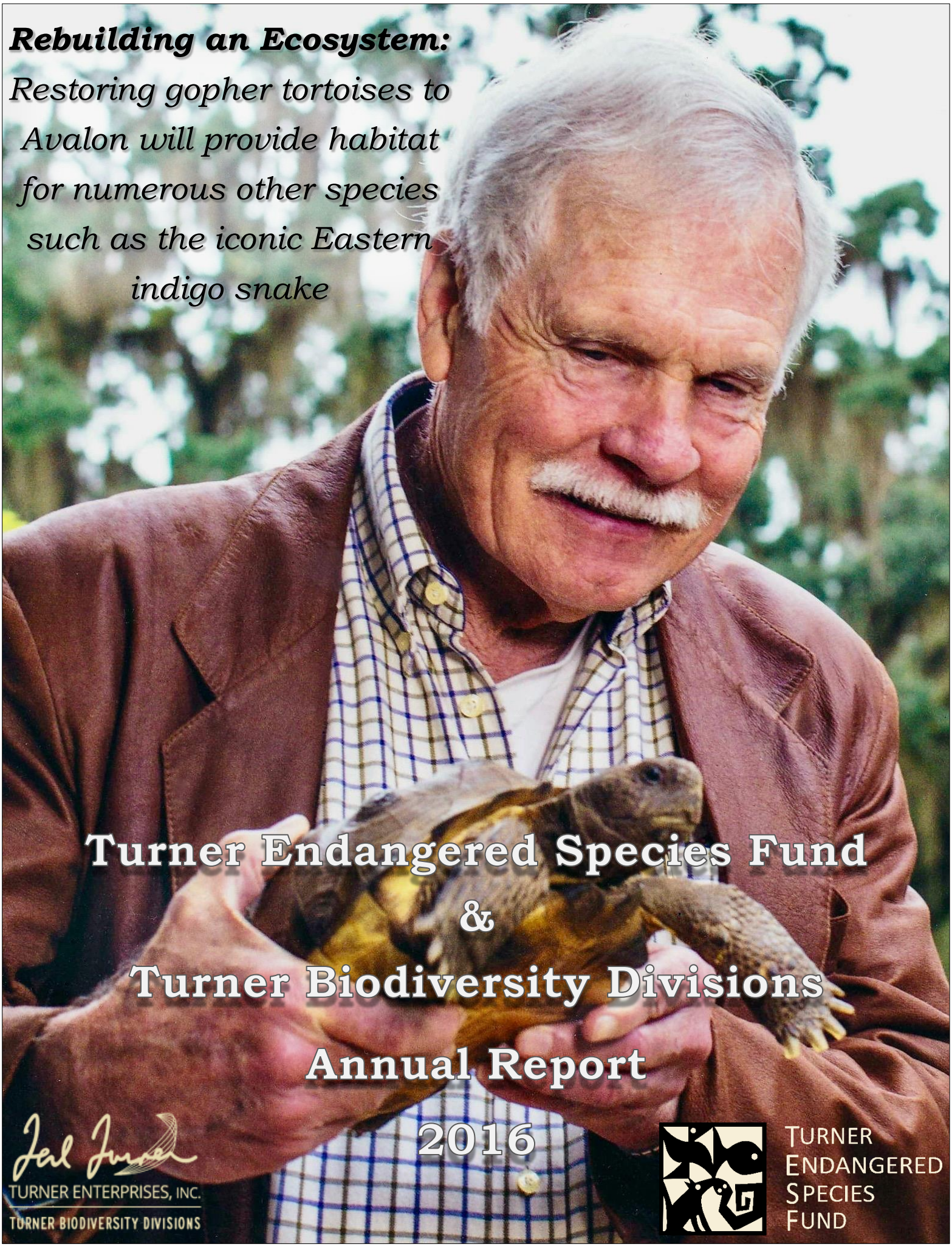
