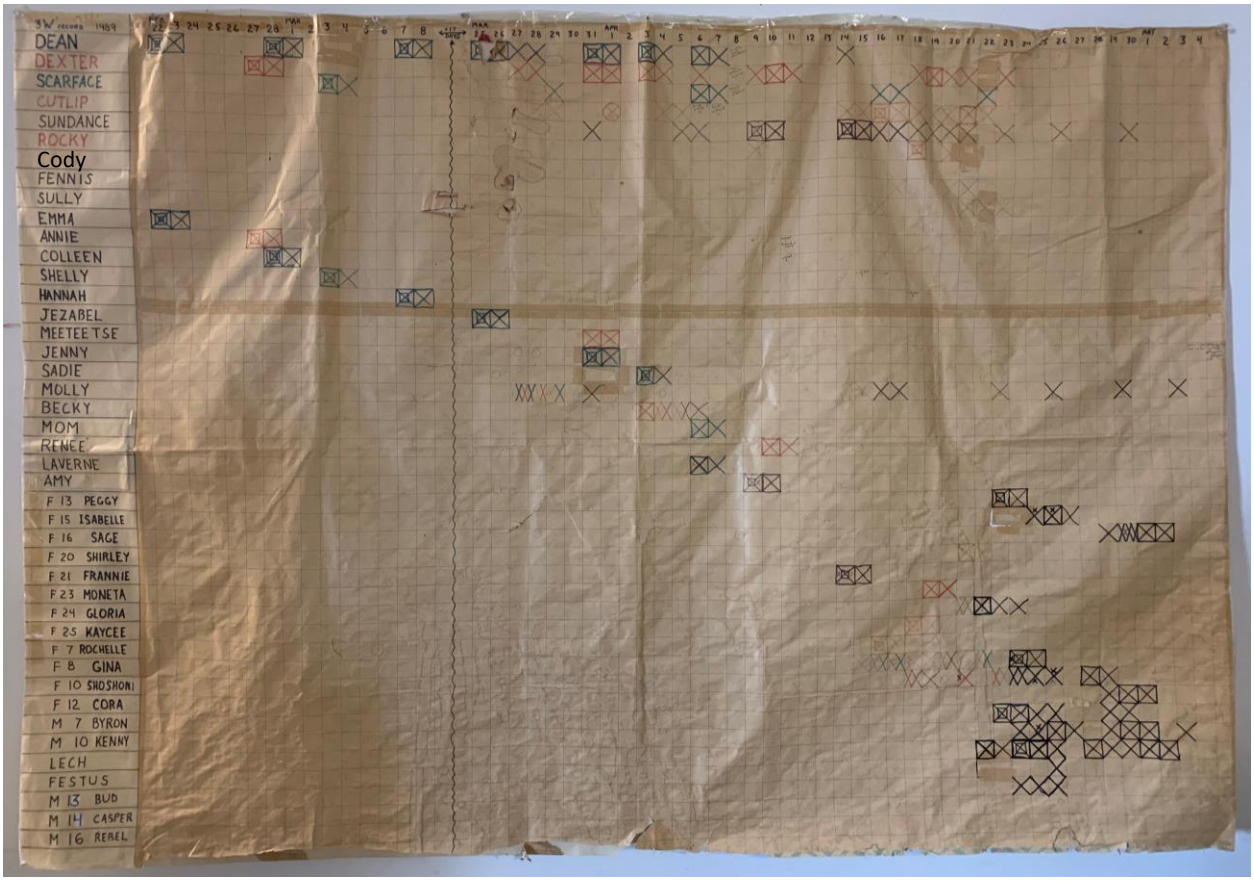


Fig. 3.4. National Black-Footed Ferret Conservation Center captive breeding chart from 1989, showing the founding individuals (Dean, Dexter, Scarface, Cutlip, Sundance, Rocky, Cody) and their offspring. All black-footed ferrets alive today are descended from these seven founding individuals

Since 1992, the BFFRIT has reintroduced over 4,300 captive ferrets to 30 wild locations across Wyoming, South Dakota, Montana, Arizona, Colorado, Utah, Kansas, New Mexico, Canada, and Mexico (Fig. 3.5). Each year, 150 to 220 black-footed ferrets are preconditioned and reintroduced into the wild from the captive breeding population. Today, there are approximately 300 Black-footed ferrets living in the wild.

These reintroductions represent a major success for the BFFRIT, which is working toward a goal of 3,000 wild black-footed ferrets. Once the wild population reaches that size, black-footed ferrets will be downlisted from endangered to threatened, with the ultimate goal of removing the species from the endangered species list to join the American Alligator and Bald Eagle among the Endangered Species Act's conservation successes.

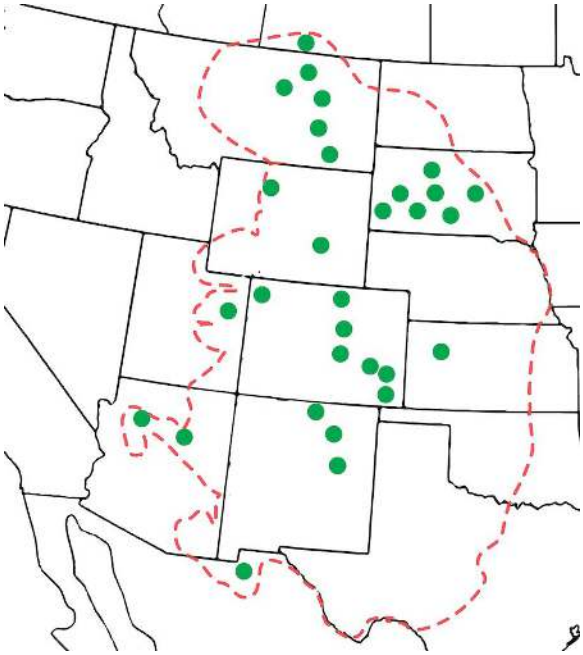


Fig. 3.5. black-footed ferret reintroduction sites in 2020 (dashed red line indicates historical range)

CHALLENGES TO FULL RECOVERY

To successfully recover black-footed ferrets, genetic rescue solutions are needed to overcome two major threats to the species: eroding genetic diversity and the threat of disease, particularly sylvatic plague.

A Lack of Genetic Diversity

Owing to the severe reduction of the wild black-footed ferret population to just 18 individuals, the species remains threatened by an overall loss of genetic diversity. Of the last 18 wild ferrets brought into captivity, some were members of the same family and others died before successfully breeding. It is estimated that all living black-footed ferrets today trace their ancestry to just seven founders (Fig. 3.4).

With such a limited gene pool, small, reintroduced ferret populations are at risk of experiencing an "extinction vortex" without continued management. This is a progressive weakening of a species' genetic fitness brought on by inbreeding, genetic drift, and an overall loss of genetic diversity stemming from small population size and lack of gene-flow from new immigrants. Staving off the extinction vortex requires continued supplementation to wild populations from captive breeding centers. However, maintaining the genetic diversity of captive black-footed ferrets, and thereby helping wild populations, is the challenge that has prompted the aid of genetic rescue biotechnologies. Genetic rescue can help reverse or prevent an extinction vortex (Fig. 3.6).

At the outset of the captive breeding program, Wyoming Game and Fish had the foresight to biobank cell lines, semen, and ovaries. Sperm samples archived for decades at the Smithsonian Conservation Biology Institute have been used to recover lost genetic diversity from the founders through artificial insemination, the first efforts demonstrating the value of reaching back in time for genetic rescue. Historic cell lines stored at the San Diego Zoo Wildlife Alliance Frozen Zoo® since the 1980s are the focus of the Revive & Restore genetic rescue cloning efforts to bring new founders into the population, thereby improving the current gene pool.

The Threat of Disease

The ultimate survival of wild black-footed ferret populations is jeopardized by disease. Aside from habitat loss, sylvatic plague (*Yersinia pestis*) is the single largest challenge to the species.

The plague bacterium is a generalist pathogen of flea (Siphonaptera) vectors and mammalian hosts. In colonies of prairie dogs, *Y. pestis* causes occasional epizootics, killing ≥ 90% of prairie dogs within weeks to several months.

Y. pestis was inadvertently brought to North America from Asia by humans in the late 1800s. Nearly 150 years later the disease is widespread over the western United States and Great Plains. Black-footed ferrets contract the disease primarily from their prairie dog prey. While domestic ferrets (*Mustela putorius furo*) appear to be immune to plague, black-footed ferrets are highly susceptible. That fact, coupled with the lack of genetic

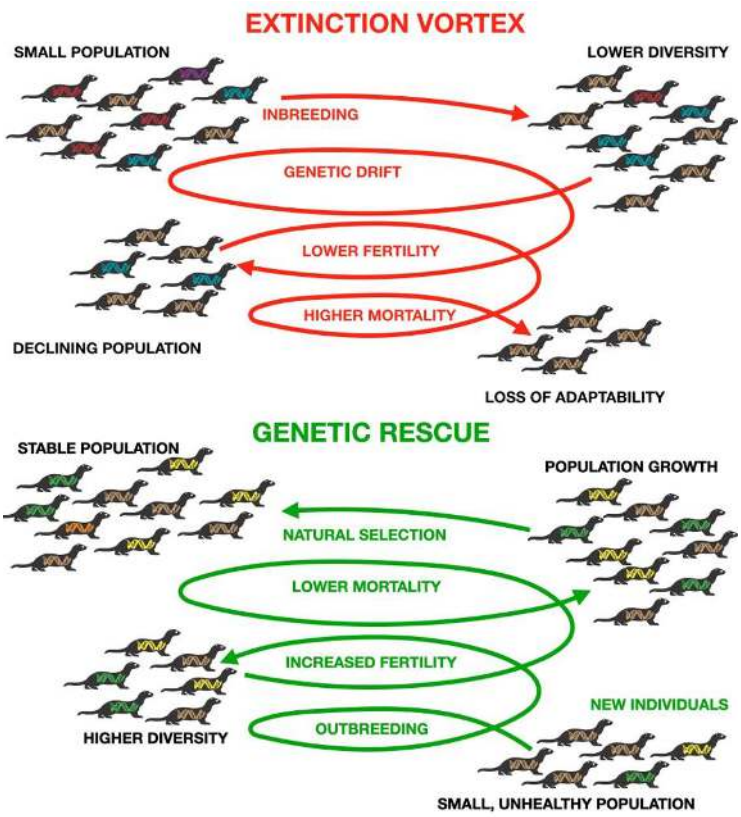


Fig. 3.6. Diagram describing the concepts of an Extinction Vortex and Genetic Rescue

diversity indicates that interventions that protect them from plague infection will continue to be needed to achieve full recovery.

The complex epidemiology of plague and its widespread abundance on the landscape makes it impossible to eradicate. This reality, coupled with the extreme susceptibility of black-footed ferrets to the disease, means that successful species recovery will depend on managing plague on the landscape and creating improved plague tolerance for this species. The consensus of dozens of scientists and conservationists is that success will not be achieved by treating any one link in the chain of disease transmission. Currently, there are two options available to mitigate plague on prairie dog colonies: (1) application of an insecticide at prairie dog burrows (deltamethrin dust or fipronil grain) which kills the fleas that vector the disease, and (2) distributing Sylvatic Plague Vaccine (SPV) bait pellets on colonies to vaccinate prairie dogs against plague.

Deltamethrin has been shown to be a highly effective tool for plague management on prairie dog colonies, with mean population size on deltamethrin-treated plots increasing by 88%, compared with 97% declines in nontreated plots. However, evidence suggests that chronic use of this insecticide over time can lead to resistance in the treated flea population.

Conversely, examination of SPV performance in the field showed an average change in population during epizootics of -69% on vaccine plots compared with -83% for associated nontreated (placebo) plots. An overriding limitation to achieving sufficient protection rests with vaccine delivery constraints. Late summer/fall bait distribution results in the highest bait uptake rates. However, the prairie dog birth pulse each spring can double the size of populations in most years, greatly reducing the proportion of vaccinates in populations and diminishing potential herd immunity benefits. In addition to nonvaccinated juveniles and PD that do not consume bait, incomplete vaccine protection and time required for immunity to develop leaves a large majority of prairie dog populations vulnerable to plague for 6–7 months or more each year (Matchett et. al. 2021).

A further disadvantage of both insecticide treatments and SPV strategies are that they are very expensive to implement across the thousands of acres needed to protect sufficient prairie dog colonies needed for ferret recovery (Table 3.1).

Continued study of plague mitigation techniques, and development of novel approaches are needed to refine and develop a more integrated and affordable strategy for plague management. A promising new method that is currently under development by USFWS biologist, Randy Matchett, involves incorporating very small amounts of fipronil into a flour-based bait pellet (named FipBits) that can be broadcast on the landscape very efficiently (compared with current approaches of depositing deltamethrin dust or fipronil grain at each prairie dog burrow). Initial, small-scale field trials of FipBits, conducted 2018-2020, that measured the degree and duration of flea control on black-tailed prairie dogs in Montana and on Gunnison's prairie dogs in Arizona found that fleas were virtually eliminated in Montana from 1-month post-treatment to 1 year later and remained substantially depressed 2 years post-treatment. Flea control in Arizona was significant from 1-month post-treatment to 1 year later, but flea abundance had recovered by 2 years post-treatment. Follow-up FipBit trials in South Dakota, from 2020-2021, evaluated 3 concentrations of fipronil in FipBits (0.68, 0.71 and 0.83 mg/FipBit). Fleas were essentially eliminated for 10 months on the 0.83 mg plot and were substantially reduced on the two 0.71 mg plots. Fleas were reduced on the 0.68 mg plot, but the degree of control was less than observed on other treated plots. These results suggest that the impacts of plague on prairie dogs and black-footed ferrets would likely be greatly reduced by the levels of flea control observed with FipBits. Registration of FipBits with the Environmental Protection Agency is being pursued for expanded field trials of what may become a highly practical, affordable, and effective plague mitigation tool.

Timeline of TESF Activities at Vermejo (1999 – 2020)

Vermejo: 1998

TESF BFF project began with **captive preconditioning**

Vermejo: 1999-2006

393 BFF captive preconditioned at VPR

Vermejo: 2005-2007

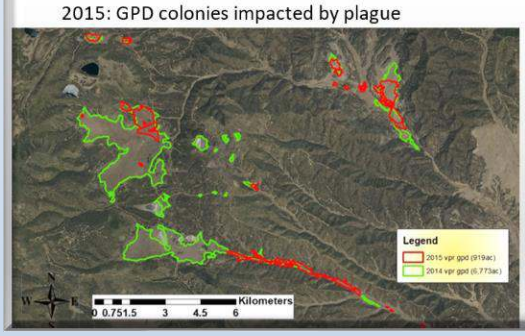
Wild preconditioning on BTPDs: 75 BFFs
(36 recaptured; 48% recapture rate)

Vermejo

2012: First releases of BFFs on GPD colonies

Vermejo

2012: First releases of BFFs on GPD colonies
2015: GPD colonies impacted by plague



Vermejo: 2008-2012

- Year-round BFF releases at VPR
- **2009:** First wild-born BFF in NM in over 75 years

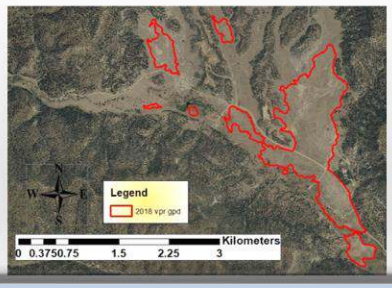
Vermejo: 2008-2012

- Low BFF survival due to drought indicated that habitat unlikely to sustain a stable population over time
- Ceased BFF releases on BTPD in 2013

Vermejo

2019: Ranch initiated prairie dog reduction effort

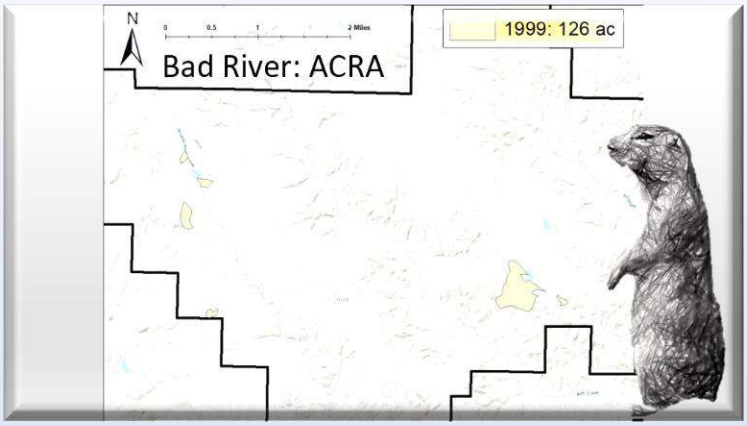
- GPD around Headquarters area

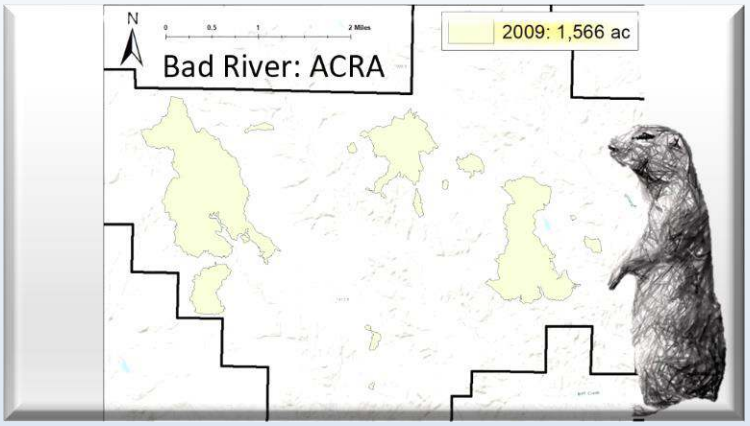


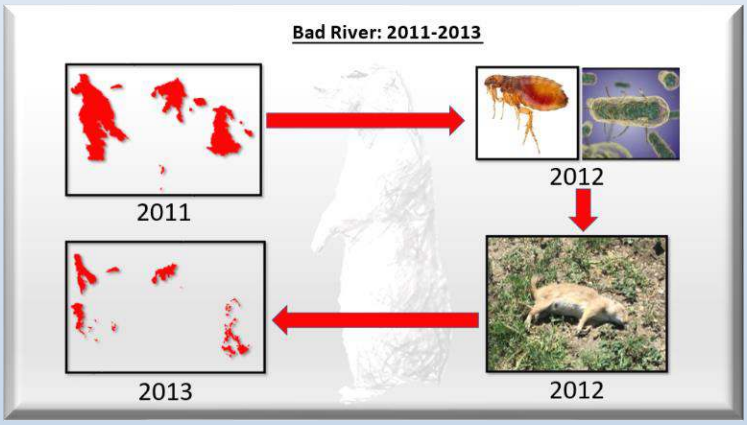
Vermejo Review

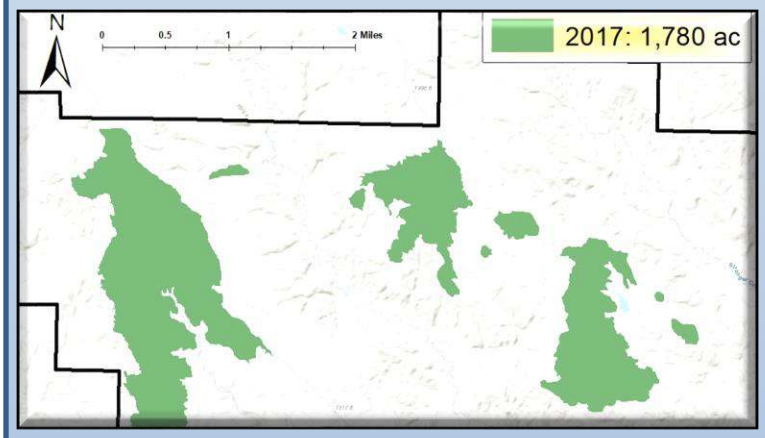
- Early successes with growing prairie dog colonies and BFF preconditioning (captive & wild)
- BFFs released to the wild with successful reproduction
- Drought-linked habitat degradation BTPD colonies led to soil erosion and loss of BFFs
- Plague periodically decimates GPD colonies; led to the loss of reintroduced BFFs
- **High cost of chronic plague management**
- Challenges in identifying SHA Conservation Zones that contribute to BFF recovery (i.e., 30 adults) while fitting ranch priorities

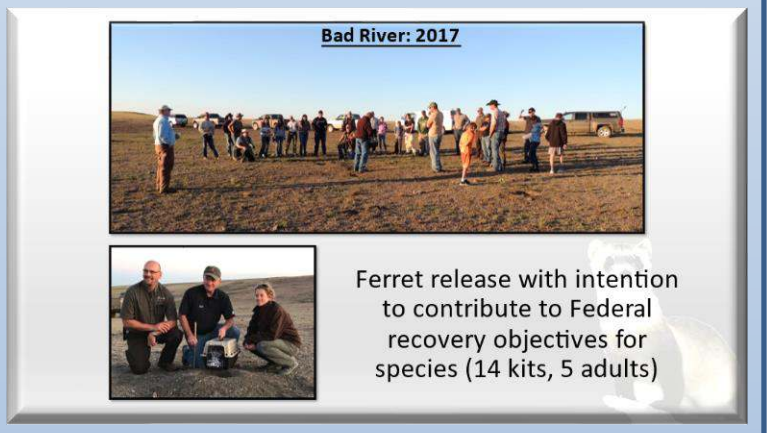
Timeline of TESF Activities at Bad River (1999 – 2020)

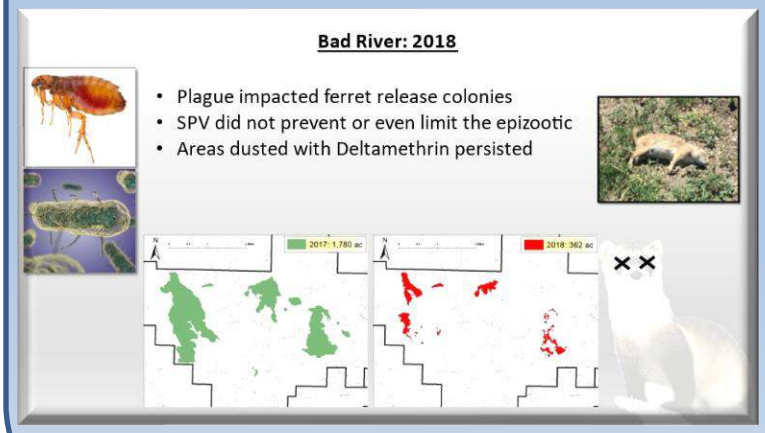












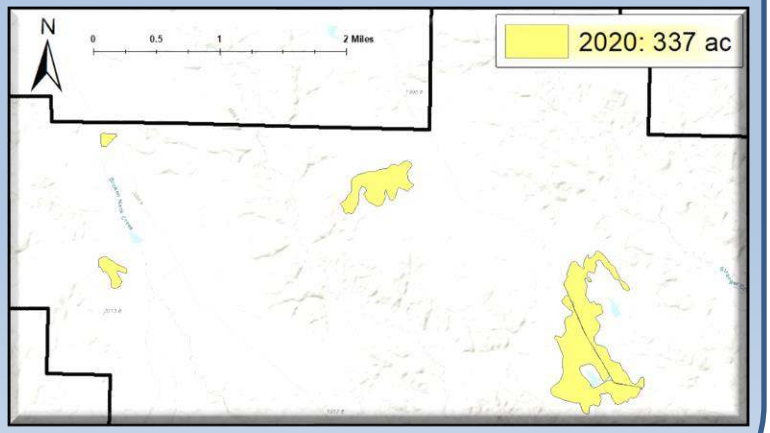


Table 3.1. Estimated costs of various plague mitigation methods.

Method	Cost/acre
Deltamethrin dust	$25.00Φ
Fipronil grain	$26.50 Φ
SPV	$23.41 Φ
FipBit*	$5.85Ψ

*** = 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 and support range-wide species recovery efforts.

Objectives – Contribute to range-wide 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*
Captive breeding population: ≥ 280 adults (105 males, 175 females), distributed among ≥ 3 facilities.	Captive breeding population: ≥ 280 adults (105 males, 175 females), distributed among ≥ 3 facilities.
Free-ranging black-footed ferrets: ‣ ≥1,500 breeding adults ‣ ≥10 populations ‣ ≥6 of 12 States within historical range of the species ‣ ≥30 breeding adults in any population ‣ ≥3 populations on Gunnison's/white-tailed prairie dog colonies ‣ Maintain these for ≥3 years prior to downlisting	Free-ranging black-footed ferrets: ‣ ≥3,000 breeding adults ‣ ≥30 populations (≥1 population in ≥9 of 12 States) ‣ ≥ 30 breeding adults in any population ‣ ≥ 10 populations with ≥ 100 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.

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).

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):*

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

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 2021

Bad River Ranches, SD:

Prairie dog colony perimeter mapping

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 2021, we mapped a total of 856 acres of occupied black-tailed prairie dog habitat at the ACRA, existing as four discrete colonies (Fig. 3.7).

Sylvatic plague mitigation

We treated 291 acres of existing black-tailed prairie dog colonies (Fig. 3.8) in the ACRA with fipronil grain. 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.

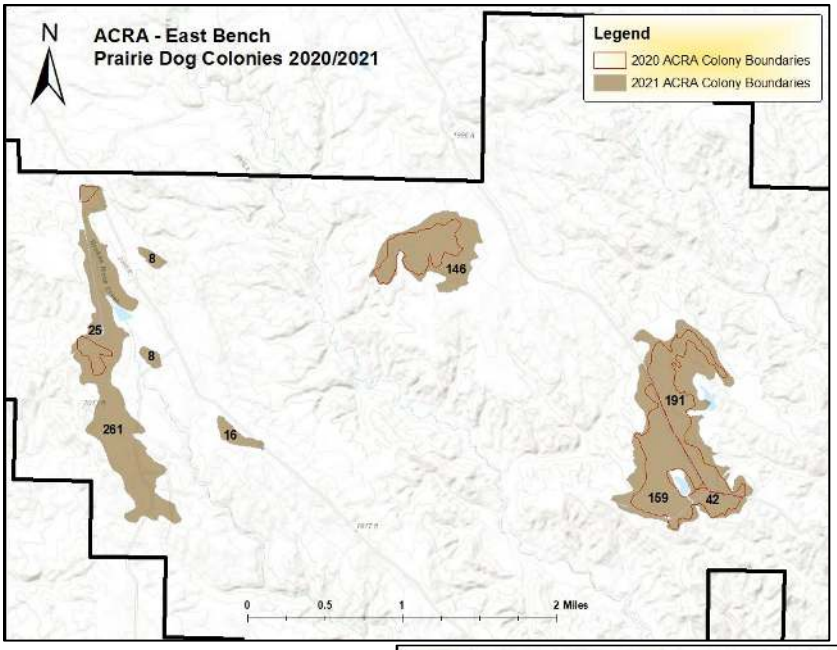


Fig. 3.7. Results of prairie dog colony mapping at Bad River Ranches, showing a total of 856 acres of black-tailed prairie dog colonies in the ACRA in 2021. This represents a growth of 154% relative to 2020 acreages

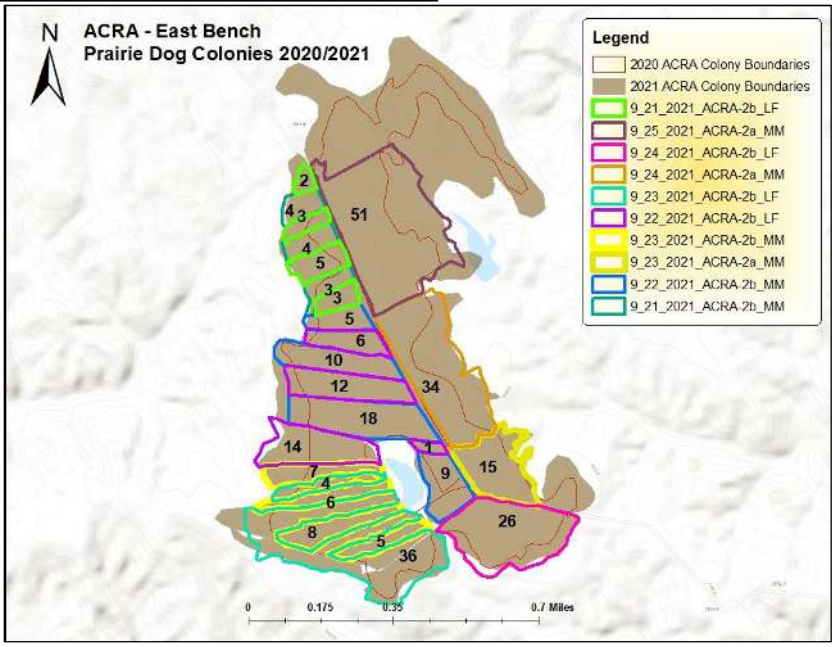
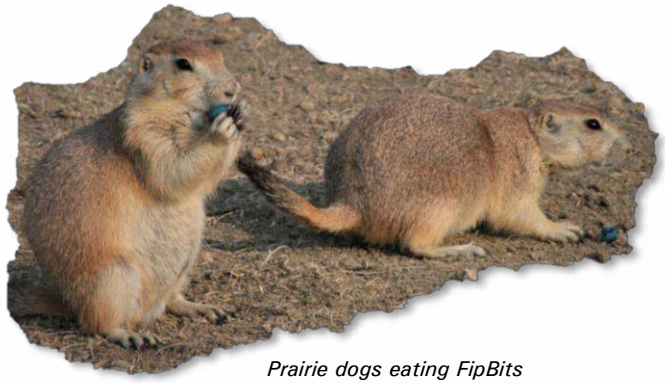


Fig. 3.8. Area of ACRA's east bench that was treated with fipronil grain in 2021. Legend indicates the date of treatment, area ID, and applicator ID (MM = Magnus McCaffery; LF = Levi Fettig)

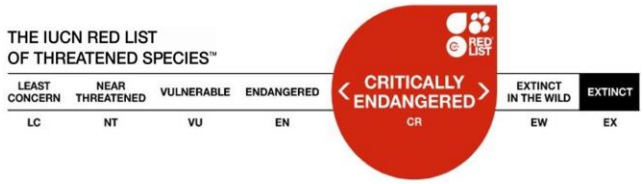
Proposed Future Activities and Considerations – In 2022, we aim collaborate with USFWS biologist, Randy Matchett, to set up a FipBit production lab in TEIs Bozeman office. Once FipBits have been approved for widespread application by the EPA, we aim to provide a low-cost supply of baits to other black-footed ferret recovery partners to implement multi-year, landscape-scale experimental field testing of this potential plague mitigation method.



Prairie dogs eating FipBits

4. BOLSON TORTOISE

(*Gopherus flavomarginatus)* [AKA : Chihuahuan Desert Tortoise]



Project Biologists

Scott Hillard *Chris Wiese*

Threats – Population decline, and range contraction are due to collection for food as well as habitat loss. Recent estimates suggest fewer than 2,500 bolson tortoises remain in the wild in Mexico.

Project Locations

Project Partners in 2021 (for a complete list of Project Partners 2006 – 2021 please see Appendix 4.1)

Goal – 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 population of bolson tortoises in the US.

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.

The pattern of scales on the head of a bolson tortoise are as beautiful and unique as its shell pattern and help researchers identify and distinguish individuals

A juvenile bolson tortoise basking inside its burrow on the Armendaris Ranch

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, ongoing habitat loss has resulted in continued population decline, with fewer than 2,500 individuals remaining on the landscape today (Kiester et al., 2018).

Our starting point for the bolson tortoise reintroduction project was a group of 30 bolson tortoises that were collected and unintentionally 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 Ranch 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 7 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. The burrows are an important part of a healthy desert ecosystem – providing shelter for myriad other species of mammals, birds, reptiles, and insects.

Activities in 2021

As of October 2021, the bolson tortoise project has 28 adult bolson tortoises that serve as the founder population for all juveniles produced by the project (plus a pair of adult tortoises at the El Paso Zoo that have not yet contributed offspring but may do so in 2022). To date, we have produced over 1000 hatchlings, and in 2021, 703 of these juvenile tortoises were known to be alive (70% survival).

Personnel – The work for this project was carried out by TESF biologists Chris Wiese and Scott Hillard with help from two technicians (Jenna Zarlingo, Dan Martin) whose main responsibilities consisted of feeding and watering juvenile tortoises in the headstart pens on the Ladder Ranch during thte tortoise active season (April – October) and helping with tracking radio-transmittered tortoises in various locations.

Successes and milestones attained in 2021

The most important and major milestone of 2021 was the rewilding of 55 juvenile bolson tortoises to a remote area of the Armendaris Ranch we named "Goodluck Prairie" (see Box 4.1 and below for more details). This is the beginning of a much larger endeavor to release up to ~250 tortoises over the next year or two. We plan to study this group intensively over the next three to five years to gain a better understanding of the survivorship, habitat use, and short- and long-distance movements (if any) of bolson tortoises in the Northern Chihuahuan Desert. These data will inform future management and additional releases of tortoises on Turner Ranches and elsewhere.

Other important milestones reached in 2021:

- We added 76 hatchlings to our population in 2021.
- We continue to monitor the oldest and largest juvenile females (15-16 years old) for signs of reproduction. None of them are producing eggs yet.
- We initiated a collaboration with JJ Apodaca at Tangled Bank Conservation to re-analyze the genetics of our bolson tortoise group and to re-evaluate the relatioftruett
- nships among the group of bolson tortoise adults TESF received from Ariel Appleton's estate in 2006. We plan to develop tools to help identify additional pure-blooded bolson tortoises among promising candidates, and to evaluate the contributions made by individual male tortoises to the next generation. This study will set the stage for future genetic work on bolson tortoise populations in the US and Mexico.
- We established a new partnership with NMSU Professor and Assistant USGS Coop Unit Leader Dr. Abby Lawson, who will study the newly released bolson tortoises on the Armendaris Ranch. Dr. Lawson applied for and obtained funding from the Turner Institute of EcoAgriculture (TIE) to support an M.S. student starting in May 2022.

Dr. Abby Lawson, shown here with Gertie in July 2021, is the Assistant Unit Leader – Wildlife, USGS, New Mexico Cooperative Fish and Wildlife Research Unit, Department of Fish, Wildlife, and Conservation Ecology, New Mexico State University

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 offspring, but Abby Q put her late May clutch of 6 eggs into the ground at the El Paso Zoo without anyone noticing, so it is possible that hatchlings may appear in the exhibit in 2022. The El Paso Zoo also houses two subadult tortoises (1:1) that were transferred 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 2021 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 performed hands-on surveys (mass, shell dimensions) and health-checks of the TESF tortoises in the fall of 2021 but otherwise monitored them only visually from a distance. In years with severe drought, we provide supplemental irrigation to the forage in the tortoise pens, and this was done at the Deep Well pen (but not at the Cedar Tank pen, where 20 of the adults and ~70 juveniles resided) in 2021. However, the onset of monsoons provided ample forage for tortoises in all locations. Moreover, we continued to intensively manage adult females during nesting season (April – July) to maximize egg production, which includes offering water to females following oviposition. We collected a total of 106 eggs in 2021 (Table 4.2).

Hatchling production – We used 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.
2. As the time for nesting approaches, move gravid females to smaller enclosure where they are able to choose nest sites. Within the enclosure, nests are protected in place.
3. Collect hatchlings, mark them with a unique code, and bank blood for future genetic studies and paternity testing.

2021 Egg collection – We used well-established methods (radiography combined with palpation and weight monitoring) to time the transfer of gravid females to an enclosure where nests could be identified and eggs could be transferred to incubators, or, alternatively, nests could be protected *in situ* to allow the eggs to develop in the ground. About half of the eggs were left in the ground in 2021, while the other half of the eggs were placed in one of two incubators set at male or female producing temperatures, respectively. Table 4.2 summarizes the eggs produced and collected (and hatchlings hatched) for each of the adult female tortoises in the Turner group. The tortoises produced a total of 26 clutches in 2021. This is on the lower end of the spectrum, most likely caused by drought and a relatively prolonged cool spring in 2021. Most tortoises produced two clutches of eggs in 2021; three tortoises (the largest two tortoises, Gertie and Pancha, and Tortoise F) each produced only one clutch. Three of the 13 females (K, X, and T) produced a third clutch of eggs in 2021. This number is low compared with previous years: we saw 5 triple clutches in 2013, 7 triple clutches in 2015, and 9 triple clutches in 2017. The reason for this variation in number of clutches is not known but is likely to be related to environmental conditions.

Table 4.2. Egg production and hatching success in 2021 for each female in the Turner group

ID	No. of eggs in successive clutches (1st / 2nd / 3rd)	No. of eggs recovered & incubated	No of offspring produced	Hatching success rate
1	4 / 5 / -	9	7	77.8
2	3 / 5 / -	8	7	88
4	3 / - / -	0	0	0
A	7/ 6 / -	13	9	69.2
F	6 / - / -	6	5	83.3
G	9 / - / -	9	0	0
J	4 / 4 / -	8	7	87.5
K	3 / 5 / 5	10	8	80
L	1 / 4 / -	4	4	100
P	4 / 5 / -	9	9	100
S	3 / 4 / -	7	5	71.4
T	3 / 4 / 4	11	6	54.5
X	5 / 6 / 2	13	9	69.2
TOTAL	**55/ 48 / 11**	**106**	**76**	
MEAN	**4.2 /4.8/3.7**	**8.2**	**5.8**	**67.8**

We detected a total of 113 eggs in the 26 clutches in 2021. Of these, we did not collect 7 eggs (or 3 clutches). We left 14 clutches (57 eggs) in nests in the ground in the protected ATP pen for most of the incubation period, and only transferred those eggs to incubators a few days before the expected hatch date. Nine clutches (49 eggs) were dug up within a day of nesting and were transported to incubators for artificial incubation for the entire egg development period in 2021. Of these, 25 eggs were incubated in a male-producing incubator and 24 eggs were placed in a female-producing incubator.

Egg incubation

Natural nests in 2021:

Nests left in the ground were marked with flagging to facilitate locating them at the end of the incubation period, and the nests were protected from accidental excavation by a tortoise with a 1' x 1' mesh. Eggs remained in the ground for up to 100 days (i.e., until shortly before expected hatching and well *after* the temperature sensitive period for sex determination had passed), at which point they were transferred to labeled trays and placed in an incubator (the "pipping chamber"). Five of the fourteen (35.7%) naturally incubated nests had at least one live hatchling or pipping egg by the time they were excavated, making estimates of time-to-hatching more challenging. However, most eggs hatched after a few days in the incubator, with a mean of ~110.7 days to hatching in 2021 (and a range of 97-174 days). Interestingly, tortoises incubated in natural nests hatched after an average of only ~101 days in 2019, with a range of 89-131 days.

Eggs in incubators:

Approximately half of the eggs produced in 2021 (49 of 106) were placed in artificial incubators kept at male (n=25) or female (n=24) producing temperatures. Hatchlings emerged from eggs after an average of 81.8 days when incubated at male temperatures (range: 78-90 days; n = 18), or an average of 76.3 days (range: 71-90 days; n=11) when incubated at female temperatures.

Regardless of incubation regime, newly hatched hatchlings were kept in the pipping chamber for up to two weeks to finish hatching and absorb residual yolk before being moved to holding facilities on the Ladder Ranch.

The 76 new tortoises hatched on the Armendaris in 2021 bring the total number of tortoises produced by our captive adults to *over 1000 since project inception* in 2006. In addition to the 76 hatchlings emerging from eggs laid in 2021, we also found 6 unmarked small tortoises in the Cedar Tank enclosure. These tortoises most likely hatched from a 2020 nest. This brings the total number of 2020 hatchlings found fortuitously - produced in a year when eggs are not actively collected - to 18. This means that we are able to find fewer than 1/3 of the expected number of hatchlings produced in an average year, underscoring the important role of egg collection, nest protection, and egg incubation for the overall success of the bolson tortoise breeding program. The "found" 2020 hatchlings were added to the group of 2021 hatchlings and were transferred to headstart facilities on the Ladder Ranch.

A hatchling bolson tortoise tackles a prickly pear "tuna" nearly twice its own size. Prickly pear fruit are a favorite food for tortoises of all sizes. We extend the "tuna" season for tortoises by freezing (and storing) tunas when they become available in autumn

Hatching success rates – A total of 76 hatchlings emerged from 106 potentially viable eggs in 2021. This makes for a 71.7% hatching success rate, a record for our breeding program (Table 4.3; the previous record of 69.4% was set in 2011). All Turner females except for Gertie and Pancha contributed to this reproductive effort in 2021 (Table 4.2).

Overall hatching success rates vary widely amongst females (Table 4.2), and for a given female from year to year. Moreover, hatching success in 2021 was dependent on incubation method: female incubator hatching success was 46%, male incubator hatching success was 72%, and natural nests showed an 81% hatching success rate – the highest hatching success rate recorded for the 16 years of the bolson project to date. Nonetheless, overall hatching success has remained relatively stable around 62.5% since 2011 (Table 4.3), and ranges from a low of 53.4% in 2015 to a high of 71.7% in 2021. The previous record of 69.4% was reached in 2011.

Over the past few years, we maximized the number of bolson tortoise juveniles produced each year to enable the implementation of the next phase of our conservation program – establishing wild populations. Several factors, including age, size, and number of reproductive years, contribute to the fecundity of each individual female. The number of offspring produced per female, and the number of offspring from each female currently alive, varies nearly 5-fold. We aim to normalize these numbers over the next few years, thus allowing each female to contribute similar numbers of offspring to the conservation efforts.

Table 4.3. Hatching success rates of Turner group tortoises since 2010. This rate is the percentage of eggs that hatched from those that were placed into incubators. Eggs not incubated were either lost, broken, or not collected. Eggs were not collected in 2020

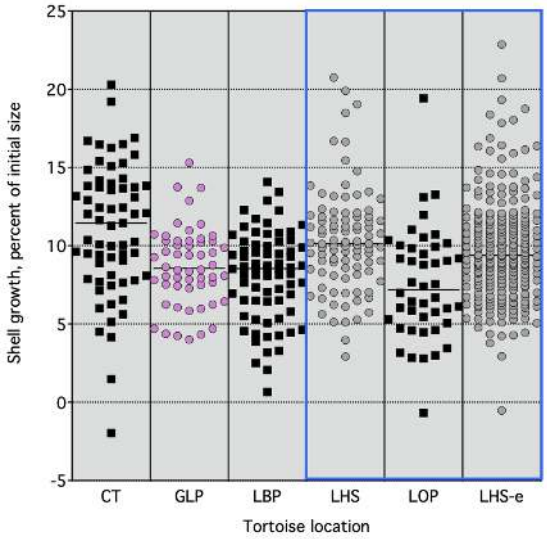
Year	No. of eggs hatched	No. of eggs recovered & incubated	No. of eggs not recovered	Hatching success rate
2010	51	78	13	65
2011	50	72	3	69
2012	63	118	10	53
2013	87	126	8	69
2014	96	172	11	56
2015	76	140	32	54.3
2016	54	89	55	61
2017	83	137	44	60.6
2018	83	125	9	64.8
2019	67	107	6	62.6
2020	N/A	N/A	N/A	N/A
2021	76	106	7	71.7
Mean	**71.5**	**115.5**	**18**	**62.5**

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:

- 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 at least once a year in the fall to monitor growth rates and health.

Since 2006, our captive population has grown to about 700 new tortoises at the end of 2021. The overall survival of bolson tortoise juveniles in our project lies around 70%. In contrast, survivorship in the wild is thought to be between 1 and 3%.



Shell growth between fall 2020 and fall 2021 for juvenile tortoises held in various locations on the Armendaris or Ladder ranches. CT = Cedar Tank; GLP = Goodluck Prairie; LBP = Ladder Big Pen; LHS = Ladder Headstart Pen; LOP = Ladder Open Pen; LHS-e = Ladder Headstart Expansion. Blue box indicates the enclosures that comprise the headstart facilities (LHS, LHS-e, LOP)

All juvenile tortoises not large enough to be held in unprotected enclosures were managed in headstart enclosures in 2021 with supplemental feeding and watering. Headstart pen maintenance includes grass-clipping and weeding to remove non-forage plants from the enclosures. Wild globemallow plants and wild grape leaves were harvested from the Ladder Ranch and were provided in the enclosures 3-5 times a week for supplemental feeding; native plants were supplemented with timothy hay and Bermuda grass and the occasional treat of prickly pear fruit.

While individual growth rates vary between animals, most tortoises appear to be growing at acceptable rates (5-10% per year) using these protocols.

Tortoise Surveys and Health Checks

Because our long-term veterinary collaborator, Dr. Jim Jarchow, was unavailable to travel to NM in 2021, fall heath checks were performed by the TESF Tortoise Team in 2021. The team was aided in the field by licensed veterinary technician and repeat volunteer Tara Klimek from San Antonio, TX. Moreover, El Paso Zoo veterinarians Dr. Misty Garcia and Dr. Vikki Milne, along with Dr. Jim Jarchow, are always only a phone call away to consult on any issues that may arise. Health and growth data provide an opportunity to identify juveniles that might need additional management to attain their full growth potential. The 2021 health checks revealed tortoises on the Ladder and Armendaris ranches continue to be in good or excellent health, and aside from soaking a juvenile tortoise overnight to resolve a case of mild constipation and providing some ointment to resolve a mild eye infection in another juvenile, no special treatments were required in 2021.

In addition, Deer Creek Ranch Manager and TEI Bison Veterinarian Dr. Tom Bragg visited the bolson tortoise project in August of 2021 and took the opportunity to meet and examine some of the bolson tortoises first-hand.

TEI veterinarian Dr. Tom Bragg gets to know Pancha, the largest of the bolson tortoise females in the Turner group, during his visit to the bolson tortoise project in August 2021

Tortoise releases – 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 large predator-accessible fenced areas that also house (or could house) the adults on the Armendaris and Ladder Ranches. Although the ultimate goal was to establish unfenced wild populations, the fenced "releases" provided important information regarding the behavior and

predation pressures for released tortoise juveniles until all of the required state and federal permits were in place to allow unfenced releases. For example, the release studies revealed that in most years, most of the juvenile tortoises do not travel long distances from the initial site of release. Since 2012, we transferred a total of 250 juvenile tortoises to predator-accessible (but fenced) enclosures on the Armendaris and Ladder ranches.

These release studies also revealed that, in general, tortoises were killed in a number of different ways, and that a single predatory species or cause of death could not (yet) be identified. Problems associated with environmental conditions that contributed to increased incidents of bacterial and fungal infections caused by particularly wet winter conditions were an important potential factor in causing tortoise deaths.

The tortoise project reached a major milestone in 2021 when we succeeded in obtaining a state permit allowing us to release tortoises in controlled environments on the Armendaris Ranch and study their movements, habitat use, and survivorship. We chose a remote but accessible area within potential tortoise habitat at least 2 miles from the nearest ranch boundary to conduct initial releases, and began preparing headstarted tortoises for release by outfitting tortoises with a 3-year VHF radio transmitter. As described in Box 4.1, we recruited Southwest Regional Director Amy Lueders and members of her staff to participate in the first ever release of bolson tortoises in the US, along with leaders and staff from the Bosque del Apache NWR, the Sevilleta NWR, and the Ecological Field Services Office in Albuquerque. Together, the USFWS crew released the first 12 bolson tortoise on April 27, 2021. By the end of 2021, a total of 56 bolson tortoises had been released at the Goodluck Prairie release site in three waves: 19 in the spring (April/May), 27 in the summer (July), and 10 in the fall (October). In August, one of the released tortoises was unfortunately found tangled in dense vegetation following the monsoons. This tortoise died due to overheating shortly after it was discovered. The radio transmitter attached to another tortoise stopped transmitting shortly after the release; this individual is currently lost-to-follow-up. The remaining 54 "wild" tortoises found or made new homes for themselves at the release site and eventually settled in for the winter. On average, the tortoises had moved a linear distance of 161.8 m from where they were released (range 23.7 – 1082.6 m; median: 111.9 m). Three tortoises had moved more than twice as far as all the other tortoises and had traveled 631.2 m, 751.9 m, or 1082.6 m, respectively. All other tortoises settled into an overwinter burrow located within at most ~350 m of where they were released (Figs 4.1 & 4.2).

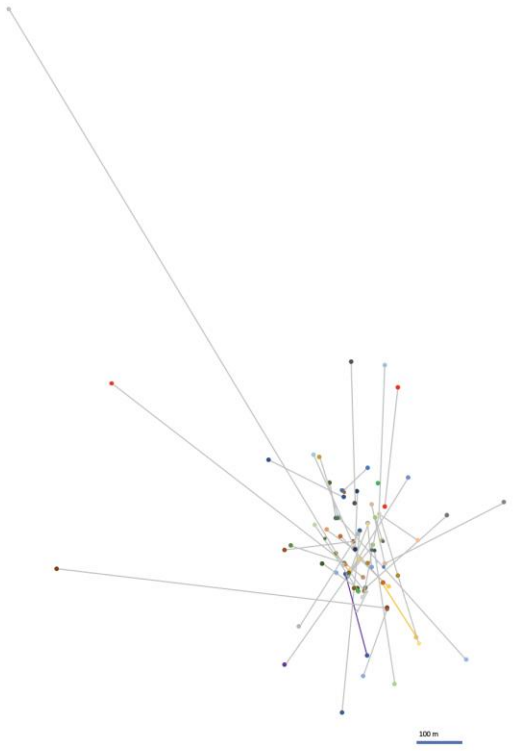


Fig. 4.1. Graphic representation of the linear displacement exhibited by the first 54 juvenile bolson tortoises allowed to move freely within the US. Each line represents one tortoise and connects the spot representing the site of release with the spot representing the location of the first overwinter burrow chosen by the tortoise. All tortoises were released near the center of the "starburst" figure

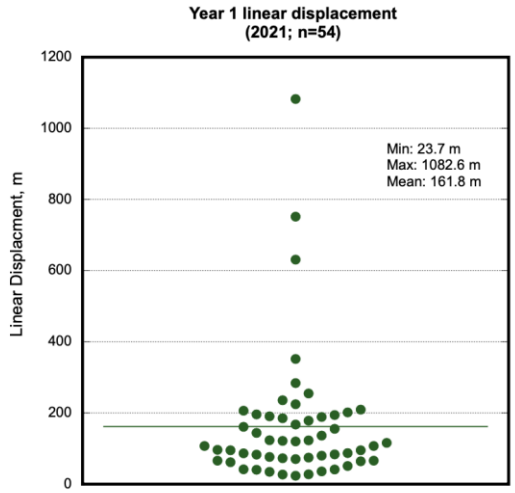


Fig. 4.2. Released *juvenile bolson tortoises stayed within ~1 km of where they were released, although the vast majority (51 out of 54) settled within 350 m or less during their first winter. Each dot represents one tortoise*

Outreach and other activities in 2021

- Hosted Turtle Survival Alliance (TSA) President Rick Hudson, who helped with tortoise releases; May 3-5, 2021.
- Hosted Round River Conservation staff to learn about the Turner Ranches and bolson tortoises; May 3-5, 2021.
- Once again hosted a Ohio University PhD student studying the thermal ecology of *Gopherus* species in the summer of 2021 (June 3- August 10). The student is planning on briefly returning to the Armendaris in 2022 to finish up her studies on the bolson tortoise.
- Helped develop a plan for a USFWS DFP internship to map potential bolson tortoise habitat at the Bosque del Apache and Sevilleta NWRs in 2022.
- Worked on and received a commitment for an additional 3 years of funding from the Turtle Conservancy and Re:Wild.
- Trained a USFWS ACE intern to track tortoises (October 2021).
- Obtained a state permit to conduct experimental tortoise releases on the Turner Ranches and study their movement.
- Presented a summary of TESF's bolson tortoise work during the (virtual) annual meeting of the Turtle Survival Alliance on August 17, 2021.
- Built a greenhouse and started to grow food (mostly kale and other leafy greens) for overwinter tortoises
- Participated in the preparation of a Safe Harbor Agreement for the Armendaris Ranch
- Collaborated with Dr. Lawson to develop a proposal for an M.S. student to study the newly released bolson tortoises
- Helped screen 87 M.S. applicants
- Hosted Dr. Matt Bandy (Resi Solutions) on three separate occasions to help develop drone-based survey methods for tortoises and tortoise burrows
- Hosted Furman students and volunteers to learn about the bolson tortoise project (September 2021).
- Continued our search for additional bolson tortoise adults to strengthen the genetics of the US bolson tortoise population; identified one potential candidate in southern NM (awaiting genotyping results) plus a potential source of additional animals in Texas.
- Continued to monitor box turtles on the Ladder and Armendaris to set the groundwork for studying the effect on box turtle populations of releasing bolson tortoises in their habitat

Furman *University "Wild Semester" students and instructor listen attentively as TESF biologist Scott Hillard introduces them to their first bolson tortoises*

Future Activities and Considerations

Our major objectives for 2022 will be to:

- Continue building a robust captive population of as a source for wild releases.
- Continue to release juvenile tortoises on the Armendaris to build a strong, repatriated, minimally managed, wild population of Chihuahuan desert tortoises.
- Continue to collaborate with partners to expand the reach and scope of the bolson tortoise project.
- Continue the search for additional breeding adult tortoises to introduce additional genetic diversity into our breeding group.
- Continue our efforts to obtain state and federal permits to release tortoises outside of enclosures on non-Turner lands.