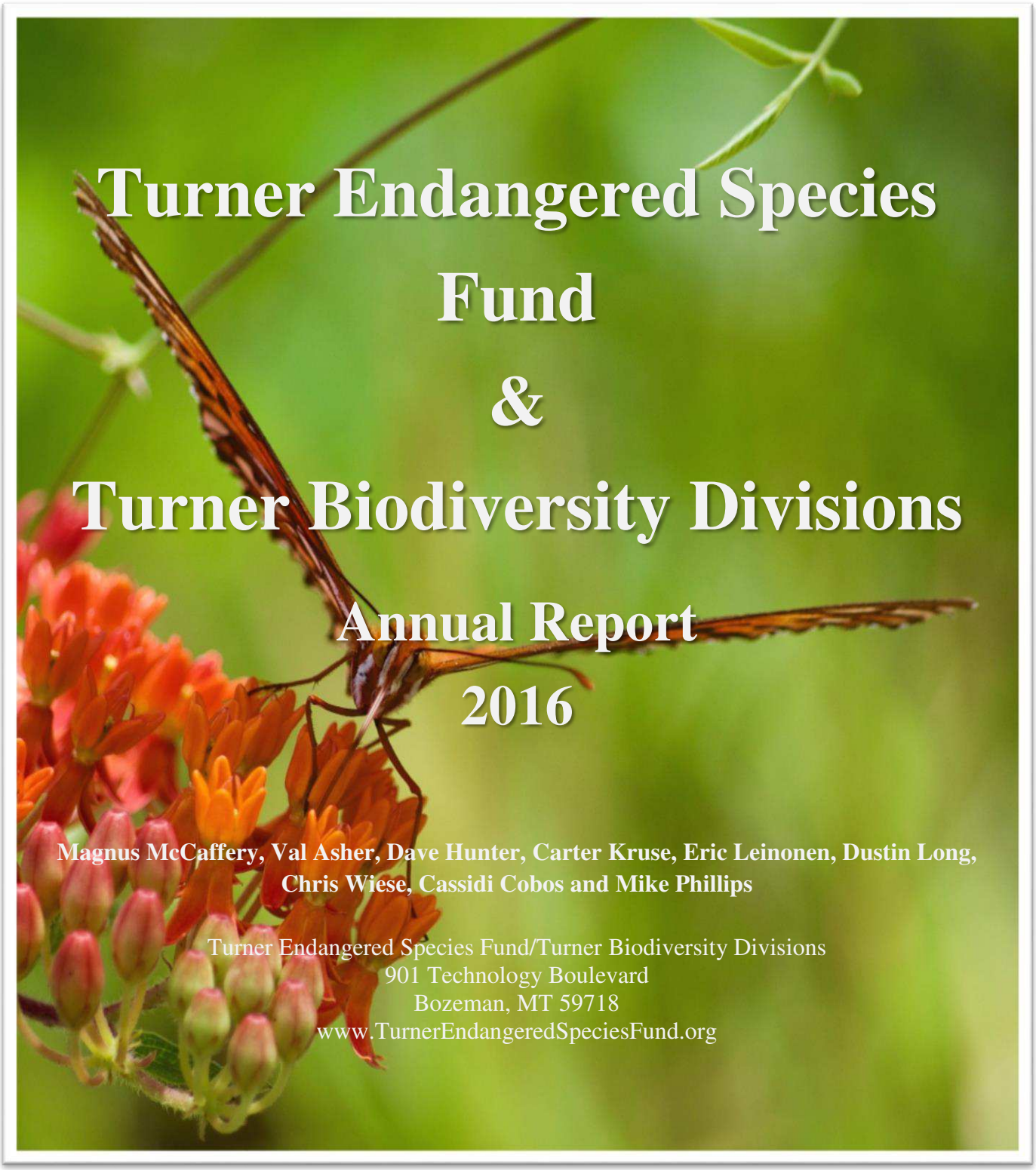