Appendix 4.1. Contributors to the Bolson tortoise project since its inception in 2006

Type of Support	Individual/Organization
Funding	The Turtle Conservancy Re:Wild Lynnie Appleton
Veterinary	Dr. Jim Jarchow, DVM Dr. Peter Koplos, DVM Dr. Victoria Milne, DVM Dr. Misty Garcia, DVM
Tortoise Donation	The Appleton family LDZG Albuquerque BioPark Susan Serna
Supplies Donation	San Antonio Zoo Dr. Peter Koplos, DVM Holohil Systems, Ltd.
Volunteer Labor	Heidi Hubble, Matt Keeling, Tricia Rossetie, Andrew Lincourt, TTR staff, Ladder Ranch staff
Training	Dr. Stephen Divers, DVM *Endoscopy training*
Intellectual	Dr. Sean Graham
Research	Dr. Vikky 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. JJ Apodaca, PhD. Tangled Bank Conservation *Bolson tortoise genetics*

We continued to monitor box turtles (Terrapene ornata luteola) like this male turtle on the Ladder Ranch to obtain baseline data to inform future studies on the potential interaction between box turtles and bolson tortoises.

Box 4.1: Home at last! Rewilding Bolson Tortoises to the Northern Chihuahuan Desert

TESF teamed up with the USFWS for the first ever bolson tortoise release in the US. History was made in the late afternoon of April 27, 2021, when Southwest Region Director Amy Lueders set free tortoise 14-S24, the first of twelve juvenile bolson tortoises to be released in the "Goodluck Prairie" pasture on the Armendaris Ranch that day. The tortoises carry VHF radio-transmitters so their whereabouts can be tracked and their fate and movements can be studied to inform future releases and permitting requests. Pictured with soon-to-be-released tortoises, left to right: Chris Wiese (TESF); Dan Martin (TBD); Scott Hillard (TESF); Jeff Sanchez (USFWS), Jenna Zarlingo (TESF); Krystin (USFWS); Deb Hill (USFWS); Debbie Williams (USFWS); Kathy Granillo (USFWS); Shawn Sartorius (USFWS); Southwest Region Director Amy Lueders (USFWS); Assistant Southwest Region Director Peter Fasbender (USFWS).

Bosque del Apache NWR Biologist Jeff Sanchez releases a tortoise at a human-made starter burrow on April 27, 2021.

TESF biologist Scott Hillard points to tortoise tracks leading to a starter burrow.

Turtles like to use roads to get to where they are going. Tank-like tortoise tracks along the road near the release site highlight the need to look out for turtles and tortoises when driving on ranch roads during the tortoise active season (mid-March to Early November).

TESF Tortoise crew biologists Chris Wiese (light blue shirt, standing), Scott Hillard (white shirt, standing), and Jenna Zarlingo (blue shirt, kneeling) were joined by Turtle Survival Alliance President Rick Hudson (tan shirt, standing), veterinarian Bonnie Raphael (tan shirt, kneeling), and Round River Conservation Studies instructors Benjamin Szydlowski (grey shirt, standing) and Eli Brunner (dark blue shirt, kneeling) for the second round of tortoise releases at Goodluck Prairie on May 4, 2021.

Box 4.2: 2021 Deep Well Floods






Following several years of drought and a dry spring, heavy monsoons in the summer of 2021 resulted in flash floods and running water in the low-lying areas of the Chihuahuan desert grasslands, such as the area named "Deep Well" in the southern portion of the Armendaris Ranch. While causing no harm to the tortoises held in the "Cedar Tank" enclosure, the floods wreaked havoc on the group of tortoises held at the "Deep Well" tortoise enclosure. Although Deep Well adults were able to float or find safety on small islands of vegetation (marked by red rectangles in the left-hand pictures above), we decided to move them (back) to the Cedar Tank enclosure to prevent any further problems. Senior Biologist Scott Hillard is pictured in the photos above locating tortoises in the flooded pen using radiotelemetry.

Fortunately, the tortoise crew was also able to rescue the majority of the Deep Well juveniles from the flooded pen (or surrounding areas) the first time the area flooded, in mid-July. However, despite our best efforts we were too late for eight of the juveniles, who either drowned in the flood or were injured and succumbed to their injuries. Two juveniles - who were either swept far afield or whose radio-transmitters may have failed - are yet to be located.

Although translocations of reptiles during the heat of the summer are not advisable under normal circumstances due to the potential risks associated with overheating, we decided to move the rescued tortoises to the release site in mid-July and were relieved to have done so before the second, more severe flood in mid-August (shown in the pictures above). Mid-summer translocation of tortoises required a combination of close monitoring of the translocated animals and making management decisions that resulted in temporarily returning a handful of the translocatees to captivity until they could be more safely re-released in the fall.

5. CHIRICAHUA LEOPARD FROG

(*Lithobates chiricahuensis)*

Project Biologists

Cassidi Cobos

Carter Kruse

Magnus McCaffery

Project Partners

Administrative

Administrative

Research: Dr. Jamie Voyles

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

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.

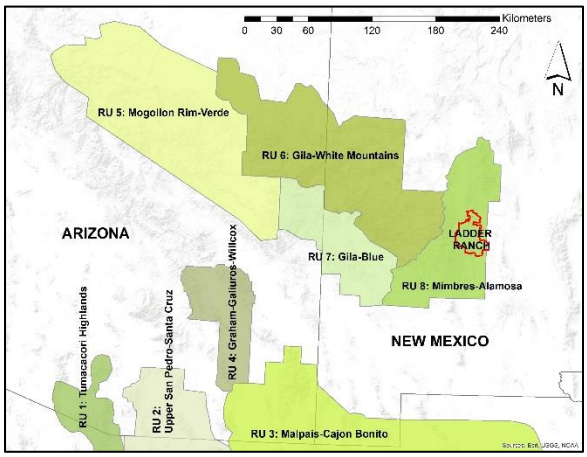


Fig. 5.1. The Ladder Ranch is a CLF Management Area within Recovery Unit (RU) 8

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; (e) implementing research to support recovery actions and adaptive management.

Activities in 2021

Wild population monitoring – We monitored all known sites occupied by wild CLF during 2021. 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 chytridiomycosis-causing fungus, *Batrachochytrium dendrobatidis* (*Bd*).

Habitat actions on the Ladder Ranch –

- Cattail and sedges were manually removed from Johnson Well (Fig. 5.2).
- Cattail were removed by hand from Artesia.

Fig. 5.2. Cattail removal at Johnson.

Captive refugia program

In 2021, 7 metamorph/adult frogs from the Beaver Creek source population were stocked in USFWS-designated Avant refugia tank Table 5.2). Overall, refugia tanks designated for both Ladder Ranch and USFWS use produced 41 viable egg masses in 2021 (Table 5.3).

Table 5.1. 2021 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	0	0	17
[b]N. Seco	43	20	15	80
[b]Pague	2	10	25	17
[b]LM Bar	11	10	15	45
[b]Fish	8	0	0	9
[b]Johnson	95	>100	40	230
[b]S. Seco	0	0	0	2
[c]Artesia	2	0	1	7

KEY:
a=Las Palomas drainage
b=Seco drainage
c=Ash Canyon drainage

EM=egg mass
TP=tadpole
MM=metamorph
AD=adult

Table 5.2. Number of egg masses (EM), Tadpoles (T), and metamorph (MM)/adult-form (AF) frogs from source populations (Pop.) stocked into USFWS designated captive refugia tanks on the Ladder Ranch in 2021

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.	0	0	7
Wildhorse	Cuchillo	0	0	0

Table 5.3. Egg masses detected in captive refugia in 2019

Refugia	No. Egg Masses	No. Viable
Antelope	0	0
Seco Well	20	20
Wildhorse	7	7
Fox	1	1
No. 2	12	12
Avant	1	1

Captive breeding: ranarium program

The ranarium (Fig. 5.3) housed adults from nine source populations, spanning four CLF Recovery Units, (Table 5.4). Egg masses produced in adult cages were transferred to the integrated tadpole rearing facility.

Fig. 5.3. Ladder Ranch ranarium

There are ten tadpole rearing tanks in the ranarium, which can hold around 1,000 tadpoles each. In 2021, 34 viable egg masses were transferred from adult cages to tadpole tanks. 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 just under 10,000 tadpoles in 2021. These tadpoles were released to wild or captive sites across New Mexico and Arizona on both public and private lands.

Table 5.4. CLFs in ranarium cages during 2021

Cage No.	Source population	No. ♂/♀	Date of entry
1	Seco X Cuchillo	0/2 2/0	5/22/19 7/11/19
2	Alamosa W.S.	2/2	7/27/19
3	Allen Spr.	6/6	6/15/21
4	San Francisco Haplotype	3/3	5/7/20
5	Diamond Cr.	4/2	11/3/15 5/1/19 10/7/20
6	Blue Cr.	3/1 0/1 0/2	5/1/15 11/2/15 6/8/18
7	Moreno Spr.	1/0 4/1 0/2	6/28/12 10/17/12 10/29/13
8	Galiuros	5/6	6/24/21
9	Las Animas Cave Cr.	4/2 1/4	6/13/13 6/13/15

KEY:
Cr. = Creek
W.S. = Warm Springs
Spr. = Springs

Fig. 5.4. Hybrid found at Johnson Well

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 2 .5 2	4/6/21 5/7/21 6/4/21 5/21/21	5/25/21 7/14/21 7/14/21 7/14/21	Cuchillo W.S.
2	Alamosa W.S.	1 1 2 1 1.5	4/5/21 5/7/21 5/21/21 6/16/21 7/26/21	5/25/21 7/15/21 7/15/21 7/15/21 9/24/21	Taylor Tank (JER)
4	San Fran	1 1 .5	4/15/21 4/18/21 5/24/21	5/20/21 5/20/21 7/16/21	Reserve, NM
5	Diamond	2 1 1	4/4/21 5/10/21 6/17/21	6/15/21 6/15/21 9/1/21	Lincoln Tank
6	Blue Creek	1 1	4/7/21 4/29/21	5/25/21 7/15/21	Turney and Garcia Tanks (JER)
7	Moreno	1 2 2	5/12/21 5/24/21 7/23/21	6/15/21 6/15/21 9/30/21	TNC property North Star tank
8	Galiuros	1 2 1	7/10/21 8/2/21 8/20/21	8/3/21 8/23/21	Arizona
9	Animas	1 1 2 1	4/18/21 4/18/21 6/6/21 8/17/21	5/24/21 5/24/21 7/12/21 9/20/21	Artesia

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

Table 5.6. Production and disposition of offspring produced at the ranarium in 2021

Date	Source	EM	TP	Meta	Release type
5/20/21	San Fran	2	520	-	W
5/24/21	Animas	2	258	-	W
5/25/21	Alamosa	1	799	-	C
5/25/21	Blue	1	977	1	C
5/25/21	Seco x Cuchillo	1	472	-	W
6/15/21	Diamond	3	215	-	W
6/15/21	Moreno	3	2315	12	W
7/12/21	Animas	1	33	-	W
7/14/21	Seco x Cuchillo	3.5	1134	5	W
7/15/21	Alamosa	4	865	-	C
7/15/21	Blue	1	420	-	C
7/16/21	San Fran	.5	320	-	W
8/3/21	Galiuros	1	-	-	W
8/23/21	Galiuros	2	-	-	W
9/1/21	Diamond	1	296	-	W
9/20/21	Animas	1	221	-	W
9/24/21	Alamosa	1.5	409	-	C
9/30/21	Moreno	2	700	-	W

KEY:
Animas = Animas Creek
Diamond = Diamond Creek
Beaver = Beaver Creek
Blue = Blue Creek
San Fran = San Fran Haplotype
Moreno = Moreno 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 seen moving up the Animas, Seco, Las Palomas, and Cuchillo drainages. In 2018, while capturing frogs at Johnson well we found several odd-looking frogs that had characteristics of both CLF and PLF (Fig. 5.4). CLF and PLF hybridization has not been previously recorded. Toe clippings collected in 2020 from the odd- looking frogs were sent to Pisces Molecular and showed evidence of hybridization.

In 2021, hybrid looking frogs and PLFs were captured and removed from the Seco drainage. We are continuing genetic testing and are discussing management options with USFWS.

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

MONTANA STATE UNIVERSITY

Funding

TROUT UNLIMITED

NorthWestern Energy

Research

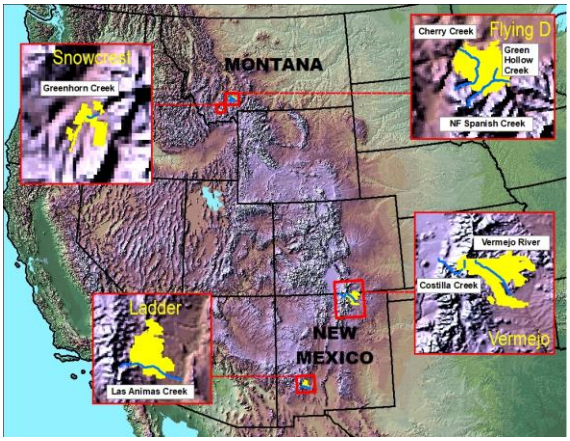
Idaho State University

WILDLIFE CONSERVATION SOCIETY

Research/Management

B.B. Shepard & Associates

Locations



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.

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 2012-21 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 now consistently capture 50-150 WCT between up to 400 mm in length, annually. 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 second 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 were determined, with advancements in genetic testing, to contain Colorado River cutthroat trout genetics and phase I was 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 – 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. This is also 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). 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.

To improve the RGCT 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 solution 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. This is expected to be at least a ten-year, multi-student project before any conclusive results are available.

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.

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 in 2020. Tissue samples were collected (n=93) from Upper Leandro and Middle Leandro. These samples were compared to the library of upper Vermejo basin genetic samples collected between 2011-2017 (n=338). 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 – 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 in Las Animas Creek. 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 to not conduct a rotenone treatment to remove the longfin dace. Electrofishing surveys in 2018-2021 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, but 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. Most 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 and their inlet and outlet streams in 2019 (two treatments), as well as Willow Swamp. Treatment is scheduled to continue through 2021.

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 will be completed and reported on in 2022, but sampling in 2019 and 2020 provided 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 Arctic 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 14,966 and annual catch has been less than 100 individuals the last six 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 and TBD 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., $\geq$ 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.

Table 6.1. Summary of TBD's native cutthroat trout efforts

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%)**

Activities in 2021

Cherry Creek – Three of five long-term monitoring sites were sampled in 2021, results indicate the restored WCT population continues to do well. Mean abundance of WCT across all sites was 192 fish/100 m in 2021 and has remained relatively stable with a slight increasing trend over the last five years (Fig. 6.1). Recreational anglers continue to report high catch rates on Cherry Creek within the restoration area. Furthermore, catch rates of WCT by anglers on the main stem Madison River have continued to increase for the last few years. The native WCT fishery in the Madison River is one example of the valuable public benefit provided by the conservation efforts of TBD and TESF. For example, in 2021 MTFWP captured 96 WCT between 178-402 mm in the Madison River near the Cherry Creek confluence. 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. TBD maintained a partnership with Idaho Game and Fish and BB Shepard and Associates to assist with genetic analyses related to success of founder stocks. This work suffered a setback due to the untimely death of an important colleague but will be reset in 2022. TBD continued to look for a disease free, genetically related source of Rocky Mountain sculpin to stock into the Cherry Creek restoration area. MTFWP seems willing to consider a sculpin translocation from Elk Creek on the Flying D pending disease testing.

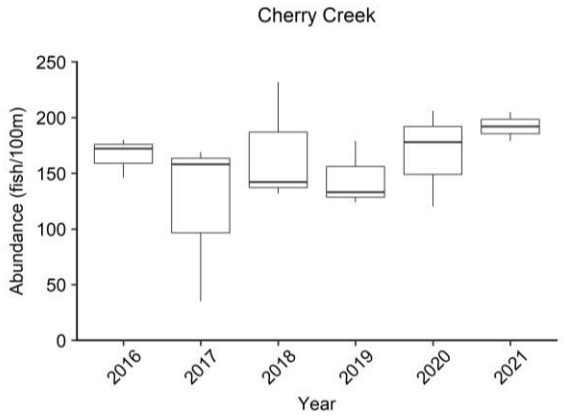


Fig. 6.1. WCT abundance (all fish > 80 mm total length) at annual monitoring sites from 2016 through 2021

Costilla Creek – Annual monitoring for RGCT occurred at eight long term sites on Costilla Creek and five sites on Casias Creek. Monitoring in 2021 indicates the population is characteristic of years past (Fig. 6.2).

However, there was a slight decline in fish abundance at the downstream monitoring sites in both streams. This decline is most likely a result of drought conditions persisting in the region. Nevertheless, detection of all size classes of RGCT including young of the year provides evidence of continued successful reproduction. Guest anglers continued to use the Costilla Basin in 2021. Angler catch rates averaged just above 3 fish per hour in 2021, which is slightly lower than the nearly 5 fish per hour in 2020. The potential for population level impacts and aquatic disease transmission will increase with increased guest visitation at Vermejo Park Ranch; TBD will increase vigilance to detect negative impacts, if any, moving forward. From 2018 through 2021 five of the temporary, man-made fish migration barriers that were installed to facilitate the treatment have been removed from the Costilla Basin; the largest and last barrier was removed in September 2021 (Fig. 6.3).

Fig. 6.2. Female (left) and male (right) RGCT sampled in the Costilla Basin

Fig. 6.3. Before (top) and after (bottom) images of Costilla Creek temporary fish migration barrier removal

Vermejo River – In early 2021 an independent genetic consultant verified some concerns TBD had about the genetic diversity analyses completed in 2020, thus in 2021 TBD collected additional genetic samples from the Vermejo River system that were submitted to the University of Montana Wild Trout and Salmon Genetics Laboratory for additional analyses. These analyses will be completed in 2022. The first graduate student (NM State University) on the YY brook trout project completed his thesis in October of 2021 and was able to demonstrate that stocked YY male brook trout were surviving well in Leandro Creek on Vermejo Park Ranch, were becoming sexually mature, and in 2020 fathered over 50% of brook trout young of year. A new graduate student will continue to study the effectiveness of YY male brook trout as a restoration tool.

Las Animas Creek – No monitoring of the RGCT in Las Animas Creek occurred in 2021. Our best information suggests that no RGCT have moved down onto the Ladder Ranch from the population stocked into Las Animas Creek on the Gila National Forest in 2017-18 (*as described in Project Background above*). The current focus on the Ladder Ranch portion of the stream is Rio Grande sucker and Rio Grande chub re-establishment.

NF Spanish Creek – TBD, along with primary project partners MTFWP and US Forest Service, completed the final planned year of rotenone treatment for this project in August 2021. TBD and MTFWP spent time looking for any remaining non-native fishes with electrofishing and eDNA sampling. Brook trout eDNA was detected at Big Brother Lake, one of the two headwater lakes within the treatment area. This could mean that a fish(s) was missed during treatment or that there is residual DNA in the environment from decaying carcasses, etc. Out of an abundance of caution, TBD will assist MTFWP in collecting additional eDNA samples throughout the project area in 2022. If no fish are detected with eDNA, restocking of the project area will begin in late summer 2022; however, detection of eDNA will likely mean an additional rotenone treatment and/or delay in stocking. Because no non-native trout eDNA was detected at Chiquita Lake, Arctic grayling were stocked into the lake fall 2021.

Greenhorn Creek – The University of Montana graduate student funded by TBD successfully completed a final year of demographic and genetic sampling in Greenhorn Creek in 2021. The restored WCT population continues to grow and is reaching carrying capacity. A master's thesis, as well as associated publications and project reports will be finalized in 2022.

Green Hollow Creek – Mechanical removal of brook trout via backpack electrofishing continued in 2021. TBD staff removed 30 brook trout from the system, three individuals were less than 100 mm indicating successful reproduction in the past year. Given the difficulty in achieving 100% eradication of brook trout in Green Hollow Creek, TBD is now working with MTFWP to develop a plan to chemically remove brook trout from Green Hollow Creek upstream of Green Hollow Reservoir II.

7. LESSER PRAIRIE-CHICKEN

(*Tympanuchus pallidicinctus*)

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

STATUS REVIEW

Project Biologists

Grace Ray

Eric Leinonen

Carter Kruse

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

Background

The status of LPC has been heavily litigated, particularly during the last ten years. The species was first listed as federally threatened on April 10, 2014, finally settling nearly 20 years of legal action by environmental organizations against the U.S. Fish and Wildlife Service (USFWS) in response to the Service's 1998 determination that listing of the LEPC was "warranted but precluded" by other priorities. The listing status was short lived, as in 2015 a Texas court vacated the FWS status designation to rule in favor of a Texas oil trade group. Subsequent lawsuits by several environmental groups sought to list the species once again. The FWS entered a settlement with those plaintiffs and on May 24, 2021, the FWS released a proposed rule to list two distinct population segments (DPS) of LPC under the Endangered Species Act (ESA). If the listing decision is finalized as currently proposed, the Southern DPS (LPC populations existing in West Texas and eastern New Mexico) will be listed as endangered, and the Northern DPS (which covers populations in the Northern Panhandle of Texas, Oklahoma, Kansas, and Colorado) will be listed as threatened.

In 2015 TBD began to manage 32,525 acres of the Z Bar Ranch to benefit the lesser prairie-chicken (LPC) through a cooperative 10-year agreement with the Western Association of Fish and Wildlife Agencies (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 to help create the vegetative mosaic required by LPCs. By year two of the project, we had satisfied all required habitat restoration and grazing requirements (e.g., Fig. 7.1). In March 2016 the 400,000 Anderson Creek Fire (largest wildfire in Kansas history) burned 96% or 41,000 acres of the Z Bar. Ecologically, the Z Bar largely benefitted from this 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 LPCs.

Project Partners

Administrative

Funding

Goal – Restore a lesser prairie-chicken breeding population to Z Bar.

Objective – We will increase lesser prairie-chicken numbers at the Z Bar by restoring ~25,000 acres of mixed grass prairie to a condition suitable for LPCs, and 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, with a minimum 10-year fire rotation.
- Mechanical removal of woody vegetation from uplands to limit avian predation and improve LPC habitat.

- Use grazing to produce a mosaic of habitats that include lightly grazed pastures/robust standing vegetation, and heavily grazed pastures/minimal standing vegetation.

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

Supporting Rationale for Objective

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

Activities in 2021 – There were several LPC sightings at the Z Bar throughout the year, but it is unlikely the ranch supports a breeding population. This assumption is supported by annual lek surveys performed by the TESF, WAFWA, and the TNC, which did not detect any leks on the ranch in 2021. We have begun to critically evaluate suitable habitat and population trends to determine whether conditions support translocating LPCs to the ranch. A graduate student working through TEI/TESF and Montana State University is evaluating the specific habitat suitability of Z Bar Ranch compared to the surrounding areas that do host LPCs and their breeding habitat.

Results from WAFWA's 2021 LPC habitat surveys indicate the Z Bar continues to make progress in restoring necessary habitat. For example, in each of the last six years the ranch has surpassed predicted habitat values. However, there remains one additional habitat component–brood-rearing habitat–which may be population limiting at the ranch. Ideal brood rearing habitat is described as forb-dominant (broad-leafed herbaceous vegetation). This habitat not only allows the chicks to move more freely under protective vegetative cover—it also produces a higher abundance of insects, which make up the high protein diet that the growing chicks need. To remedy this shortcoming, we petitioned and received permission from WAFWA to increase bison grazing in 2019 which, in combination with prescribed fire, should result in an increase in that specific habitat type. In 2021 we continued to improve on LPC habitat by utilizing targeted bison grazing and by conducting prescribed fires.

Future Activities & Considerations

The direction of the lesser prairie-chicken project at the Z Bar hinges on documenting reproduction and increasing the population. Habitat evaluation metrics suggest the habitat requirements have been met at the Z Bar, yet LPC sightings remain infrequent. We will continue work to encourage establishment of a resident LPC population by examining vegetative composition, vegetative community structure and arrangement, distance from source populations, or a combination of these factors. Evaluation of these parameters through a collaboration between TEI/TESF and MSU graduate research will be completed by 2022, with this research helping guide next steps for the lesser prairie-chicken project and determine the likelihood of natural repopulation or illuminate the need for managed translocations.

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 is restoring preferred monarch host plants on Turner properties, and adapting management practices to benefit these early successional, disturbance-loving plants.

In 2015, we conducted 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.

Partners

Funding *Implementation*

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.

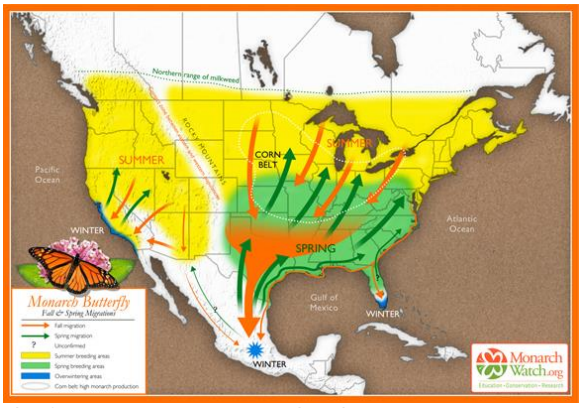


Fig. 8.1. Monarch butterfly migration routes

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

Monarch Butterfly/Native Pollinators Project Activities (2018-2019)

The local ecotype swamp milkweed planting efforts at Avalon, which began in 2016, produced seed pods for the first time in 2018. These seed pods were collected, dried, and cold stratified prior to planting in spring 2019. The prepared swamp milkweed seeds were germinated and grown in a greenhouse on the Avalon Plantation for three months (February-May 2019), then 180 swamp milkweed plugs were planted at 27 locations around the property in spring 2019 (Figure 8).

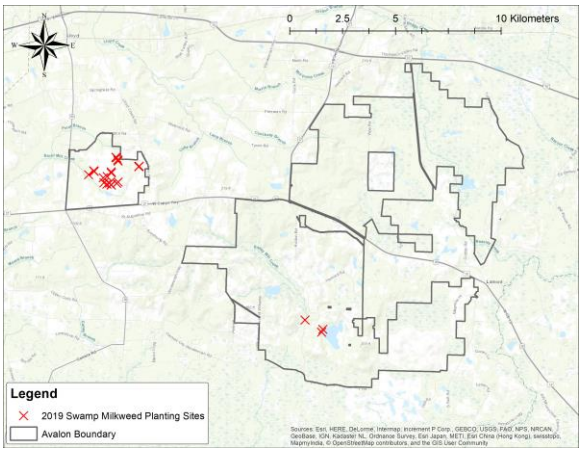


Figure 8.4 180 swamp milkweed plugs were planted at 27 locations on the Avalon Plantation in 2019.

Activities in 2021

In September, we planted around 300 milkweed seedlings at the Avalon Plantation. Milkweed starts were grown by botanist, Scott Davis, and his team at the Southeast Monarch Milkweed Initiative. The milkweed were planted at several locations on the Annex and on Avalon Proper:

- 150 Swamp Milkweed (*A. incarnata)* planted at Iamonia Lake and Scurrycut Pond on Avalon Proper (Figs. 8.5 – 8.7).
- 150 Sandhill, Pinewoods Milkweed (*Asclepias humistrata*) planted at 3 locations around Duck Pond on the Annex (Fig. 8.8).

Figure 8.5. Swamp milkweed ready for planting at Iamonia Lake

Figure 8.6. Locations of swamp milkweed plantings at Iamonia Lake

Figure 8.7. Locations of swamp milkweed plantings at Scurrycut Pond

Figure 8.7. Locations of Sandhill milkweed plantings on the Annex

Aquatic milkweed (*Asclepias perennis*) is an important milkweed species for monarch butterflies which we aim to plant at Avalon in 2022

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 – Rio Grande Sucker (RGS) and Rio Grande Chub (RGC) have experienced range-wide declines due to competition and predation by a variety of non-native fish species, as well as habitat degradation. They were petitioned for listing under the ESA in 2014. The USFWS concluded in 2016 that both species may be warranted for federal listing protections. Species status reviews are underway. RGS are listed as an endangered species in Colorado. Both species are considered Species of Greatest Conservation Need by the NM Department of Game and Fish (NMDGF) and Colorado Parks and Wildlife (CPW).

Historically, RGS occurred in the Rio Grande, Mimbres, and Gila drainages. RGC occurred in the Rio Grande, Pecos, and Canadian drainages and an isolated population in the Davis Mountains in Texas. The

Partners

Funding/Management

Funding

Management

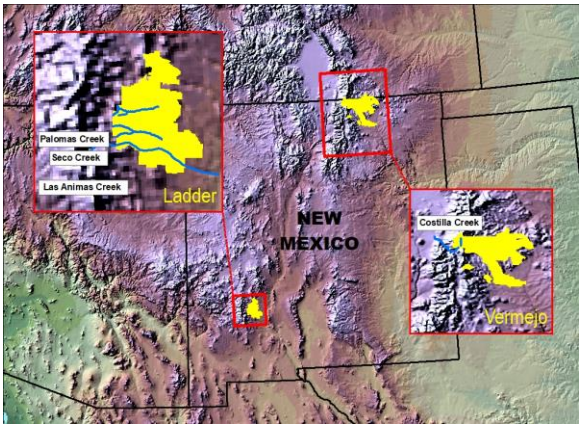
Genetic processing/Data Analysis

THE UNIVERSITY OF NEW MEXICO

Genetic processing/eDNA development

USDA FOREST SERVICE
ROCKY MOUNTAIN RESEARCH STATION

Locations



Background

Early fishery surveys documented RGS and RGC in three of the four drainages that flow from west to east across the Ladder Ranch – Palomas, Seco, and las Animas creeks (Cuchillo Negro is the fourth). Although all four streams are tributaries to the lower Rio Grande River and were historically connected (allowing recolonization and genetic movement), water diversion, dams, and non-native fish populations have effectively 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 monsoon rains 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 levels. This severe population bottleneck event led TBD to partner with University of New Mexico to investigate the effects of isolation and population bottleneck on genetic diversity of these 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 from 2014-16 confirmed the extirpation of RGS and RGC from Seco Creek, and the total 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 – *see Cutthroat Trout project summary).* NMDGF approved a TBD proposal in 2017 to translocate RGC (Fig. 9.1) and RGS (Fig. 9.2) from Palomas Creek back into Seco and las Animas creeks. Since then, modest numbers of RGC and RGS have been collected from Palomas Creek and translocated into Animas and Seco creeks (Tables 9.1 & 9.2).

Fig. 9.1. A massive 190 mm RGC in Palomas Creek

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 then worked with the National Genomic Center for Fish and Wildlife Conservation at the US Forest Service Rocky Mountain Research Station, Missoula, MT, to develop and test the eDNA markers. The results of that work were summarized in a Project Completion Report. 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.

Fig. 9.2. A large 130 mm RGS captured and returned to Palomas Creek. Some of the offspring of this fish have likely been collected and transferred into Seco and Las Animas between 2018-2020

Although identified as suitable habitat within their historic range, neither RGS or RGC have ever been sampled in Costilla Creek on Vermejo Park Ranch. It is unknown if the habitat is unsuitable or if extirpation occurred due to anthropomorphic habitat changes (creation of Costilla Reservoir) or predation by an introduced non-native trout population (which has now been restored to native Rio Grande cutthroat trout (RGCT) – *see Cutthroat Trout project summary*). Restoration of RGC and RGS in Costilla basin will be considered in 2022, as restored native trout populations have become re-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 RGC and RGS populations in 100 km 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 and at least two sites will include the full native community of RGS, RGC, and Rio Grande cutthroat trout:

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

Restored populations of RGC will 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 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 completed for both RGC and RGS. These documents will guide conservation and restoration activities for RGC and RGS across jurisdictional boundaries. Objectives outlined 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, unknown 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 2021

After three years of collecting RGS from Palomas Creek for transfer into las Animas and Seco Creeks, no fish were moved among the Ladder Ranch drainages in 2021. Population monitoring occurred in Palomas, Seco, and las Animas Creeks in 2021, as follows:

Palomas Creek – Population surveys were conducted at four locations in Palomas Creek. Mean density of RGC and RGS across all sites in 2021 was 0.16 (RGC) and 0.87 (RGS) fish/m^2. These densities have remained relatively stable over the last five years despite the 1,000+ RGS that have been collected and transferred to Seco and las Animas Creeks (Table 9.1). Tissue samples were collected from a subset of the fish sampled in 2021 for future genetic analyses.

Seco Creek – Population surveys were conducted at two locations in Seco Creek. Mean density of RGC and RGS across all sites in 2021 was 1.98 (RGC) and 0.64 (RGS) fish/m^2. These densities are a dramatic increase from 2020 and nearly a seven-fold increase from the density stocked in 2018-2019 (Fig. 9.3). Tissue samples were collected from a subset of the fish sampled in 2021. TBD intends to compare the RGS genetic diversity in Seco Creek to pre-Silver Fire levels to better understand genetic bottlenecks in a population recovering (or refounded in this case) following stochastic population declines.

Las Animas Creek – Population surveys were conducted at four locations in las Animas Creek (Fig. 9.4). Additionally, extensive 'spot-shocking' (i.e., random quick samples) was conducted to search for RGS. In total only 8 RGS were collected - three during surveys and five while spot-shocking – all in lower las Animas (i.e., downstream of ranch headquarters). It is unknown why RGS have not re-established in upper las Animas despite 680 RGS transferred from Palomas Creek into upper las Animas between 2018-2020.

Extensive habitat and low numbers have likely hampered detection of RGS in this section. Predation from and competition with non-native Green Sunfish (*Lepomis cyanellus*), Large Mouth Bass (*Micropterus salmoides*), and crayfish (*Cambarus spp.)* is likely to be a significant challenge to RGS recovery in lower las Animas. TBD removed 500 Green Sunfish from the Warm Springs section and lower las Animas in 2021. Rio Grande chub are found in high densities throughout las Animas Creek.

Other Activities

In response to potential listing of RGC and RGS, NMDGF, CPW, USFWS, USFS, BLM, Tribal entities and TBD have partnered together to form a working group focused on the conservation of these fishes. The working group is guided by conservation strategies, one for each species. TEI is a signatory on both documents and has agreed to adhere to the goals and objectives listed. These goals are in-line with goals TBD has previously established; to work with State and Federal partners to advance RGC and RGS conservation and recovery, and contribute to conservation science through innovation, implementation, and research in the field.

Earnest discussions about introducing RGS into Costilla Creek were initiated with NMDGF. Pending results of pre-translocation disease testing, it is likely RGS will be stocked into Costilla Creek in 2022.

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

Rio Grande Sucker				
Site	**2018**	**2019**	**2020**	**Total**
Seco	250	100	0	350
Upper Las Animas	100	150	200	450
Lower Las Animas	150	30	50	230
Palomas	-550	-280	-250	-1080

Table 9.2. Total RGC translocated between 2018-2020. Palomas negative numbers reflect fish collected for transfer into Seco and las Animas

Rio Grande Chub				
Site	**2016**	**2018**	**2017, 2019, 2020**	**Total**
Seco	29	88	0	117
Upper Las Animas	0	2	0	2
Lower Las Animas	0	88	0	88
Palomas	-29	-60	0	-89
Artesia Tank	0	-60	0	-60
North Seco Tank	0	-56	0	-56

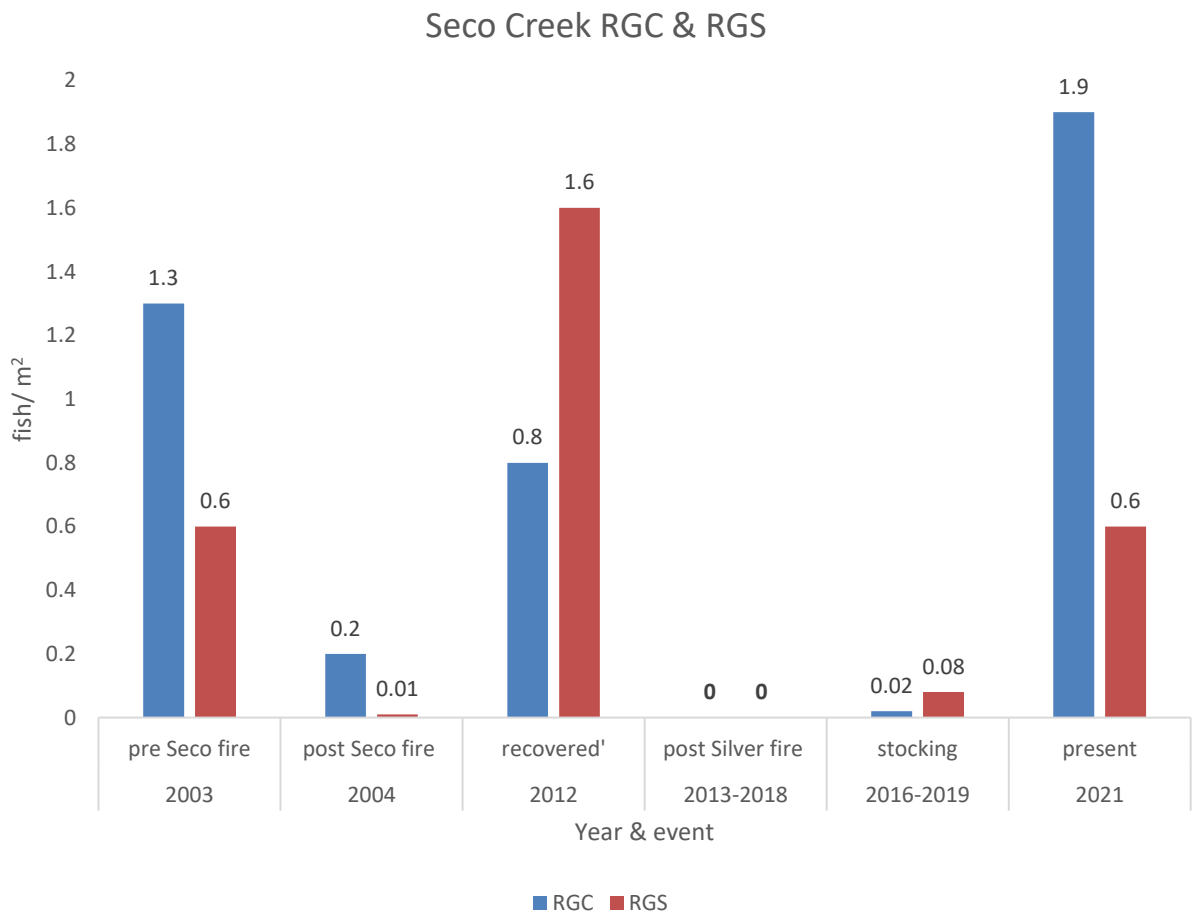


Fig. 9.3. A bar graph depicts the change in RGC and RGS densities before and after wildfires and subsequent restoration in Seco Creek

Fig. 9.4. TBD Fisheries crew backpack electro-fish Las Animas Creek, surveying for RGC and RGS

10. RED-COCKADED WOODPECKER

(Picoides borealis)

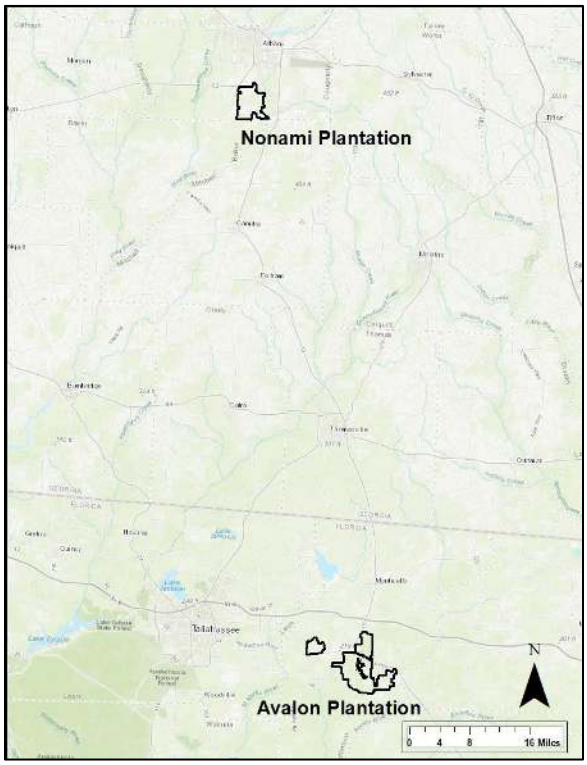
Project Biologists

Greg Hagan

Mike Phillips

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

Locations



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 Proper unit of the Avalon Plantation (Fig. 10.1). 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.

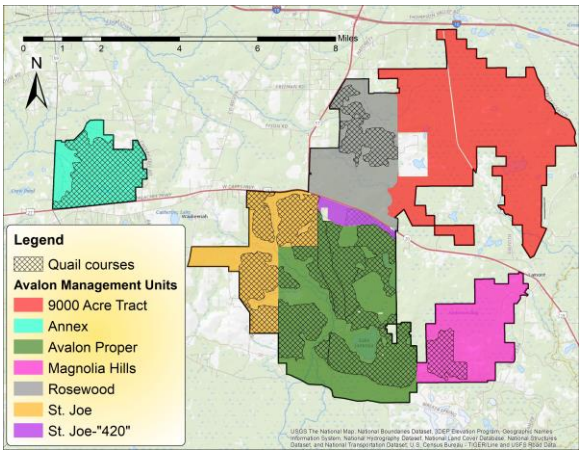


Fig. 10.1. Property Units that comprised the Avalon Plantation in 2021

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; the highest number of active clusters on Avalon since project inception.

In 2020, we developed a 5-year plan (Table 10.1) to expand our RCW program beyond Avalon Proper, with the goal of establishing RCW populations at the Avalon Annex (Fig. 10.2) and the Nonami Plantation (Fig. 10.3).

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. 10.1 and 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.

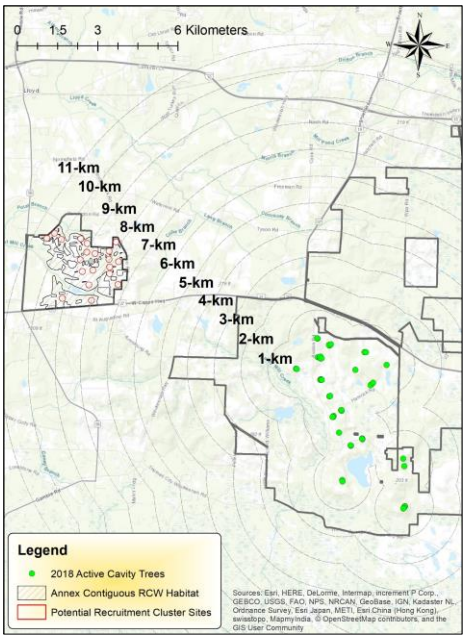


Fig. 10.2. The location of suitable RCW habitat and potential 10-acre recruitment cluster sites relative to active RCW clusters at Avalon Proper. Buffers at 1-km increments from active clusters indicate that recruitment clusters sited on the Annex would be approximately 7 – 11 km of active clusters.

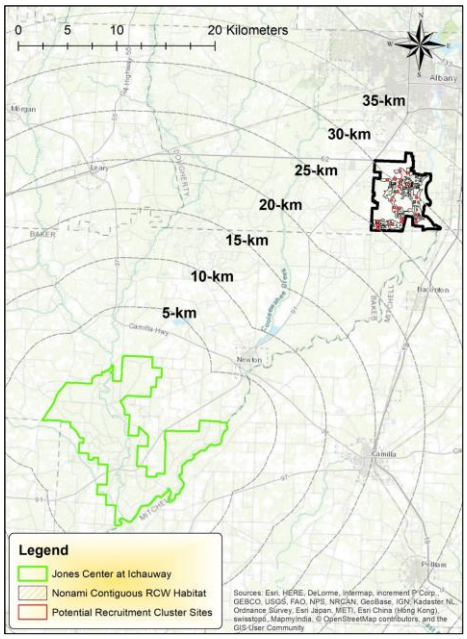


Fig. 10.3. The location of suitable RCW habitat and potential 10-acre recruitment cluster sites relative to the nearest active RCW population at the Jones Center at Ichauway. Buffers at 5-km increments from Ichauway indicate that recruitment clusters sited on the Nonami would be at least 25-km from the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

Goal – Restore red-cockaded woodpeckers to the Avalon and Nonami plantations.

Objectives – Restore ≥ 20 breeding groups to Avalon that. Once this is achieved, Avalon will become a donor site for translocations to other recovery sites (e.g., Nonami).

Strategies

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

Activities in 2021: Avalon Proper

Cluster Demographics & Status Cluster demographics and activity status of each cluster was documented during the pre-breeding season, breeding season and post-breeding season. In addition, all new cavity trees were recorded and flagged along with activity status. At the end of 2021, 19 active groups were documented with 18 being potential breeding groups and 1 single bird group (Fig. 10.4).

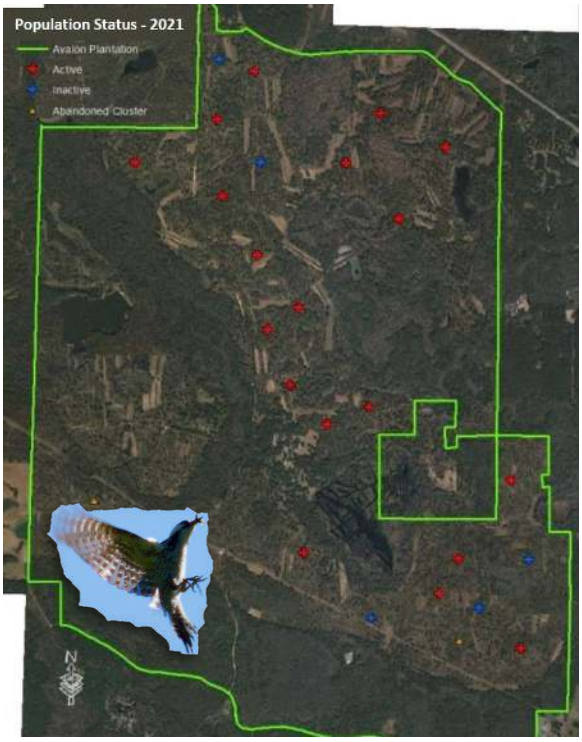


Fig. 10.4. 2021 RCW Cluster Status at the Avalon Plantation

Supplemental Cavities – No supplemental cavities were installed in 2021. All clusters maintained the minimum number of 4 cavity trees. As special note, in an effort to help expedite expansion, no artificial (supplemental) cavities will be installed in clusters that meet the minimum cavity requirements (4); regardless of the number of individuals. Our goal is to limit the number of helpers to two individuals in order to have "surplus" birds disperse to potential new territories.

Cavity Tree Management – All clusters and cavity trees were mowed in late January 2021 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 implemented at Avalon in March and April 2021.

Activities in 2021: Avalon Annex

Recruitment Clusters – We installed 3 recruitment clusters on the Annex in December 2021 (Fig 10.5). Each recruitment cluster consists of 4 cavity trees, and all cavity trees were flagged with pink flagging.

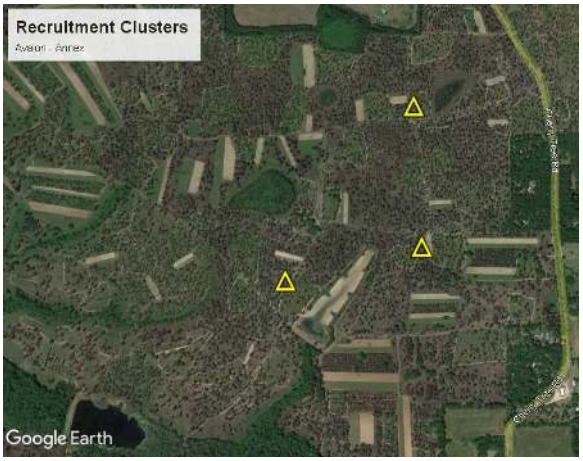


Fig. 10.5. Recruitment cluster locations on the Avalon Annex

Activities in 2021: Nonami

Recruitment Clusters – We installed 3 recruitment clusters on Nonami in October 2021 (Fig 10.6). Each recruitment cluster consists of 4 cavity trees, and all cavity trees were flagged with pink flagging.

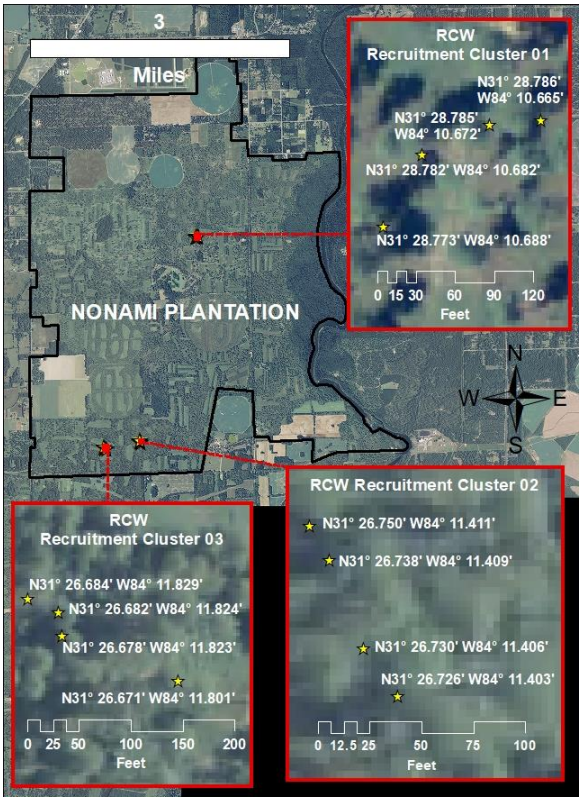


Fig. 10.6. Recruitment cluster locations on Nonami Plantation

Proposed Future Activities & Considerations

In 2022, we will monitor recruitment clusters at the Avalon Annex and Nonami Plantation for signs of RCW immigration and establishment. We will also perform recruitment cluster maintenance, as needed. If recruitment clusters 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.

11. SANDHILLS WET MEADOW HABITAT

Project Biologist

Carter Kruse

Conservation Status Loss and modification of Sandhills wet meadow and wetland habitat due to ditching and draining for hay, grazing, and agriculture production. Up to 45% 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

Sandhills Task Force
"Where People and Land are One"

Funding & Logistical Support

NEBRASKA GAME PARKS

USDA
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). 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.