Rebuilding an Ecosystem:
Restoring gopher tortoises to Avalon will provide habitat for numerous other species such as the iconic Eastern indigo snake

Turner Endangered Species Fund
&
Turner Biodiversity Divisions
Annual Report
2016

TURNER ENTERPRISES, INC.
TURNER BIODIVERSITY DIVISIONS

TURNER ENDANGERED SPECIES FUND



Turner Endangered Species Fund & Turner Biodiversity Divisions

Annual Report 2016

Magnus McCaffery, Val Asher, Dave Hunter, Carter Kruse, Eric Leinonen, Dustin Long, Chris Wiese, Cassidi Cobos and Mike Phillips

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Bozeman, MT 59718
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Lake Iamonia on the Avalon Plantation

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All photos not otherwise marked are TESF/TBD photos.

Cover photo: *Ted Turner holding a gopher tortoise on the Avalon Plantation. [Photo courtesy of The Tortoise magazine, issue 5]*

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TURNER ENDANGERED SPECIES FUND/TURNER BIODIVERSITY DIVISIONS

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 (background picture) 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., 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.

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 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 several successful restoration projects for imperiled plants, birds, fishes, mammals, an amphibian, and an invertebrate. The projects have been of sufficient scope to 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?

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**.**

TEAM TURNER

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 adult members of the Turner family are acutely aware of and keenly supportive of the work of the Turner Endangered Species Fund and Turner Biodiversity Divisions.

BEAU TURNER: Beau is **Chairman of the Board of Trustees for TESF**; **Vice Chairman of TEI** – He oversees wildlife projects, is a Trustee for the Turner Foundation, Inc., and serves on the boards of the Jane Smith Turner Foundation and the Captain Planet Foundation. He is passionate about getting youngsters outdoors and excited about nature. To achieve this, he founded the Beau Turner Youth Conservation Center in Florida.

MIKE PHILLIPS: Executive Director, TESF; Coordinator, TBD. ***mike.phillips@retranches.com*** – Mike co-founded TESF and TBD with Ted Turner in 1997. He received a M.Sc. in Wildlife Ecology from the University of Alaska in 1986. Mike's career focuses on imperiled species, integrating private land and conservation, ecological economics, and socio-political aspects of natural resource use. He was elected to the Montana legislature in 2006 where he will serve through at least 2016.

CARTER KRUSE: Director of Natural Resources, TEI; Senior Aquatics Biologist, TBD. ***carter.kruse@retranches.com*** – Carter joined TBD in 2000. He has a Ph.D. in Zoology from the University of Wyoming. Carter developed the TBD Native Cutthroat Trout Conservation Initiative and administers a variety of projects that include water rights issues, native species conservation, and species management.

DAVE HUNTER: Wildlife Veterinarian, TESF, TEI. ***dave.hunter@retranches.com*** – Dave has served as TEI/TESF veterinarian since1998. He has a Doctor of Veterinary Medicine from Washington State University, and is Adjunct Professor at Texas A&M University and Associate Professor at several other universities.

DUSTIN LONG: Senior Biologist, TESF. ***dustin.long@retranches.com*** – Dustin joined TESF in 1998, and leads the black-footed ferret, black-tailed and Gunnison's prairie dog, Chupadera springsnail, lesper prairie chicken and bat projects. Dustin has a M.Sc. in Life Science from New Mexico Highlands University. He lives in Bozeman, MT but spends much of his time at Turner properties in the west and south.

MAGNUS McCAFFERY: Senior Biologist, TESF. ***magnus.mccaffery@retranches.com*** – Magnus joined TESF in 2010. He is lead biologist on the Chiricahua leopard frog and gopher tortoise projects. 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.

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

CHRIS WIESE: Senior Biologist, TESF. ***chris.wiese@retranches.com*** – Chris joined TESF in 2012. She oversees the bolson tortoise and Mexican gray wolf projects on the Ladder and Armendaris ranches in New Mexico. Chris received her PhD in Cell Biology from the Johns Hopkins Medical School in 1996.

ERIC LEINONEN: Senior Biological Technician, TBD. ***eric.leinonen@retranches.com*** – Eric joined TBD in 2011 as a seasonal member of the Native Cutthroat Trout Conservation Initiative. In 2015 he became a full time employee, where he continues to work with cutthroat trout, and provides support to the Chiricahua leopard frog and gopher tortoise projects. Eric received a B.A. in Environmental Science, as well as a second B.A. in Geography from The University of Montana.