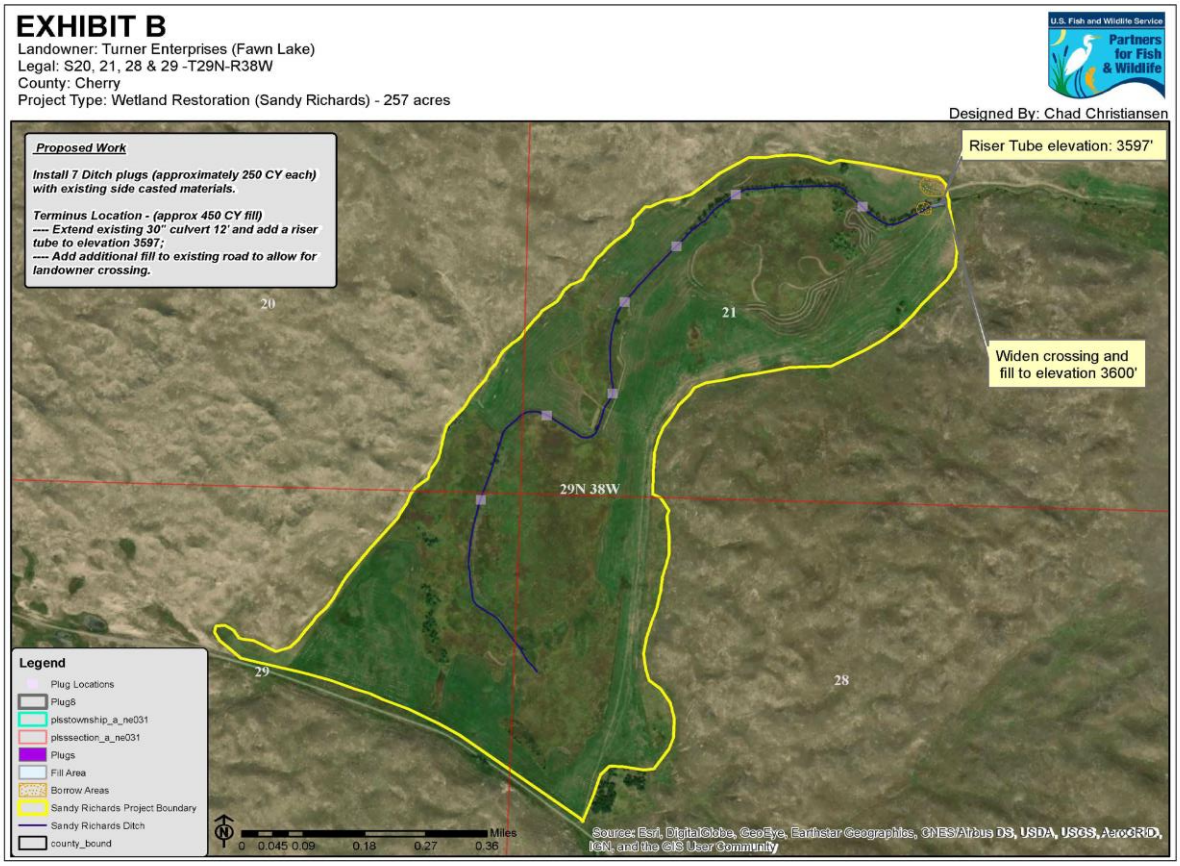


Fig. 11.3. Final design schematic for Sandy Richards Phase 1 restoration work at Fawn Lake Ranch.

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

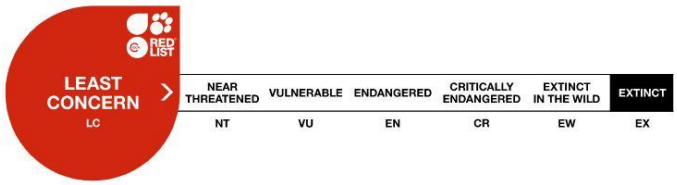
To implement at least ten separate wet meadow restoration projects, including at least one on each of the five Turner Sandhills ranches, impacting 1,000 acres of wetland, fen, or stream habitat. Projects will be conducted in collaboration with like-minded partners willing to cost share of the project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

Activities in 2021

Over the past year Arrow Survey Group completed a topographic survey of the Sandy Richards Phase I and II sites, and TBD finalized restoration plans for the Sandy Richards Phase I at Fawn Lake (Figure 3). This project will impact approximately 250 acres of wet meadow. Ducks Unlimited and US Fish and Wildlife Partners Program agreed to collaborate on the project by providing wetland delineation services and 404 permitting, respectively. Final permitting is in progress. Restoration work is anticipated to occur in August 2022. The Turner Institute of Ecoagriculture funded a masters level project through Oklahoma State University entitled "Management of Sandhills Wet Meadows: Impacts on Soil Health and Biotic Communities" that will investigate the impacts of wet meadow habitat management on carbon storage and soil health. A contract for this project was completed in 2021 and the graduate student will begin work at McGinley and Fawn Lake ranches in summer 2022. Fawn Lake Ranch is also logistically supporting a University of Nebraska-Lincoln masters project on movement and genetic structure of northern pearl dace in the Sandhills ecoregion. Much work is needed to understand the population ecology of non-game fishes in Sandhills streams, wetlands, and wet meadows, and the impact of land management actions on these fishes.

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 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 2021

Wolves housed at the LRWMF in 2021

A total of 14 different wolves were held at the LRWMF in 2021, with a maximum of 11 at any one time. The studbook identification numbers (and a brief synopsis of the history) of the wolves housed at the Ladder Ranch during 2021 are summarized in Table 12a.1.

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 road-kill 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 have access to fresh water at all times. 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. 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.

Health Checks: All wolves received thorough health checks, vaccinations, and anti-parasite medication before arriving at the LRWMF. Similarly, all wolves leaving the LRWMF in 2021 received deworming and anti-parasite medication (ivermectin, selarid, 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). All wolves in the facility at the end of December 2021 were current on their vaccinations and treatments.

Rhett Turner and Laura Seydel at a wolf capture.

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.

Mexico recovery: The LRWMF has been instrumental in Mexico's wolf recovery. In 2021 the Ladder housed two pairs of wolves that were eventually released in the Sierra Madre Occidental, in Mexico. All four wolves

were removed from the San Carlos Apache Reservation (SCAR). F1828 was captured with her five 4-week-old pups and brought to the LRWMF. F1828 and pups were introduced to M1582 in hopes of making a pack for release. M1582 was previously removed from the SCAR in 2020. Unfortunately, the introduction did not go as planned and three of the pups were killed. M1582 was removed from the pen. Mexico later decided on just releasing M1582 and F1828 without pups. The pups were removed from the pen and M1582 was paired back up with 1828. In November, a pair (M2693/F1841) also occupying the SCAR, were removed from the wild and transferred to the LRWMF. Both pairs were transferred to Mexico for release in February 2022.

Kat Schultz restraining a wolf pup for vaccinations.

Births in 2021

There were no pups born at the Ladder Ranch Wolf Management Facility in 2021.

Deaths in 2021

There were three deaths at the Ladder in 2021. Three 8-week-old pups were killed when a new male was introduced to them. The introduction seemed to be going well until the fourth day. When feeding the facility, the three pups were found at the bottom of the pen with obvious fatal injuries. They were collected and sent off for necropsies. All came back with trauma from crushing from an adult wolf. We believe M1582 was responsible but cannot confirm. The two remaining pups survived overnight in the same pen with both adults.

Releases in 2021

A pack comprising, M1693, F1728 and six pups, was released on the Ladder Ranch in July 2021. M1693 and F1728 were preemptively removed from the Gila National Forest after establishing a territory where livestock conflict could occur. They were taken to the SWMF to whelp pups before release. USFWS and NMDGF decided the best release site was on the Ladder Ranch.

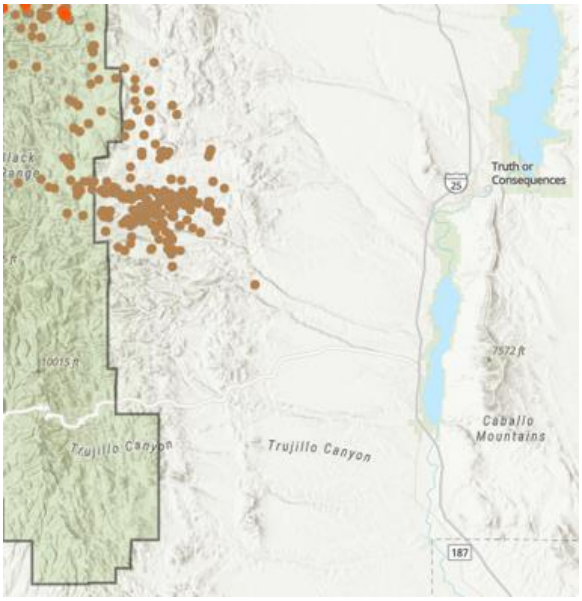
F1728 whelped six pups (4m,2f) on May 1st. In collaboration with USFWS a temporary release pen was constructed in the Seco Creek drainage on the ranch. The pack was ultimately renamed the Seco Creek pack. The pack was transferred to the release site on June 17th when the pups were 6 weeks old. We timed the release with elk calving and to have the pups be young enough to provide an anchor for the adults. The pups received their first round of puppy vaccines during this capture. The door was open the night of July 1st. The pups were the first ones to exit the pen going in and out at their leisure but stayed near the pen. The adults were extremely cautious leaving the pen. M1693 eventually left the pen on July 3rd and did some exploring across the ranch. F1728 left the pen on July 5th. A food cache nearby to help care for the pups while the adults adjusted to life on the Ladder.

All eight wolves were seen for the first time on camera on July 15th. The pack continued to remain on the Ladder with occasional visits to the National Forest through the end of 2021.

Adult wolf and puppy tracks alongside black bear tracks on the Ladder Ranch.

First time Seco Creek pups caught on camera after the release.

Seco Creek pups.



GPS points across the Ladder.

Facilities

New den/ capture boxes were constructed. The new boxes are half the height of the original design. We hope this will make it easier for the wolf handlers during captures.

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, health checks and cross-fostering at the SWMF, conducting breeding observations at the SWMF, wolf transfers to Mexico 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). A total of 72 captive born MGW pups have been placed into the dens of a wild wolf packs that was known to rear young that avoid conflict with humans since 2016 (USFWS, 2015, 2017, 2021).

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 2021, 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).

Table 12a.1 Wolves housed at the Ladder Ranch Wolf Management Facility in 2021

Wolf ID	Sex	Birth Date	LRWMF Arrival Date	LRWMF Pen	Eligible for Release/Translocation?	Transferred from	Notes
M1966	M	5/20/19	12/16/20	3	Yes	SWMF	Transferred from SWMF to make room for new animals. Doing well, easy to care for.
M1968	M	5/20/19	12/16/20	3	Yes	SWMF	Transferred from SWMF to make room for new animals. Doing well, easy to care for.
F1828	F	2019	5/7/21	2	Yes	SCAR	Brought in from SCAR with 5 pups. Takes good care of pups and chases off any threats. Planned for Mexico release in 2021.
mp2642	M	4/12/21	5/7/21	2	Yes	SCAR	One of 5 pups brought in with 1828. One of 2 pups remaining. Planned for Mexico release in 2021.
mp2643	M	4/12/21	5/7/21	2	Yes	SCAR	One of 5 pups brought in with 1828. Was doing well. M1582 was introduced to pack on June 3rd, all seemed ok until feeding on June 7th. Found dead from trauma with two other pups. We believe 1582 was responsible.
fp2644	F	4/12/21	5/7/21	2	Yes	SCAR	One of 5 pups brought in with 1828. Was doing well. M1582 was introduced to pack on June 3rd, all seemed ok until feeding on June 7th. Found dead from trauma with two other pups. We believe 1582 was responsible.
fp2645	F	4/12/21	5/7/21	2	Yes	SCAR	One of 5 pups brought in with 1828. Was doing well. M1582 was introduced to pack on June 3rd, all seemed ok until feeding on June 7th. Found dead from trauma with two other pups. We believe 1582 was responsible.
fp2646	F	4/12/21	5/7/21	2	Yes	SCAR	One of 5 pups brought in with 1828. One of 2 pups remaining. Planned for Mexico release in 2021.
M1582	M	2019	6/3/21	2 then 5	Yes	SCAR	Poker male transferred from the SWMF on June 3. Placed in with Rose pack, 1828 and pups. All seemed fine. Coward towards 1828 and pups. Seen wagging tail towards pups. One June 7th 3 pups found dead due to trauma. We believe 1582 was responsible. 2 pups still alive. 1582 was captured on to remove from pen. However, in the process of capturing him he bit personnel, this was caused by human error. He was later paired back up with F1828 without pups and they are now released in Mexico and traveling together.
F1969	F	5/20/19	11/16/21	4	Yes	SWMF	Arrived with F2046 and F2047. Separated from family pack so no breeding occurred. All doing well. May get paired up for a Mexico release in the future.
F2046	F	5/2020	11/16/21	4	Yes	SWMF	Arrived with F1969 and F2047. Separated from family pack so no breeding occurred. All doing well. May get paired up for a Mexico release in the future.
F2047	F	5/2020	11/16/21	4	Yes	SWMF	Arrived with F1969 and F2046. Separated from family pack so no breeding occurred. All doing well. May get paired up for a Mexico release in the future.
F1841	F	Unknown	11/3/21	3	Yes	SCAR	Removed from SCAR with M2693. Sent to Mexico for release February 1, 2022.
M2693	M	Unknown	11/4/21	3	Yes	SCAR	Removed from SCAR with M2693. Sent to Mexico for release February 1, 2022.

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

Project Biologists

Val Asher

Mike Phillips

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

Location

Goal – To 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.

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.

Activities in 2021

Wolf population

The Beartrap pack produced 3 black pups this year (Fig. 12b.1). Using Montana Fish, Wildlife and Parks criteria where final counts end Dec. 31, 2019, our highest visual count at the end of the year was 14 individuals. There are no working radio collars in the pack and we renewed our permit to trap and collar two wolves in 2022. The Beartrap pack uses the entire ranch and occasionally travel through neighboring properties to the north. One female died of natural causes.

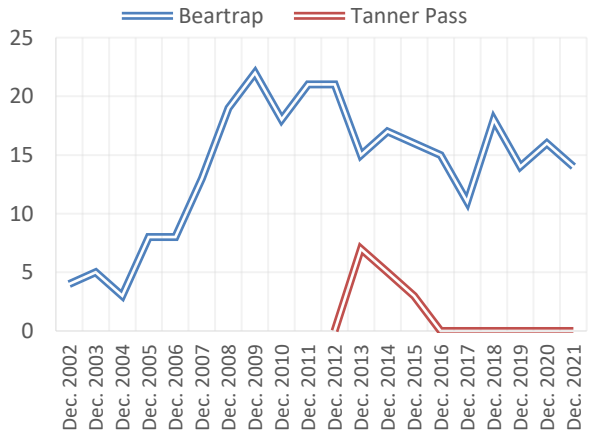


Fig. 12b.1. Minimum number of wolves in the Beartrap and Tanner Pass packs from 2002 to 2021

Food habits

Of the 1,557 carcasses investigated since monitoring began in 2010, 519 were documented as predator kills. 373 were attributed to wolves, with the remainder categorized as coyote (103), 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).

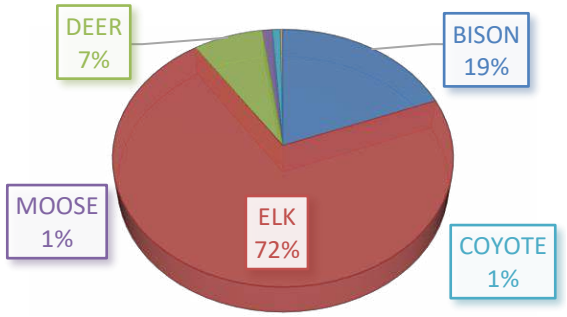


Fig. 12b.2. Percentage of wolf kills by prey species.

Eight years of scat data was analyzed from 2010-2017. Elk was the main food source for wolves, which was consistent with our kill data (Fig. 12b.3). Deer was also an important food source but because of their small size, are much harder to find. Bison hair was visually identified between adult and bison calves less than ~ 4 months of age (i.e., red calves). Red calf hair was detected in only 2% of wolf scats, suggesting that this livestock type is not readily predated by wolves.

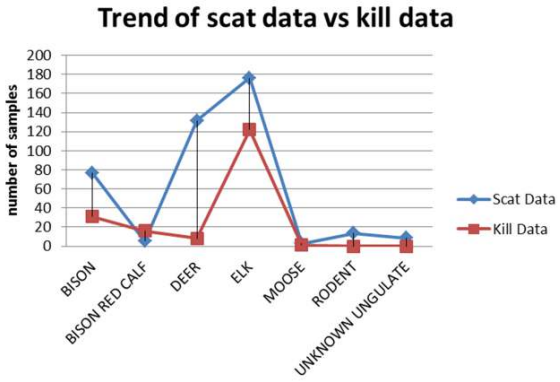


Fig.12b.3. Comparison of wolf scat data to observed verified wolf kills

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 an animal's 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.4).

Marrow was collected from 308 wolf killed ungulates showing 71% in marginal to poor health condition (Fig. 12b.5).

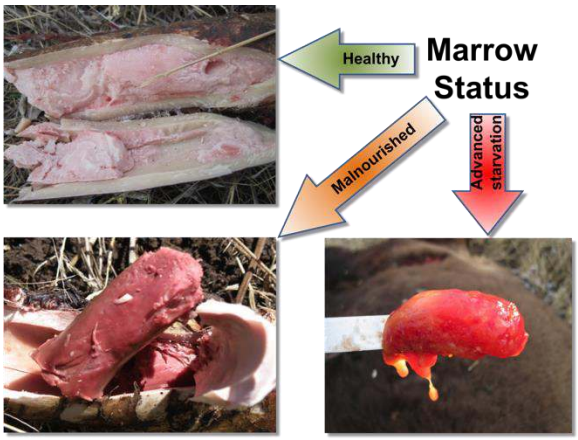


Fig. 12b.4. Femur marrow helps determine the condition of prey species

A second dramatic vulnerability has been disfigured/injured hooves and legs. Of the 426 elk carcasses investigated of varying cause of death, 47 (11%) had visible deformities. Interestingly, 37 (81%) were killed by wolves. 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 (Fig. 12b.6). Once legs have been boiled, we can see in more detail the calcification and arthritis that has developed (Fig.12b.7)

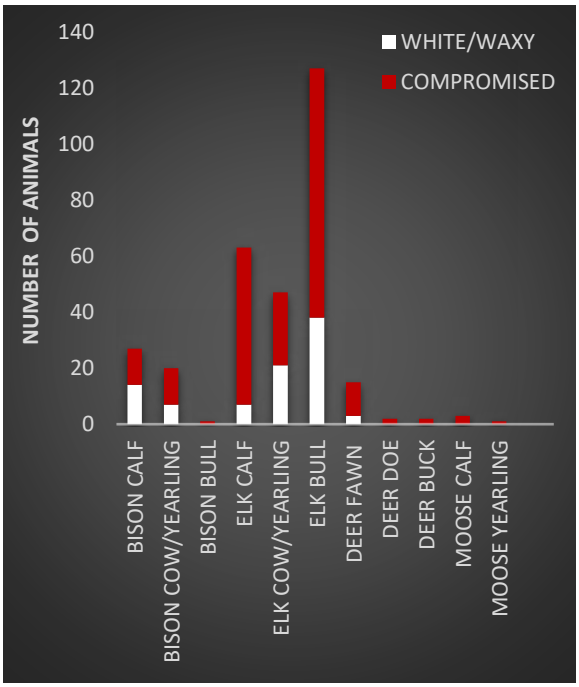


Fig 12b.5. Bone marrow condition of wolf-killed animals

Fig. 12b.6. Examples of elk legs with visible and varying deformities

Fig. 12b.7. Abnormal front left hoof from bull elk and normal front right from the 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 at the end of 2022.

Flying D bull elk have been battling a parasite (*Psoroptes* spp.) causing hair loss (mange) over the last few years. Wolves have taken advantage of this vulnerability both by targeting poor animals or scavenging on elk that succumbed to the disease.

Education

Information dissemination is important as we learn more about wolves on the ranch. In 2021, we conducted 9 tours and talks on the Flying D totaling ~122 since 2010. We share our population estimates with MTFWP and produce monthly and annual reports on wolf activities and food habits. Finally, we partnered with Mountain Journal to produce a well-received short documentary about the wolf project on the Flying D (https://mountainjournal.org/how-ted-turner-gets-along-with-one-of-largest-wild-wolf-packs-on-earth).

Proposed Future Activities and Considerations –Wolf SW039F was fitted with a GPS collar September of 2018. She whelped pups in 2019 (a year when we had two litters of pups on the ranch) and died of natural causes in June of 2021. Of the 5,803 locations received since the collar was deployed, we that learned this female has been off the ranch eight percent of the time (Fig. 12b.8). The majority of these off-ranch events have taken place in the winter months. SW039 also made several visits to the Green Ranch, having to cross the Madison River. We were unable to determine if she swam or crossed on an ice bridge. We will analyze the GPS cluster data to measure success of finding carcasses and to see if there is a correlation between weather events and kill rates. We also intend to place additional GPS collars on wolves to better understand individual and pack movements and the impact of the Beartrap pack on wolf population dynamics in southwestern Montana.

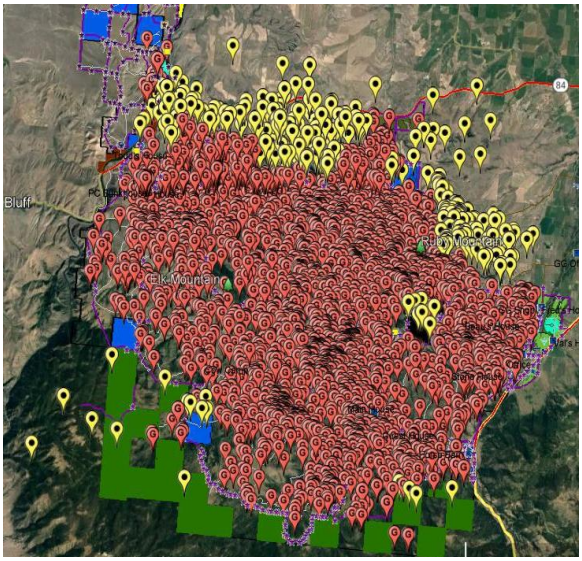


Fig. 12b.8. Red balloons show locations of the collared female (SW039) on the Flying D. Yellow balloons indicate locations off the ranch. (August 2018-June 2021)

Bear Hair Snag study – Eighteen hair snag sites were deployed on the Flying D ranch to collect bear hair for genetic analysis. The goal is to learn how many bears occupy the ranch and determine sex ratios. Hair samples were submitted to the Dr. Jane Huffman Wildlife Genetics Institute in Pennsylvania and results are pending. We will continue this effort in 2022.

Mexican wolf/Livestock council - We continue to hold a seat on the Mexican Wolf/Livestock Council to assist in technical support related to compensation for depredations and proactive measures to avoid wolf livestock conflicts in the southwest.

American Kestrel Partnership – 2021 is our seventh year that nesting boxes have been placed on the ranch. Of the ten boxes deployed we continue to have a >33% average of occupation and fledgling success. This year we partnered up with the Audubon Society and banded 14 chicks.

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)

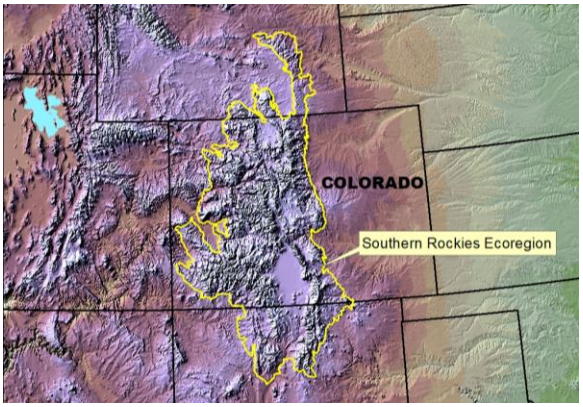
- ***ESA Endangered:*** AL, AR, CA, CO, CT, DE, FL, GA, IA, IN, IL, KS, KY, LA, MA, MD, ME, MI, MO, MS, NC, ND, NE, NH, NJ, NV, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WI, WV. Parts of AZ, NM, OR, UT, WA: (1) North AZ (north of I-40); (2) North NM (north of I-40); (3) West OR (west of Hwy 395, Hwy 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
Living with Wolves
COLORADO WOLF & WILDLIFE CENTER
WILDEARTH GUARDIANS
Western Wildlife Conservancy
Wolves of the Rockies
CENTER for BIOLOGICAL DIVERSITY
Wildlands NETWORK
DEFENDERS OF WILDLIFE
Western Watersheds Project
PROJECT COYOTE FOSTERING COEXISTENCE
SIERRA CLUB COLORADO
CAPTAIN PLANET FOUNDATION

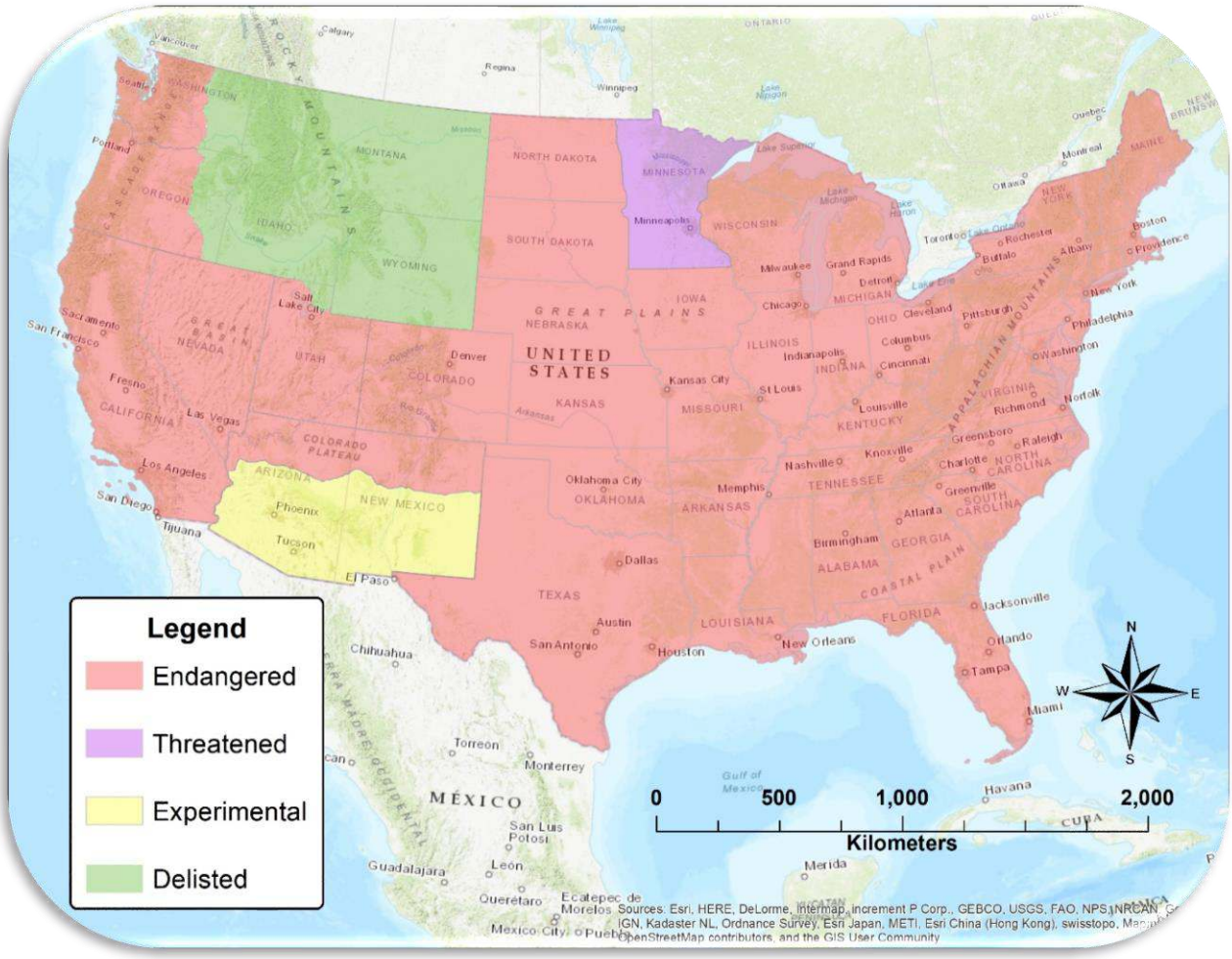
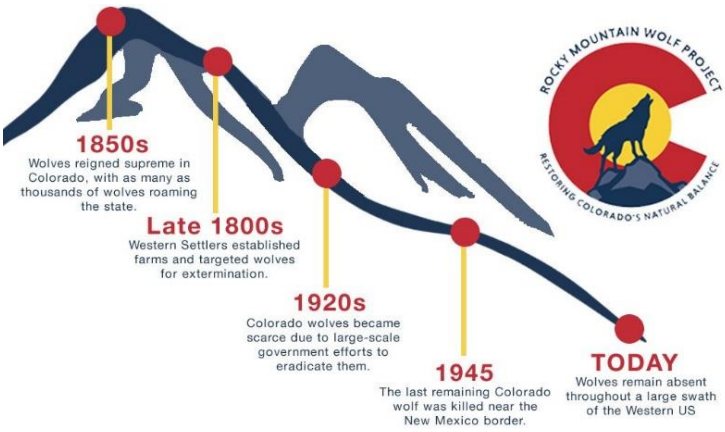


Fig. 12c.1. Listing status of *C. lupus* in the conterminous United States.

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.

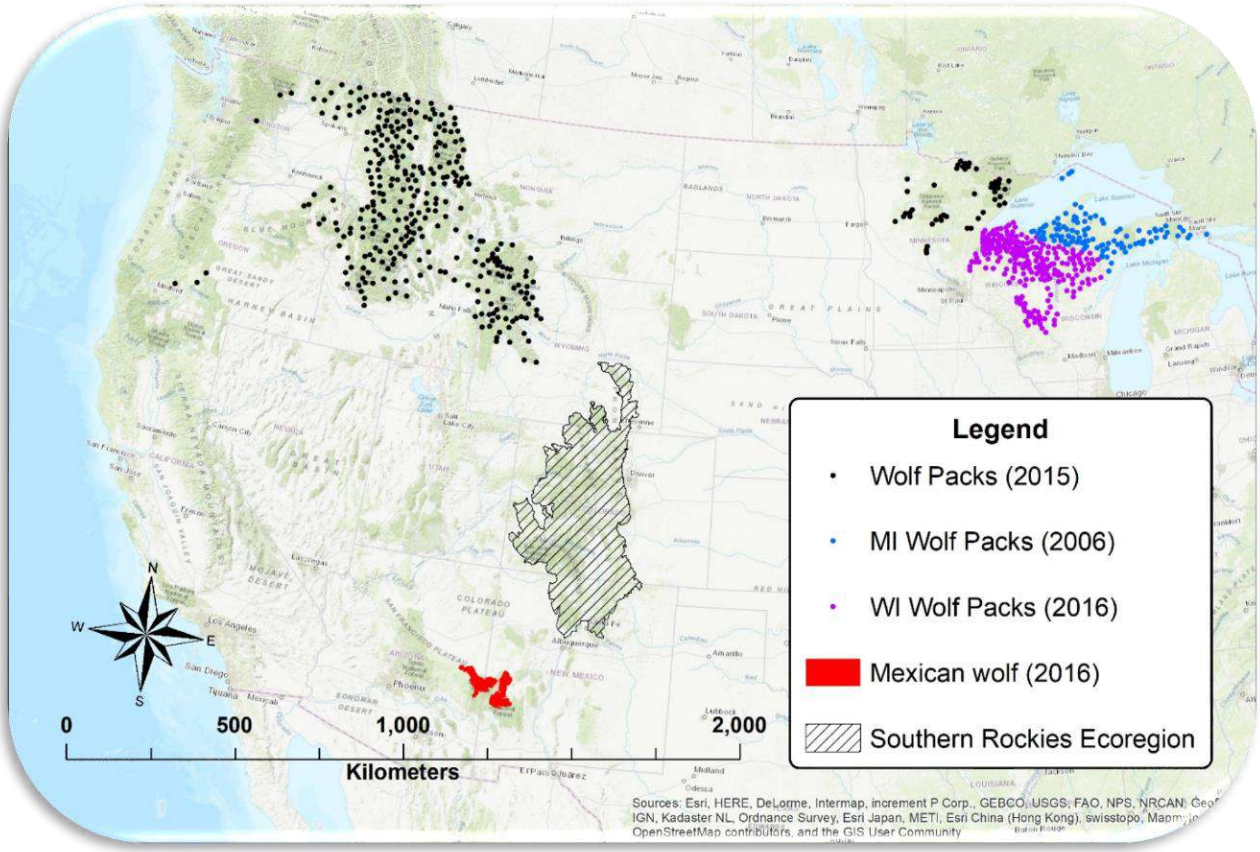


Fig. 12c.2. Distribution of wolf packs, estimated during the period 2006-2016, in the conterminous U.S. relative to the Southern Rockies Ecoregion. Wolf pack locations were obtained from relevant state gray wolf annual reports and georeferenced using ArcGIS 10.0. Michigan (MI) wolf packs represent 2006 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.

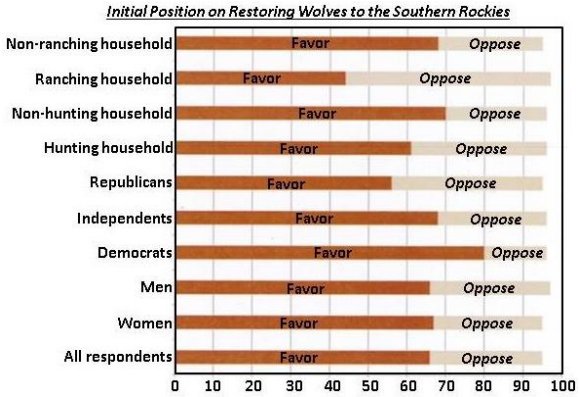


Fig. 12c.3. Results of a 2001 public opinion survey revealed widespread support for restoring wolves to the Southern Rockies. Source: Decision Research, 2001.

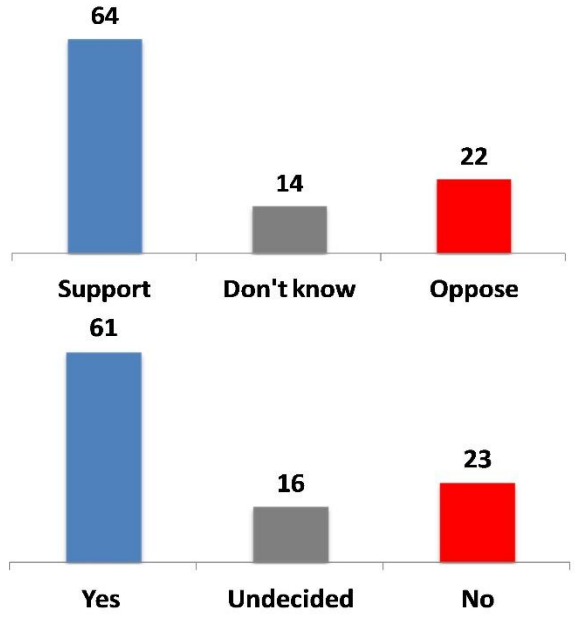


Fig. 12c.4. Results of a 2014 poll measuring support and opposition for reestablishing wolves in western Colorado (top panel), and support (yes) or opposition (no) for a combined wolf restoration ballot measure (bottom panel).

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 2021

The voters of Colorado find and declare that …. wolves shall be restored

Passage of citizen-initiated Proposition 114 in November 2020 marked the first time in history that voters enacted legislation (Colorado Revised Statute 33-2-105.8) to restore an endangered species. The first eight words are as inspiring as they are historic: *"The voters of Colorado find and declare that …."*

Proposition 114 passed by a narrow margin. Of 3,123,329 votes cast, only 1,590,146 (50.9%) supported passage. Nearly as many, 1,533,183 votes (49.1%), opposed the measure.

Such a thin win was unexpected given the longstanding and overwhelming support that Coloradan's had expressed for wolf restoration, as revealed by credible public opinion surveys conducted since the 1980s. A close election was only possible if large numbers of wolf supporters voted no on Prop 114.

Why would they do that?

At least five reasons seem relevant.

1. The COVID-19 pandemic put potential strain on the state's 2021 finances and allowed wolf supporters to conclude the restoration was unaffordable.
2. The arrival of six wolves in northwestern Colorado in early 2020 along with at least one pup during summer which allowed wolf supporters to mistakenly believe that reintroductions were unnecessary for a self-sustaining population to become established.
3. The death of three wolves under suspect circumstances in mid-summer 2020 prompted wolf supporters to conclude that rural Colorado was to hostile to the species for reintroductions to lead to the establishment of a self-sustaining population.
4. During the height of the campaign, opponents to Proposition 114 outspent supporters by 2:1 on advertising which cemented the significance of points 1-3.
5. The fall 2020 announcement by the federal government to remove Endangered Species Act protections for the gray wolf in Colorado allowed wolf supporters to conclude that the species was no longer in need of restoration.

Despite the small margin of victory, support for the proposition was recorded from across the state; > 120,000 yes votes were cast by residents of Colorado's most rural counties. This affirms that support for the wolf extends statewide. With similar support from Governor Polis and other elected and appointed officials, passage of Proposition 114 should lead to reintroductions beginning by December 31, 2023.

If 30 to 60 wolves can be reintroduced over a 12 to 24-month period, then establishment of a self-sustaining population in western Colorado (i.e., $\geq$ 200 wolves) should be a foregone conclusion. Dispersers from such a population remain the most likely animals to reinhabit Turner's Vermejo Park Ranch in southcentral Colorado and north-central New Mexico. With nearly 25 years already invested by TESF in this notion, continuing to support the restoration effort through reintroductions in Colorado is strongly indicated.

Beyond attempting to understand the 2020 election, in 2021 TESF focused on several activities to promote Colorado Parks and Wildlife's compliance with the mandate to begin reintroductions by December 31, 2023 [per C.R.S. 33-2-105.8(2)(d)].

Starting in January and then throughout the year, senior members of the Polis Administration on sought advice from TESF on the myriad biological, social, and political aspects relevant to wolf restoration. It is a high honor for our hard-earned expertise with the ins and outs of wolf restoration and management to be recognized.

Of particular importance to the Polis Administration was collaborating with the U.S. Fish and Wildlife Service to develop an administrative approach for managing wolves

if protections under the federal Endangered Species Act were reinstated. This became a germane issue after the Trump administration finalized the removal of such protections in January 2021.

During the first three months of 2021, TESF's advice was regularly sought by Coloradans interested in seeing state legislators and Governor Polis support wolf restoration through legislative action. When the first regular session of Colorado's 73rd General Assembly concluded in May, legislators and the Governor had done just by:

1. amending C.R.S. 33-2-105.8 to ensure that fees from hunting and fishing licenses are not used for wolf restoration and management, and
2. appropriating nearly $2M for developing the wolf restoration and management plan. Given the nature of the appropriations, it appears as though at least $1.1 M will be available in 2022 and beyond.

The first action was important to hunters and anglers who often feel that they are unfairly burdened with the cost of endangered species restoration effort.

The second action was historic. No other state has ever offered such clear support for wolf restoration.

Throughout the year TESF supported the efforts of the Rocky Mountain Wolf Project (RMWP, www.rockymountainwolfproject.org) to develop capacity to use non-lethal means to resolve conflicts between wolves and livestock. Central to this effort was development of a specialty license plate to raise > $100,000 annually for the work.

The design (Fig. 12c.5.) and aim of the plate was so attractive to Colorado motorists that in a few short weeks around 4,000 individuals had signed an online petition indicating a willingness to purchase the plate once it became available. This was encouraging since a minimum of 3,000 signatures are needed to introduce legislation enabling a specialty license plate. Introduction of legislation was scheduled for early 2022 during the second regular session of Colorado's 73rd General Assembly

Fig. 12c.5. Specialty Colorado license plate developed by the RMWP

In March, TESF secured support from Academy Award nominee Glenn Close to narrate the animated short – *Meet the Real Wolf* – that had been developed by the RMWP. The film was released in early April (https://vimeo.com/255961914) to help folks understand the vital role that wolves play in their ecosystems and reasons for their restoration. The film was also used to cultivate engagement from RMWP's 100,000+ followers and support for the specialty license plate mentioned above.

During May TESF assisted Ted as he offered Governor Polis access to 34,838 acres of Vermejo Park Ranch in Colorado for releasing wolves (Appendix 12c.1). He noted that Vermejo, like his other ranches, is managed as a wild, working landscape that provides good habitat and security for large predators, including the gray wolf. The offer to Governor Polis made clear that Team Turner stood ready to help as practicable with wolf restoration.

In June Mike Phillips was invited (Appendix 12c.2) by Colorado Parks and Wildlife to join a Technical Working Group (TWG) to offer advice to the agency as it develops the conservation objectives, management approaches, and damage prevention/compensation strategies for inclusion in the state's wolf restoration plan. The TWG met regularly during 2021 to this end.

In addition to the TWG, Colorado Parks and Wildlife formed a Stakeholders Advisory Group (SAG). The SAG will provide a range of viewpoints from diverse geographic areas of the state and propose considerations for the plans developed by the TWG. The SAG met regularly during 2021 to this end.

Throughout the first half of 2021, TESF exercised strategic contact with a conservation investor to help give rise to the Center for Human-Carnivore Coexistence at Colorado State University (https://sites.warnercnr.colostate.edu/centerforhumancarnivorecoexistence/about/), which has great potential to advance thoughtful management of wolves and other carnivores.

While there remain many ways for wolf restoration to be delayed or prevented altogether, all the above is cause for celebration and TESF is due much credit for the progress that was achieved. Restoring the endangered gray wolf to the Southern Rockies Ecoregion of western Colorado and northern New Mexico has been a cardinal objective for TESF since 1996. If things go as planned, by about 2030 there should be enough free-ranging wolves in the area to claim that the job is done.

Semper deliberatus …

Appendix 12c.1. Letter from Ted Turner, offering Governor Polis access to 34,838 acres of Vermejo Park Ranch in Colorado for wolf releases

VERMEJO
A TED TURNER RESERVE

May 28, 2021

Honorable Governor Polis
State Capitol Building
200 E. Colfax Avenue, Room 136
Denver, CO 80203

Honorable Governor Polis:

I write to congratulate you and your administration for exemplary action following passage of wolf restoration Proposition 114 in 2020. It is obvious that you respect the will of the voters that wolf restoration proceeds with certainty and stands as an exemplar of good governance. It seems to me that Coloradans cannot expect any more than that from state government.

I understand that Prop 114 mandated that wolf reintroductions begin by December 31, 2023 to designated lands west of the continental divide. Please know, however, that I would welcome the use of the 34,838 acres of my Vermejo Park Ranch in Las Animas and Costilla counties (east of the continental divide) for any re-releases of wolves that might be needed.

Vermejo, like my other ranches, is managed as a wild, working landscape that provides good habitat and security for large predators, including the gray wolf.

Best of luck, Governor, with the historic effort to restore the species to Colorado. Team Turner stands ready to help as practicable.

Thank you for your public service to the great state of Colorado.

Sincerely,

Ted Turner

Copy: Dan Gibbs, Executive Director, Colorado Department of Natural Resources
Dan Prenzlow, Director, Colorado Parks and Wildlife

— 40 MILES WEST HWY 555, RATON, NM 87740 —
TEDTURNERRESERVES.COM

Appendix 12c.2. Colorado Parks and Wildlife press release announcing individuals selected to join Colorado wolf reintroduction Technical Working Group

FOR IMMEDIATE RELEASE

COLORADO
Parks and Wildlife
Department of Natural Resources

Rebecca Ferrell
Branding and Communications Manager
303-291-7764 / 720-595-1449
rebecca.ferrell@state.co.us

CPW announces members selected for Gray Wolf Reintroduction Technical Working Group and Stakeholder Advisory Group

DENVER -- Colorado Parks and Wildlife (CPW) has selected the membership for both the Technical Working Group (TWG) and the Stakeholder Advisory Group (SAG) convened to serve as advisory bodies to the agency as the Commission and CPW staff plan the implementation of Proposition 114.

The combined experience and input of these groups will help guide CPW staff and the Commission in the final direction to restore and manage gray wolves in Colorado no later than December 31, 2023.

"We want to thank all of those that submitted an application or considered an offer to participate in these important advisory groups," said CPW Director Dan Prenzlow. "While this is certainly an opportunity to share perspectives and expertise, it's important to note it is also a significant commitment of time and energy, and we greatly appreciate all those who volunteered their time. We are now eager to get to work with those selected to move forward with us on the implementation process."

The TWG will review and contribute expertise towards the development of conservation objectives, management strategies and damage prevention and compensation planning. The members selected for the TWG are:

- Scott Becker - United States Fish and Wildlife Service - Wyoming Wolf Coordinator
- Alan Bitner - Bureau of Land Management - Deputy State Director - Resources
- Stewart Breck - National Wildlife Research Center - Research Wildlife Biologist
- Roblyn Brown - Oregon Fish and Game - Wildlife Biologist
- Wayne East - Colorado Department of Agriculture - Agricultural/Wildlife Liaison
- Justin Gude - Montana Fish Wildlife and Parks - Research and Technical Services Bureau Chief
- Jonathan Houck - Gunnison County Commissioner
- Mike Jimenez - USFWS retired
- Merrit Linke - Grand County Commissioner
- Steve Lohr - United States Forest Service - Renewable Resources Director Rocky Mountain Region
- Martin Lowney - Animal and Plant Health Inspection Service - State Director
- Carter Niemeyer - USFWS retired

- Eric Odell - Colorado Parks and Wildlife - Species Conservation Biologist
- Mike Phillips - Rocky Mountain Wolf Project
- John Sanderson - Center for Collaborative Conservation - CSU - Director
- Doug Smith National Park Service - Project Leader Yellowstone/Jennifer Carpenter -Associate Regional Director for Resource Stewardship and Science
- Robin Young - Colorado State University Extension Service - Extension Agent

The SAG will provide a range of viewpoints from diverse geographic areas of the state and propose considerations for the plans developed by the TWG. The members selected for the SAG are:

- Matt Barnes (W) - Dolores. Runs range science business and works with the Northern Rockies Conservation Cooperative (human/carnivore coexistence)
- Donald Broom (W) - Craig. Moffat County Commissioner
- Jenny Burbey (W) - Hesperus. President of CO Outfitters Association, Outfitter, livestock producer
- Bob Chastain - Colorado Springs. President/CEO of Cheyenne Mountain Zoo
- Renee Deal (W) - Somerset. Rancher, outfitter, member of agricultural groups
- Adam Gall (W) - Paonia. Wolf biologist for 5 years in Idaho, employed by Nez Perce tribe
- Dan Gates - Canon City. Chair of Coloradans for Responsible Wildlife Management
- John Howard (W) - Grand Junction. Former CPW commissioner
- Francie Jacober (W) - Carbondale. Pitkin County Commissioner
- Lenny Klingesmith (W) - Meeker. Rancher and outfitter, member of agricultural groups
- Darlene Kobobel - Divide. Colorado Wolf & Wildlife Center
- Tom Kourlis - Castle Rock. Rancher and Outfitter, Former Commissioner of Agriculture, member of agricultural groups
- Brian Kurzel - Denver. Rocky Mountain Regional Executive Director for the National Wildlife Federation
- Hallie Mahowald (W) - Salida. Program Director of Western Landowners Alliance
- Jonathan Proctor - Denver. Regional Director for Defenders of Wildlife
- Gary Skiba (W) - Durango. Wildlife Program Manager, San Juan Citizen Alliance

(W) - Denotes Western Slope representation

Department of Natural Resources Executive Director Dan Gibbs, Colorado Parks and Wildlife Director Dan Prenzlow and Colorado Department of Agriculture Commissioner Kate Greenberg will serve as Ex-Officio members.

For additional information on the next steps and phases of planning for the reintroduction of gray wolves, please visit the Stay Informed page on the CPW website, or sign up for CPW's Gray Wolf Reintroduction eNewsletter.

COLORADO
Parks and Wildlife
Department of Natural Resources

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

Partners

Funding/ Research

Research

Funding

Funding/ Management/ Research

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 and goats), overhunting, and habitat changes. Early restoration efforts were hampered by mountain lion predation. With concerted management by New Mexico Department of Game and Fish (NMDGF), including captive breeding, translocation, and mountain lion control, sheep populations recovered sufficiently to down list the species in 2009 and delist by 2011. The project described herein was integral to the delisting process.

Location

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. Mountain lion predation can be detrimental to introduced or recovering bighorn populations. Therefore, from 1995-2014, 50 mountain lions were captured and removed from the Fra Cristobal mountains. This intensive mountain lion management helped the sheep population to grow to a minimum count of 154 individuals in 2010, and 272 by May 2017, including 138 ewes (Table 13.1; population estimate of 300-350 sheep after adjusting for 78% 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 (2021 survey). With successful establishment of the Fra Cristobal sheep population, efforts

shifted from recovery (e.g., introductions, intensive monitoring, and intensive predator control) to management and sport harvest of the population. Since delisting in 2011, around 65 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 were documented to kill multiple sheep. Mountain lions were captured, GPS collared, and prey selection monitored with GPS point cluster analyses. Once a mountain lion was documented to have killed three ewes or five total sheep it was removed. Since that time, 10 of 23 collared lions using the mountains have been removed due to predation on sheep (see Table 13.2). Because of the collar locations, 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 Andres Mountain range. Based on information from the collared sheep, it is estimated that a minimum 15% (but likely higher) of the Fra Cristobal sheep population perished due to disease exposure in 2018; likely the biggest contributor to lower population counts from 2018-2021 (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 New Mexico.

Objectives

We will work cooperatively with the NMDGF to maintain a desert bighorn sheep population in the Fra Cristobal Mountains that exceeds 250 desert bighorn sheep and includes at least 95 adult ewes (*this objective has recently been adjusted downward*). Ideally, 15-20 adult sheep 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 1-4 mature rams annually. Mountain lions observed in the Fra Cristobal Mountains will be managed according to new set of adaptive protocols established in 2021.

Activities in 2021

The Fra Cristobal sheep population is still recovering from the 2017-2018 disease event, as well as subsequent years of extreme drought. Therefore, TBD and NMDGF initiated discussions in 2020 to modify sheep population objectives and mountain lion management protocols in order to promote sheep population growth. A new mountain lion management protocol was adopted in May 2021. The new protocol incorporates knowledge gained from data collected over the last several years of research and monitoring, and uses sheep population thresholds to inform how aggressively lions are managed. Under the new protocol there will be 3 management levels based on the total number of ewes observed during annual helicopter surveys:

- Level 1: *critical* (≤ 60 ewes) – TBD, with support from NMDGF, will capture and remove mountain lions from the Fra Cristobal Mountains as soon as possible following detection. All lions captured will be euthanized regardless of sex. Trapping efforts will focus on the Fra Cristobal Mountains proper, and avoid snaring sites off the mountain range (e.g., Rio Grande riparian corridor) unless specific circumstances dictate otherwise (e.g., kill site off mountain by lion of concern) to

reduce the risk of incidentally removing a non-depredating lion.

- Level 2: *intermediate* (60 - 95 ewes) – TBD, with support from NMDGF, will capture all lions as soon as possible following detection in the Fra Cristobal Mountains; male mountain lions will be euthanized and female mountain lions will be fitted with a GPS collar to monitor movement and prey composition. If a collared female lion is documented to kill 1 ewe or two rams it will be lethally removed as soon as possible.
- Level 3: *objective* (≥ 95 ewes) – TBD will monitor the presence of lions on the Fra Cristobal's but not capture, collar, or remove any lions.

If the ewe population exceeds 95 individuals, TBD will work with NMDGF to translocate bighorn to other mountain ranges to maintain an agreed upon density of approximately 2 bighorn per square kilometer to protect the Fra habitat from overpopulation. The Fra Cristobal population will continue to provide bighorn hunting opportunities for sportsman.

We assisted NMDGF with one helicopter sheep survey in October 2021. A minimum count of 117 sheep were observed during the survey (Table 1; population estimate of 160-180 sheep). We continued disease monitoring in 2021 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. Additional work by NMDGF has further 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 in Arizona to the San Andres mountains on White Sands Missile Range, New Mexico. The *M. ovi* bacteria can be spread between bighorn populations by transient sheep moving between mountain ranges. By the end 2019, it was likely that sheep populations in the San Andres, Fra Cristobal, Caballo, Ladrone, and Sacramento Mountain ranges in New Mexico had all been exposed to *M. ovi* bacteria.

Not unexpectedly, we detected 4-5 new (not previously captured or known) lions using the Fra Cristobal mountains in 2021. We captured five male lions in 2021, four new individuals and one previously collared male ARM14. All five of the male lions were euthanized in accordance with the new lion management protocol implemented in May 2021 (i.e., < 60 ewes surveyed in December 2020). We also captured and released one collared female lion (ARF06). Collared female lion ARF06 denned in the Rio Grande bosque habitat west of the Fras and gave birth to three kittens in October 2021.

From 2014 through 2021, 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 ($n = 22$) are killed by lions more than ewes ($n = 15$). Lion predation on bighorn sheep increases during the lambing season, February through May.

Table 13.1. Fra Cristobal desert bighorn sheep minimum population counts derived from aerial or ground surveys conducted by NMDGF and TEI staff from 2011-2021. 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	53	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[?]
10/2021	117	65	6	18	-	6	5	13	4	28	A[?]

KEY:
CI = Class I Ram (2-4 years old)
CII = Class II Ram (4-6 years old)
CIII = Class III Ram (6-8 years old)
CIV = Class IV Ram (8-16 years old)

Y. Ewe = Yearling Ewe
Unk = Unidentified age/sex
A = Aerial Survey
G = Ground Survey
AG = Combined Aerial and Ground Survey

Table 13.2. The status of mountain lions captured and collared on the Armendaris 2014-2021

Animal ID	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. Last detected by WSMR camera on 12/2020	
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	Dead - removed due to DBS depredation on 3/8/2021. Killed in snare.	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-M17	5/26/2021	Dead - removed for presumed bighorn depredation	
AR-M18	10/16/2021	Dead - removed for presumed bighorn depredation	Lion was not collared. Possibly killed 1 ewe at Summer Spring, 1 CIII ram by Top Catchment.
AR-M19	12/3/2021	Dead - removed for presumed bighorn depredation	Lion was not collared. Removed under management action level 2 of NMRPI-NMDGF MOU
AR-M20	12/9/2021	Dead - removed for presumed bighorn depredation	Lion was not collared. Removed under management action level 2 of NMRPI-NMDGF MOU
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 1/8/2022. 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, recaptured 3/25/2021	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 and collar exchanged in Fras on 12/20/2020, incidentally recaptured and released 3/25/2021	1 ewe
AR-F07	10/29/2019; recaptured 11/17/2019	Presumed alive - incidentally recaptured at powerline on 11/17/2019, collar malfunctioned in May 2021. No longer transmitting data. Last fix on BDA	

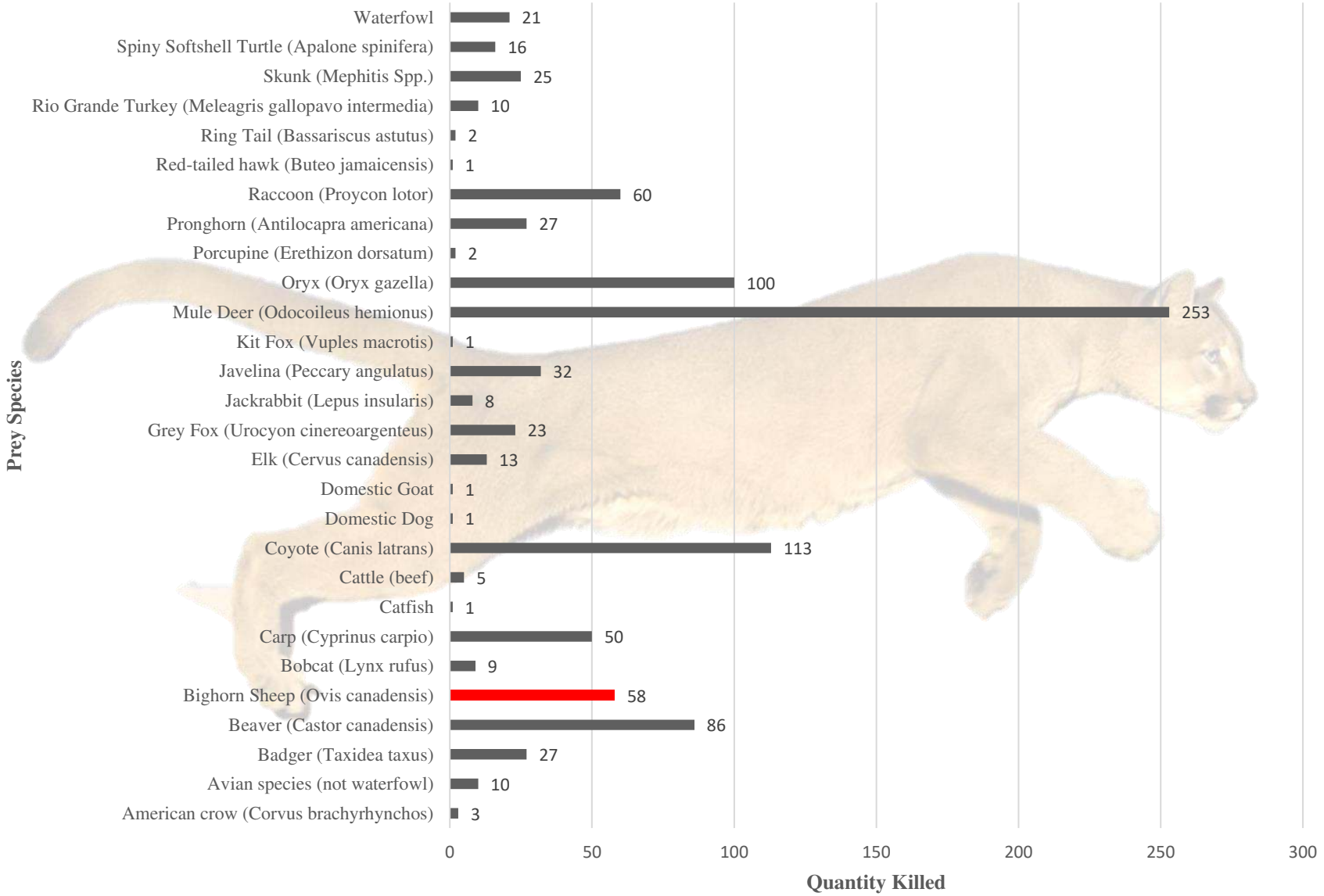


Fig. 13.1. Documented collared mountain lion kills on the Armendaris Ranch and surrounding habitat from 2014 – 2021

14. BLOWOUT PENSTEMON

(***Penstemon haydenii S. Watson***)

U.S. Fish & Wildlife Service

Listing Status under the Endangered Species Act

ENDANGERED

Nebraska Game & Parks

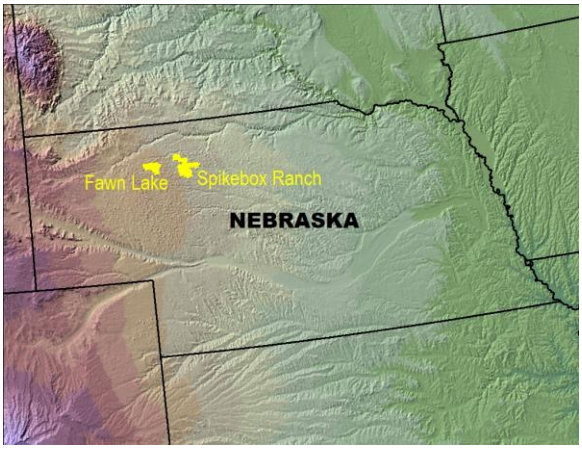
Nebraska State Listing Designation

ENDANGERED

Project Biologists

Carter Kruse

Locations



Project Partners

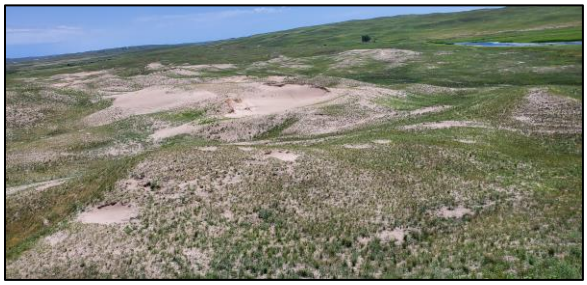
Funding *Funding/Management*

Background – Blowout penstemon is an early colonizer of open sandy soils and was once widespread across the blowing and shifting sand dunes in the Ferris Dunes of Wyoming and the Nebraska Sandhills. However, with managed grazing, fire suppression, and changing climate cycles of more recent times, the blowout habitat critical for this species continues to decline. By 1940 the species was thought to be extinct but was re-discovered in 1968. The most recent surveys in NE (2016) found only 35 native populations of blowout penstemon across the Sandhills, although other populations are likely present but unknown. Numerous penstemon reintroduction projects have taken place across the Sandhills with some success, but acreages and associated management dedicated to such projects are rarely large enough or intense enough to support sustainable populations for the long term. In fact, during the 2000's Dr. James Stubbendieck from the University of Nebraska-Lincoln planted blowout penstemon at several locations on Turner Ranches. Unfortunately, many of the planting locations are currently unknown, preventing follow-up monitoring. Although public lands projects are generally more successful, there remains an inherent lack of suitable penstemon habitat (e.g., active blowouts) 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. In 2017 TBD began a project at Spikebox Ranch to

reestablish blowout penstemon in a 250-acre pasture ("East Hunt") designated for intensive bison grazing. In 2018 and 2019 the project partners distributed approximately five pounds of penstemon seed in the pasture, and in 2019 and 2020 planted several hundred greenhouse grown seedlings. Also, in 2020 Fawn Lake Ranch fenced and initiated intensive bison grazing on a 300-acre "Hayden" Pasture to promote blowout habitat. Either of these projects, if successful would constitute the largest blowout penstemon reintroduction project ever.

Goal – To work with state and federal partners to implement blowout penstemon reintroduction on Turner Ranches and achieve naturally reproducing and self-sustaining populations that contribute to the recovery and potential downlisting/delisting of the species, and to serve as an example for other private landowners interested in conservation and restoration of the species.

Objective – TBD and our project partners will utilize focused bison grazing on Sandhills prairie pastures to create >600 acres of habitat (i.e., sand dune blowout and migration) for penstemon reintroduction across at least two restoration sites. Once the desired habitat is developed at least 10 pounds of seed will be dispersed throughout the site. 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 2021

Timely and intensive bison grazing of the Spikebox East Hunt Pasture continued throughout 2021 (Figs. 14.1 & 14.2) and began in earnest at Fawn Lake's Hayden Pasture. Annual vegetation monitoring took place in June at the East Hunt and approximately 60 flowering and 40 seedling penstemon plants were observed (Fig. 14.3 3). It appeared that most of these plants came from sowed seed rather than seedling plantings. John Halstead, the manager at Fawn Lake Ranch discovered a new wild population of blowout penstemon at the ranch. Efforts are underway to determine if this population was planted (see reference to Dr. Stubbendieck above) or is a heretofore undiscovered natural population. An additional five pounds of seed was distributed in the East Hunt Pasture in February of 2022.

Fig. 14.1. East Hunt Pasture at Spikebox Ranch in June of 2021 during vegetation surveys

Fig. 14.2. East Hunt Pasture at Spikebox Ranch in February of 2022

Fig. 14.3. Restored and flowering blowout penstemon plant observed in East Hunt Pasture at Spikebox Ranch, June 2021, during annual monitoring

15. ELITE ATHLETES INITIATIVE

During the second half of 2021, TESF helped develop the basics of an initiative of the Professional Athletes Foundation of the NFL Players Association. The initiative is centered on post-career development of professional athletes as well as emerging intercollegiate and younger aspiring elite athletes. The virtual disappearance of such development over the past 25 years has left most players without the inspiration, support, and process needed to take full advantage of their abilities and opportunities in retirement.

TESF was initially contacted about this effort by Jim Grossman in late 2020 after he listened to a wolf restoration podcast that Mike Phillips did with Tim Ferris in fall 2019.

Follow-up conversations with Mr. Grossman made it clear that TESF's mission and accomplishments could resonate well with elite athletes.

This resonance would be anchored to two features:

- Ted's life which would attract elite athletes given their tendency to gravitate to powerful role models to inform purpose and passion. Athletes would consider Ted just such a role model because of his success as a sailor, entrepreneur, newsman, activist, and owner of a major league baseball team.
- TESF's work as a spark for the curiosity and imagination needed to fuel the transformational changes faced by elite athletes when their playing days are over.

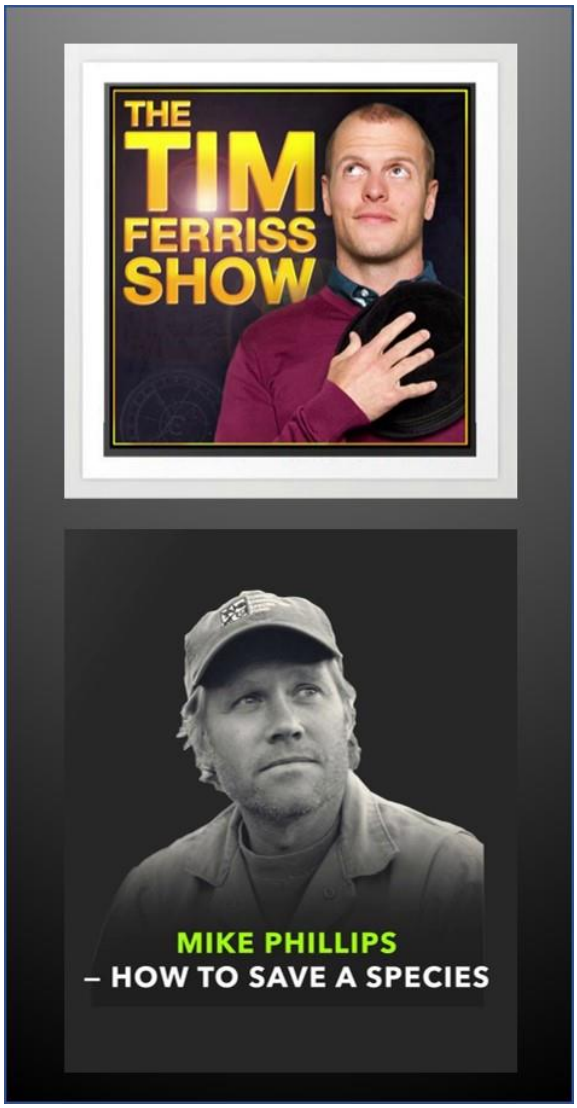
Beyond Jim Grossman, this nascent initiative has generated interest from other potentially important collaborators, including:

- Andre Collins (retired NFL, Executive Director, The Professional Athletes Foundation)
- Kellen Winslow (retired, NFL Hall of Fame)
- Dr. Cliff Schorer (Columbia University, Continuing Education)

In addition to TESF's compelling conservation stories, Turner lands could be inspiring settings for prompting engagement. From Avalon and Nonami in the southeast, to the Flying D, Vermejo, and Ladder in the west, immersive experiences on Turner properties could be inspirational.

At its core the Elite Athletes Initiative is simple: share TESF stories and Turner properties with elite athletes in an intimate manner to catalyze their engagement on pressing environmental issues, including the extinction crisis, climate change, and regenerative agriculture.

Succeeding at this would align well with Ted's, and more generally Team Turner's, determination to inspire others to use their good fortune to make the world a better place.



TESF Executive Director, Mike Phillips, featured on Episode #383 "How to Save a Species" of the Tim Ferris Show podcast (broadcast on August 21, 2019)

ALDO LEOPOLD MEMORIAL AWARD

Mike Phillips, discussing restoration ecology with E. O. Wilson, was named as the 2021 recipient of The Wildlife Society's Aldo Leopold Memorial Award

Given Mike's deep connection to TESF over the last 24 years, the award is yet another example that the organization operates at the highest level of fish and wildlife conservation with a differential focus on restoration of imperiled species.

The Aldo Leopold Memorial Award is the highest honor bestowed by The Wildlife Society and recognizes distinguished service to wildlife conservation. The basic selection criterion is the significance of an individual's contribution(s) to the wildlife field. Recipients receive a medal, plaque, and honorary membership in The Wildlife Society.

Following Aldo Leopold's death in April 1948, there was much sentiment within The Wildlife Society for establishing an award medal in his memory. The first medal, sculpted by Gifford MacGregor Proctor, was awarded to J.N. Darling at the Society's 1950 meeting in San Francisco.

Models were finished that year and dies were cast early in 1951. After the 1951 meeting, one medal was presented privately to Aldo Leopold's wife, Estella, as a token of friendship and respect. An engraved medal was sent (a year late) to J.N. Darling, and a second annual presentation was made to Carl D. Shoemaker.

PUBLICATIONS/PRESENTATIONS

Hossack, B. R., P. E. Howell, A. K. Owens, **C. Cobos,** C. S. Goldberg, D. Hall, S. Hedwell, S. K. MacVean, **M. McCaffery**, A. H. McCall, C. D. Mosley, E. B. Oja, J. C. Rorabaugh, B. H. Sigafus, M. J. Sredl. *In Prep*. Identifying factors linked with persistence of reintroduced populations: lessons learned from 25 years of amphibian translocations. Global Ecology and Conservation.

Hinderer, R. K.; A. R. Litt, and **M. McCaffery**. (2021). Habitat selection by a threatened desert amphibian. Ecology and Evolution. 11(1): 536-546.

Prude, C. H. & Cain, J. W. (2021). Habitat diversity influences puma Puma concolor diet in the Chihuahuan Desert. https://doi.org/10.2981/wlb.00875

Rohde, M. L., Geluso, K., **Kruse, C.** and Harner, M. J. (2021). Use of Soapweed Yucca (Yucca glauca) by rodents and other vertebrates in western Nebraska. Transactions of the Nebraska Academy of Sciences 41, 61–70

Rohde, M.L, A.J. Forrester, M.J. Harner, **C.G. Kruse**, and K. Geluso. (2021). Natural History Notes: Lithobates pipiens (Northern Leopard Frog) egg predation. Herptetological Review. 52,117-118.

Shepard, B. B., Clancey, P., Nelson, M. L., **Kruse, C. G.**, Al-Chokhachy, R., Drinan, D., ... & Zale, A. V. (2021). Evaluation of Remote Site Incubators to Incubate Wild-and Hatchery-Origin Westslope Cutthroat Trout Embryos. North American Journal of Fisheries Management.

Phillips, M. & Edwards, E. (2021). The Gray Wolf's Return to Colorado. International Wolf. 31:(1) 16-18.

Phillips, M. K. June 2021.Genesis and status of the Turner Endangered Species Fund and wolf recovery in the Southern Rockies. New Mexico Farm and Livestock Bureau Annual Meeting, Taos, New Mexico (invited talk).

Phillips, M. K. 2021.Carnivore conservation in the United States: current state of affairs. Invited lecturer, National Caucus of Environmental Legislators, Virtual Briefing Meeting, July 1, 2021.

PUBLIC OUTREACH

The aim of our outreach in 2021 was to recruit individuals and landowners to the cause of arresting the extinction crisis through placement of strategic messages in respected publications (e.g., *The Tortoise*) and social media platforms (e.g., Facebook, Twitter, Instagram), and utilization of 116,000 email addresses for individuals interested in conserving imperiled species. The addresses were donated by the Rocky Mountain Wolf Action Fund in recognition of our foundational work to restore wolves to Colorado. The donation is valued at > $500,000.

Selected Email Marketing in 2021

TURNER ENDANGERED SPECIES FUND

Our Pack Needs YOU!

Will you help us keep growing our team?

The mission of the Turner Endangered Species Fund is clear: we want to #SaveEverything—and we're committed to using private lands to ensure the persistence of imperiled species and their habitats.

But we need the help of people like you to do it. You've shared our goals before—especially as we worked to tell the real story of the gray wolf in Colorado—and we need your help now to continue to grow our pack to protect other animals across North America.

Will you help us by asking three friends to join our conservation team? It's quick and easy—just click here and a draft email will open in your email application. Or, you can use the sample email below:

Hi Friend,
I'm excited to tell you about an organization called the Turner Endangered Species Fund. They're working to conserve biodiversity across North America, from animals like the black-footed ferret to the bolson tortoise to the gray wolf.

Will you join me in helping in the fight to #SaveEverything by signing up to receive conservation team updates? Just click here to add your name to their growing list of wildlife advocates around the world >> https://act.tesf.org/conservation-team

Thank you for stepping up and speaking out for our imperiled species and habitats.

Together, we can continue to fight for the animals and habitats that need us. But we need people like you to help spread the word so our pack can be stronger than ever.

Will you help us? Here are three ways you can help with one click each:

Send an Email
Share on Facebook
Share on Twitter

Thank you for all you're doing to protect our lands.

-Team TESF

TURNER ENDANGERED SPECIES FUND

You are receiving this email because you have indicated that you were interested in receiving communication from the Rocky Mountain Wolf Action Fund, a group with aligned interests to ours. If you do not want to continue to receive emails, you can opt out by completing here.

Together, we brought wolves home to the Colorado Rockies. Now, let's continue to build on this work for the next generation.

Let's get to work.

Last year, Coloradans made history together by passing the first-ever citizen-led initiative to restore an endangered species to its natural habitat. While wolf activists made tremendous progress in Colorado for the gray wolf, there are countless animals across the country—and across the world—who need our help, too.

The Turner Endangered Species Fund **is committed to conserving biodiversity and protecting imperiled species and their habitats. But we can't do it without the help of people like you.**

If you're ready to roll up your sleeves and get to work to protect animals like the gray wolf, the bolson tortoise, or the black-footed ferret, we need you to take action right now by using the icons below to like, follow, and share us on social media. If not, that's okay—just click here to unsubscribe from our emails.

FOLLOW US ON SOCIAL MEDIA:

We're excited to work with you to protect our animals and their natural habitats. Please stay in touch with us on social media—including our brand new Twitter account @TurnerFund so we can continue building on the good work we did in Colorado last year.

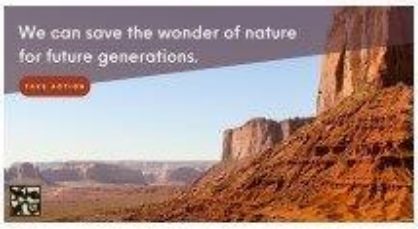
Sincerely,
The Turner Endangered Species Team

You are receiving this email because you have indicated that you were interested in receiving communication from the Rocky Mountain Wolf Action Fund, a group with aligned interests to ours. If you do not want to continue to receive emails, you can opt out by completing here.

TURNER ENDANGERED SPECIES FUND

Our team to #SaveEverything is almost 100k strong!

Will you help us hit this goal by inviting your friends to join us?



We're working hard to grow our conservation team and reach our goal to #SaveEverything, but we need the support of people like you to get there. Will you help us spread our message and grow our team by asking your friends to join us, too? Just use the link below to take action and send our sign-up form to your friends, family, and neighbors:

Take Action Now

We're confident the continued support of conservation-focused people like you will make all the difference as we work to preserve and protect our imperiled species and their habitats. Together, we can save the wonder of nature for future generations—but we must act now. Time is of the essence. Will you help us by sharing our sign-up link on Facebook to ask your friends to join?

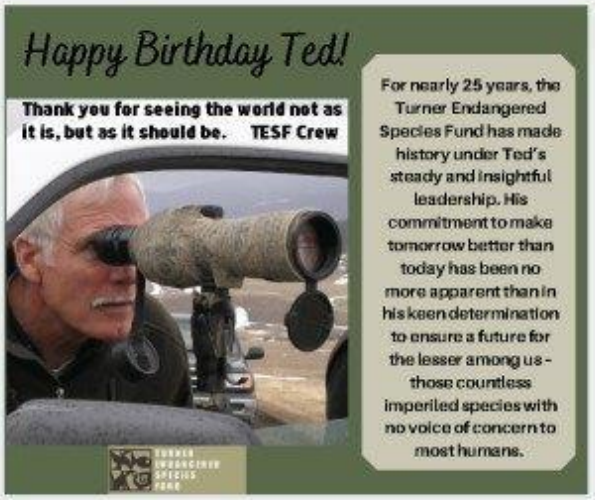
The sum of each of our small efforts will no doubt culminate in changes that will last generations. We can't do it with out you. Join us now.

Thank you,
Your friends at the Turner Endangered Species Fund

DONATE NOW

TURNER ENDANGERED SPECIES FUND

Today is a great day to join our conservation team in celebration of Ted's 83rd birthday. He is a leader worth following.



Turner Endangered Species Fund and Turner Biodiversity Divisions

January 21, 2021 2:29 PM(UTC-07:00)

The critically endangered Bolson tortoise is the largest North American land reptile. Its closest living relative is the gopher tortoise of the southeastern US, while the desert tortoises of the desert southwest are more distant cousins. Bolson tortoises occupied much of the Chihuahuan Desert during the Pleistocene, before humans greatly reduced their numbers and range. Today, only about 2,500 bolson tortoises still exist in the wild. They live in the "Bolson de Mapimi" region of north-central Mexico where the provinces of Chihuahua, Durango, and Coahila meet. The Turner Endangered Species Fund spearheads a unique bolson tortoise breeding program on two of Ted Turner's southern New Mexico ranches that lie in prehistoric bolson tortoise range at the northern edge of the Chihuahuan desert. The female bolson tortoise shown here is one of 24 semi-captive adult tortoises that live in large outdoor enclosures encompassing ranch grassland. She weighs about 12 kg (26 lbs) and her shell measures ~390 mm (16.2 in). We don't know for sure how old she is, but we know that she is at least 60. Bolson tortoises live in underground burrows (some of which were started for them by humans, but all of which were further excavated and lengthened by the tortoises themselves and many now measure more than 20 m in length) and forage on native vegetation consisting mostly of grasses. Robust reproductive output by the tortoises has resulted in over 600 new bolson tortoises to date. (Watch this space for pictures of bolson tortoise hatchlings in the future). We hope to allow these tortoises to contribute to establishing new wild bolson tortoise populations on protected lands in the near future. #bolsontortoise #savingspecies

Turner Endangered Species Fund and Turner Biodiversity Divisions

March 1, 2021 3:05 PM(UTC-07:00)

Big news from Team TESF: We're now on Twitter! Head over and hit "follow" to stay up to date as we grow and work together to #SaveEverything

Turner Endangered Species Fund and Turner Biodiversity Divisions

March 2, 2021 11:11 AM(UTC-07:00)

Our goal at the Turner Endangered Species Fund is simple: Conserving biodiversity by ensuring the persistence of imperiled species and their habitats with an emphasis on private land. In short, we want to #saveeverything

Turner Endangered Species Fund and Turner Biodiversity Divisions

March 10, 2021 10:20 AM(UTC-07:00)

We need a new generation of young scientists and policy makers to improve the balance between conservation and commerce. #SaveEverything

Turner Endangered Species Fund and Turner Biodiversity Divisions

March 23, 2021 11:30 AM(UTC-06:00)

Spring has sprung, and the butterflies will soon be emerging from their cocoons! What's your favorite kind of butterfly?

Turner Endangered Species Fund and Turner Biodiversity Divisions

March 24, 2021 7:00 PM(UTC-06:00)

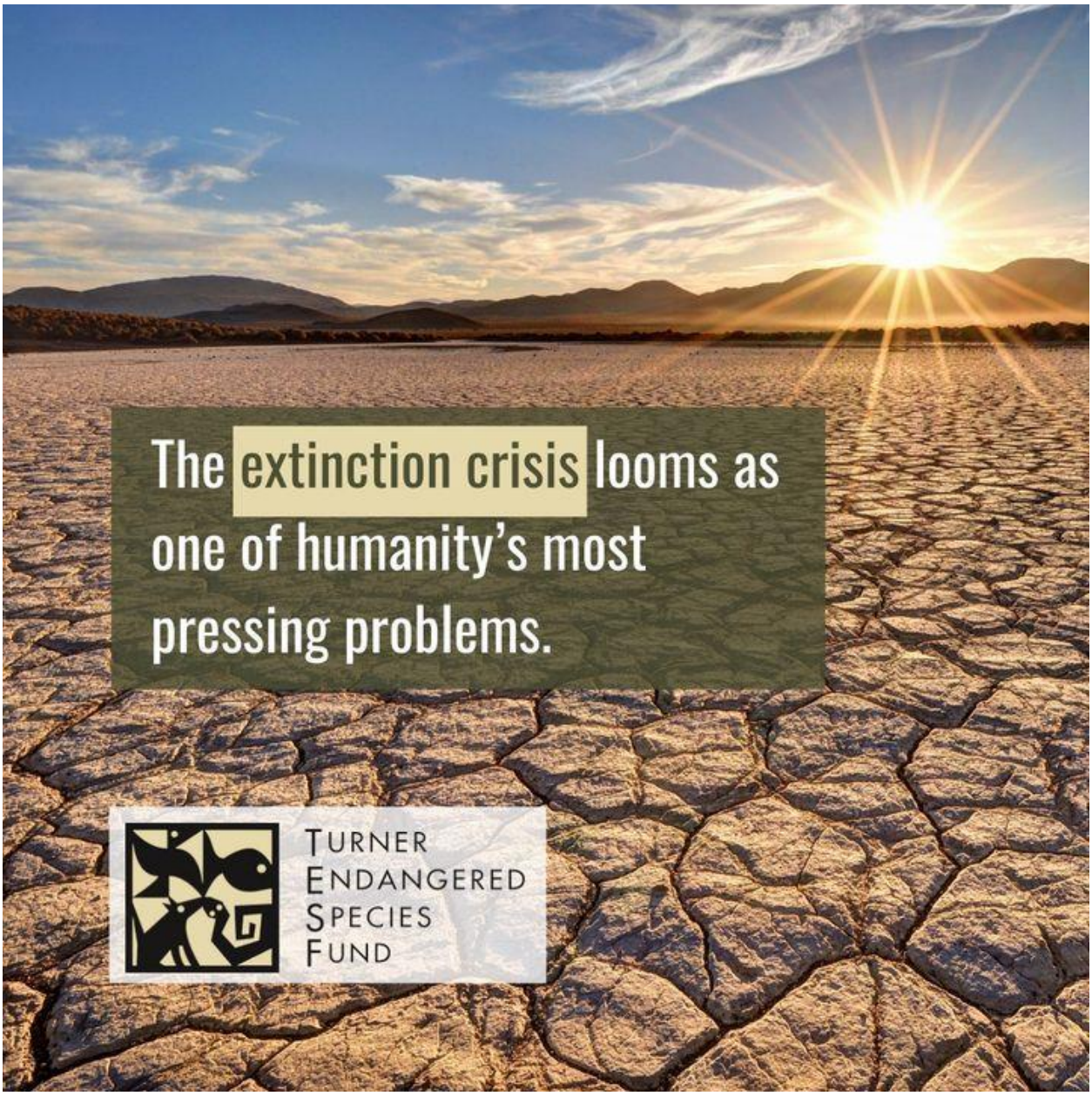
There is a huge difference between wolves that appear in fairy tales and the real animals — do you know the story of the real wolf?

https://mountainjournal.org/how-ted-turner-gets-along-with-one-of-largest-wild-wolf-packs-on-earth

Turner Endangered Species Fund and Turner Biodiversity Divisions

March 28, 2021 9:00 AM(UTC-06:00)

We can work together to #saveeverything and prevent more species from going extinct.



Turner Endangered Species Fund and Turner Biodiversity Divisions

April 22, 2021 12:06 PM(UTC-06:00)

Since 1970, people around the world have come together to celebrate the wonder of our planet and call for greater environmental protections for species under threat. At TESF, we work to protect biodiversity every day, including by conserving and restoring native milkweed and other wildflower communities to benefit threatened monarch butterflies and other native pollinators. Our work ranges from single species conservation to restoration of species assemblages.

Turner Endangered Species Fund and Turner Biodiversity Divisions

June 2, 2021 11:15 AM(UTC-06:00)

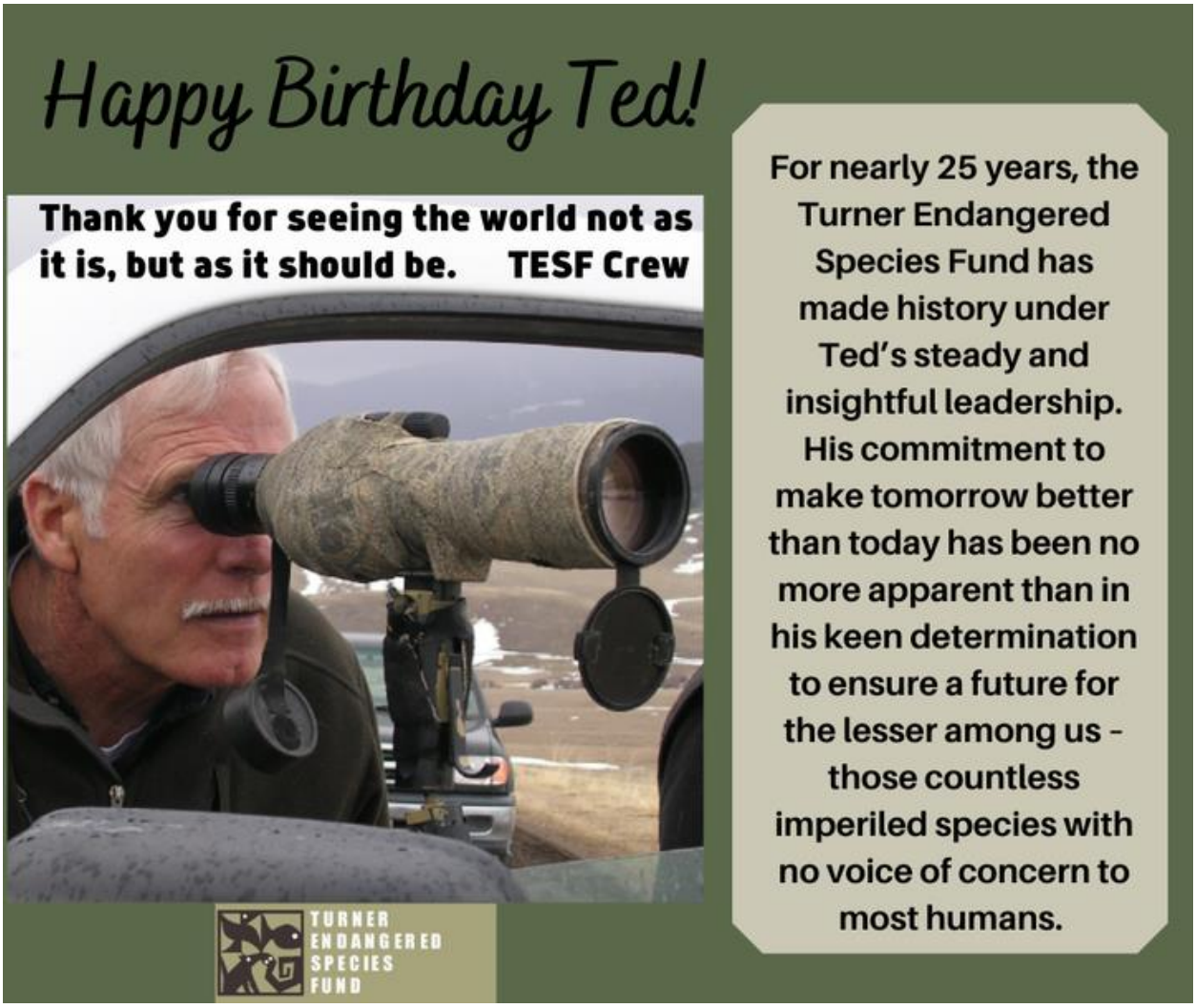
We're proud to help tell the story of the real #wolf, which has been missing from its native lands. In #Colorado, voters chose to bring back the #missinghowl. Learn about the work in CO by downloading a copy of the article in International Wolf magazine.

International Wolf Magazine Article Download: https://act.tesf.org/international-wolf-magazine-article

Turner Endangered Species Fund and Turner Biodiversity Divisions

November 19, 2021 11:52 AM(UTC-07:00)

Today is a great day to join our conservation team in celebration of Ted's 83rd birthday. He is a leader worth following.



Selected Website Pages from 2021

NEWSROOM

Gertie, the Bolson tortoise weighs 26 pounds and is at least 60 years old.

The critically endangered Bolson tortoise is the largest North American land reptile. Its closest living relative is the gopher tortoise of the southeastern US, while the desert tortoises of the desert southwest are more distant cousins. Bolson tortoises occupied much...

True Wild: The Real Story Of Wolves On Ted Turner's Montana Ranch. By Mountain Journal.

All. Recently, we collaborated with Mountain Journal, an important outlet for journalism about the Greater Yellowstone Ecosystem (www.mountainjournal.org), to develop a short film entitled True Wild. True to its name, the film celebrates the majesty of the Flying D...

All of nature matters.

Someday the COVID-19 pandemic will be history. When it faces from daily consideration, imperiled species restoration will continue to stand as evidence of our ability to repair the natural world. Such reparations buoy faith in our ability to heal an...

NEWSROOM

Mike Phillips offers his thoughts on the Colorado wolf reintroduction project, his work throughout the years, and the state of wolves and our natural world as it stands today.

https://thewolfconnection.buzzsprout.com/1081496/8055209-episode-32-mike-phillips-colorado-wolf-reintroduction

A mountain lion prowls for prey in the snowy Fra Cristobal Mountains on the Armendaris Ranch in New Mexico.

A hybrid tortoise is basking in front of one of the several burrows we started for them at the Ladder Ranch.

Ladder Tortugarium: A sanctuary for hybrid tortoises In 2019, volunteers and staff from several Turner entities (Turner Endangered Species Fund (TESF), Ted Turner Reserves (TTR), and the Ladder Ranch) teamed up to build two ~1 acre tortoise holding pens at Ladder...

NEWSROOM

The Bolson tortoise is home again.

Recently, the Turner Endangered Species Fund and partners including the Turtle Conservancy made restoration history by releasing captive-born Bolson Tortoises in the Chihuahuan Desert grasslands of New Mexico. The species has not been free-ranging in the United States...

History is being made on Ted Turner's Ladder Ranch.

The US Fish and Wildlife Service, with support from New Mexico Department of Game and Fish, has decided to release a family of Mexican wolves on the Ladder Ranch in New Mexico. This is historic since Mexican wolves have never been released on private land in the...

Graduate student Julia Joos, collaborates with TESF biologists Chris Wiese and Scott Hillard for a portion of her PhD work that involves bolson tortoises in New Mexico.

Ohio University Department of Ecology and Evolutionary Biology graduate student Julia Joos studies the thermal ecology of North American tortoises to gain a better understanding of how tortoises cope with hotter and drier environments caused by climate change. By...

NEWSROOM

Here are three short videos of the family of Mexican wolves scheduled for release on the Ladder Ranch.

The adults and five pups (three females and two males) are doing fine at the Sevilleta National Wildlife Refuge. They are scheduled to be moved to the Ladder on June 17 and released on July 1 marking the first time that Mexican wolves have been released on private...

Mother Mexican wolf with wolf pups. The pups are scheduled for release on the Ladder Ranch.

Mexican wolf father 693M with wolf pups.

NEWSROOM

Fieldwork indicates that everything is going as planned with the historic release of the Mexican wolves at the Ladder Ranch.

Wolves have visited the supplemental food caches that we established along with tubs of water with recent rains providing additional water. Both adults are out of the pen and restricting movements to the immediate area and at least two of the six pups have been...

Mike Phillips named as the 2021 recipient of The Wildlife Society's Aldo Leopold Memorial Award.

The Aldo Leopold Memorial Award is the highest honor bestowed by The Wildlife Society. Given Mike's deep connection to TESF over the last 24 years, the award is yet another example that the organization operates at the highest level of fish and wildlife...

History has been made !!!

For the first time ever, Mexican wolves have been released on private land in the U.S., Ted Turner's Ladder Ranch, to advance recovery of the species. The ranch offers an abundance of secure and high quality habitat and easy access to the vast public wildlands of the...

NEWSROOM

In This Wolf Man, There Are Enduring Echoes of Aldo.

Journalist Todd Wilkinson interviews Mike Phillips on the honor of receiving the Aldo Leopold Memorial Award and his career in conservation for The Mountain Journal....

Regal fritillaries enjoying a meal of swamp milkweed nectar on a Sandhills wet meadow.

This butterfly is considered a sensitive species in Nebraska. The Turner organization is working to conserve and restore wetland and wet meadow habitats to benefit this and other species with prescribed fire, short duration grazing, and filling in drainage ditches...

TESF has helped rescue and relocate over 500 gopher tortoises from sandhill habitats under development in central Florida.

In collaboration with our dedicated partners – Saving Florida's Gopher Tortoises and @Nokuse – we've helped rescue and relocate over 500 gopher tortoises from sandhill habitats under development in central Florida to secure Turner lands in northern Florida. These...

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NEWSROOM

A restored blowout penstemon plant in Nebraska.

This endangered plant was restored on a Turner ranch by intentionally over grazing a small pasture in the Sandhills to promote blowouts in the sand dunes. Penstemon seed was then spread into the blowouts. The species is naturally an early colonizer of blowout habitat,...

A coyote carries its catch of the day on the Armendaris Ranch in southern New Mexico.

Catfish and carp often become trapped in shallow drying pools along the Rio Grande due to fluctuating water levels caused by drought and climate change. The trapped fish are easy prey for many native predators including mountain lions, black bear, skunk, bobcat, fox,...

The wolf pups are well!

Six Mexican wolf pups still alive and well on the Ladder Ranch near the release site.

NEWSROOM

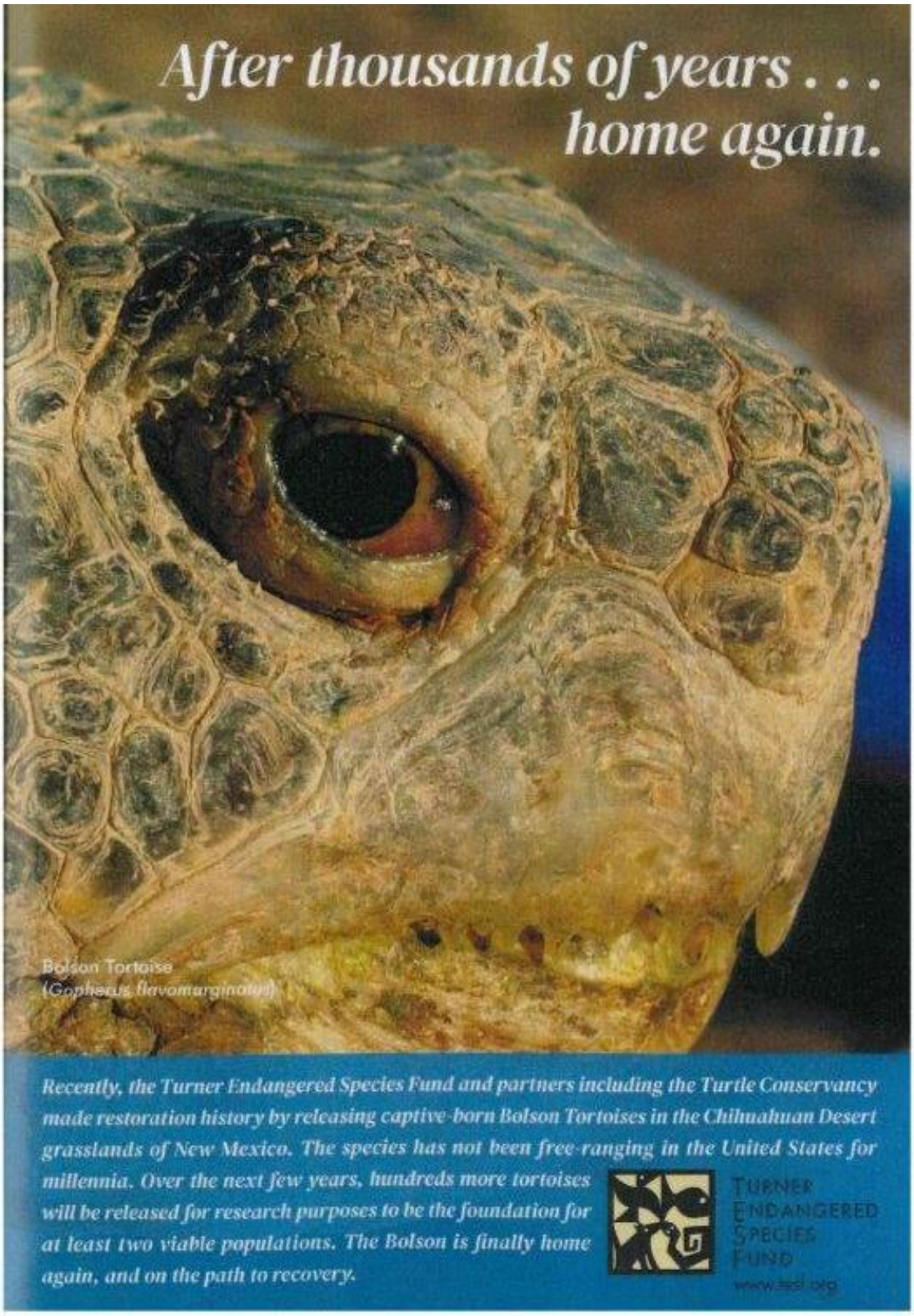
During a wildlife aerial survey on the Flying D ranch, we spotted this young wolf on 1-19-22. Since we are confident the Beartrap pack has not had gray colored pups since 2019 (and the 3 true grays in the pack have different pelage) we believe this to be a new wolf. Whether it is just passing through or incorporates itself into the pack remains to be seen.

News from The Wildlife Society's 2021 virtual conference and the acceptance of the 2021 Aldo Leopold Memorial Award by Mike Phillips. For Mike's interview go to time stamp 25:28 through 34:38.

Ted Turner launches the Turner Institute of Ecoagriculture.

The Turner Endangered Species Fund is proud to be aligned with such forward thinking efforts. Please see link to the article written by Todd Wilkinson for the Land Report.
https://landreport.com/2021/09/ted-turner-launches-the-turner-institute-of-ecoagriculture/

2021 Advertisements



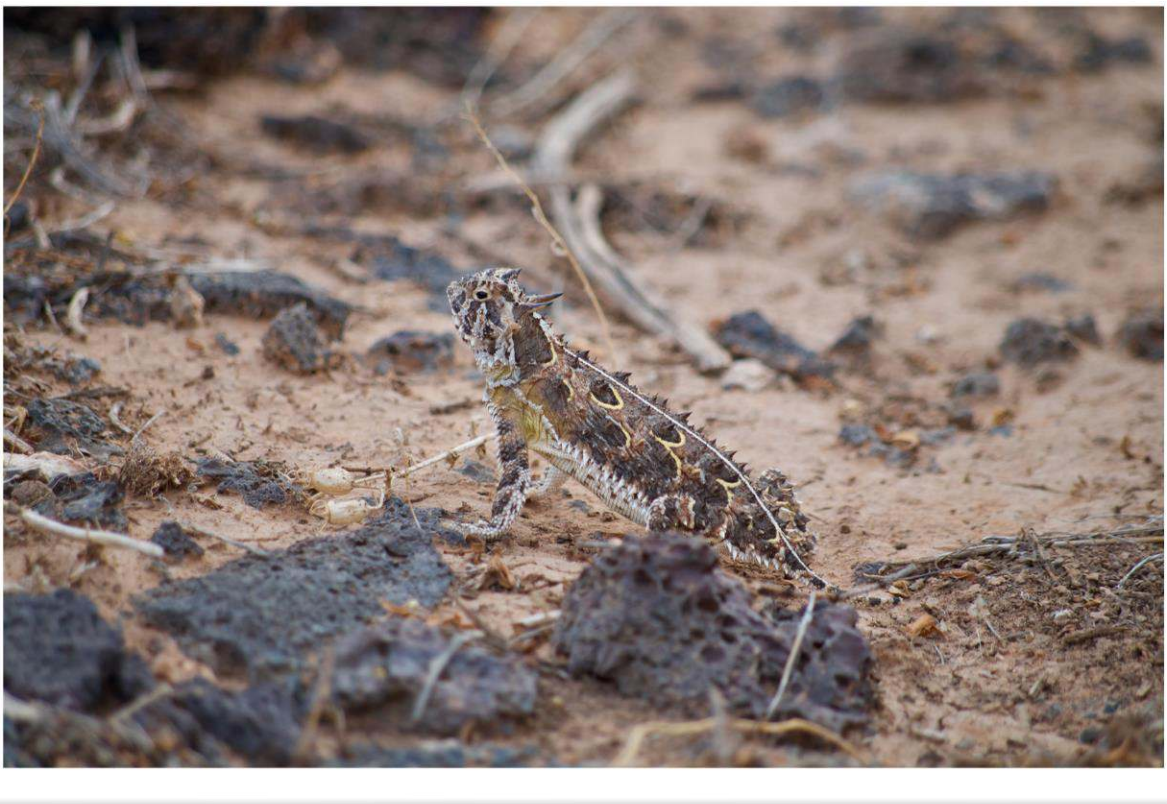
2021 outreach included reference to the historic release of bolson tortoises

We deliver an important message about restoring imperiled species as a hedge against zoonotic diseases like COVID-19 in the January 2021 issue of *The Tortoise*

FIELD GALLERY

Cherry Creek on the Flying D (Credit: Magnus McCaffery)

A monarch butterfly larvae on swamp milkweed that was planted at Avalon's Lake Iamonia in 2021 (Credit: Magnus McCaffery)



Texas horned lizard on the Armendaris Ranch (Credit: Magnus McCaffery)

Gunnison's prairie dog surveying it's domain in Vermejo's high country (Credit: Magnus McCaffery)

Flying D elk
(Credit: Eric Leinonen)

Spadefoot toad on the Ladder Ranch (Credit: Magnus McCaffery)

Fawn Lake Ranch
(Credit: Eric Leinonen)

Spikebox Ranch
(Credit: Eric Leinonen)

A tree frog perched on a door knob at Ladder HQ
(Credit: Magnus McCaffery

An older black wolf on a carcass at the Flying D
(Credit: Val Asher)

Beaver activity on the restored upper Vermejo River
(Credit: Magnus McCaffery)

Z Bar bison
(Credit: Eric Leinonen)

Northern leopard frog on Spikebox Ranch
(Credit: Eric Leinonen)

A red-cockaded woodpecker at the Avalon Plantation
(Credit: Magnus McCaffery)

ACRONYMS & ABBREVIATIONS

ABB = American Burying Beetle
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
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
LPC = Lesser Prairie-Chicken
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
SAG = Stakeholders Advisory Group
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.
TESF = Turner Endangered Species Fund
TIE = Turner Institute of EcoAgriculture
TNC = The Nature Conservancy
TTR = Ted Turner Reserves
TU = Trout Unlimited
LWG = Technical Working Group
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

Magnus McCaffery

Castle Rock at Vermejo Park Ranch was the site of the last known wild black-footed ferret in New Mexico (prior to our restoration work). It was once home to a large colony of Gunnison's prairie dogs. Plague has decimated this prairie dog population over the past few years.