CASSIDI COBOS: Field Biologist, TESF. ***cassidi.cobos@tedturner.com*** – Cassidi joined TESF in 2014, and serves as a field biologist on the Chiricahua leopard frog project. She received a B.A. in Wildlife Science from New Mexico State University.

BARB KILLOREN: Office Administrator, TESF. ***barb.killoren@retranches.com*** – Barb joined TESF as office administrator in 2001. She manages office operations and provides support to the Executive Director, project managers and field personnel. Barb provides a warm, supportive work environment for all TESF/TBD members. Barb has a B.S. from the University of Wisconsin, Eau Claire.

CHENEY GARDNER: Media and Outreach Coordinator, TESF. ***cheney.gardner@tedturner.com*** – Cheney joined TESF in 2016 as the media and outreach coordinator for an education project to advance wolf recovery to Colorado. She attended UNC-Chapel Hill, where she was received a degree in journalism after being awarded the prestigious Morehead-Cain scholarship, which provided her the opportunity to travel to and write about wild places. As the coordinator for the Colorado wolf outreach and education project, she is responsible for engaging the media, managing the project's digital presence and serving as the Colorado liaison. When she's not in the office, she can usually be found in the mountains, fly fishing, trail running and biking.

2016 REPORT TO THE TURNER FOUNDATION

As required by Turner Foundation grant #201600165 I submit this report of activities for the Turner Endangered Species Fund for 2016.

I. Achievement of Goals

What was accomplished in connection with your projects?

We implemented field activities that improved conditions for at least 11 imperiled species across eight properties owned by R.E. Turner and hundreds of thousands of acres of adjacent public and private land in Florida, Georgia, South Dakota, Kansas, Montana, and New Mexico.

How do you define and measure success of your projects?

We define success as an improvement in the security (physical, demographic, genetic) of the population(s) of the imperiled species of interest. Our ultimate measure of success is restoration of populations that persist with minimal human intervention. We measure success by collecting data that define various metrics that reveal the viability (or lack of) of a population. Such data result from counts of individuals and determination of relevant population parameters including production of offspring and mortality, and determination of the areal extent of occupied habitat.

How will you monitor the long-term results of your projects?

During 2016, we monitored results (both long-term and short-term) by employing five biologists, two seasonal technicians, and one contractor to conduct fieldwork to ensure the progress of our restoration projects. We will determine the long-term results of our project through chronic monitoring which has been a fixed feature of TESF's restoration strategy since its inception.

How are you disseminating the results of your projects with the general public, managers, and the scientific community?

We disseminate our results through print media, broadcast media, peer-reviewed publications, participation at professional meetings, and monthly activity reports that we routinely provided to our Board of Trustees, personnel from Turner Enterprises, and cooperators (e.g., state and federal fish and wildlife agencies, non-governmental conservation organizations).

II. Evaluation

During 2016, we solicited the involvement of experts to review our work and participate in our projects. Our collaborations with the U.S. Fish and Wildlife Service, state game agencies (e.g., Florida Fish and Wildlife Conservation Commission, Montana Department of Fish, Wildlife, and Parks, New Mexico Department of Game and Fish, South Dakota Game, Fish, and Parks), and non-governmental conservation organizations (e.g., Turtle Conservancy) ensured routine evaluation of our field projects.

III. Expenditure of Grant Funds

Our fundraising goal for 2016 of $1,281,480 was fully met. Funds were used to cover staff costs and fieldwork (Table 1). Actual expenses for field projects were managed to retain TESF's $25,000 emergency fund, which was established in 2003, while leaving $44,268 of dedicated funds for expenses in 2016.

Table 1. Use of TESF funds in 2016

Category	Expected Expenses	Actual Expenses
Staff	$571,525	$576,703
Field projects	$675,211	$635,509

Grant #201600165 from the Turner Foundation was essential for leveraging $126,703 of support from Turner Enterprises and $436,782 from non-Turner entities including federal and state agencies, non-governmental conservation organizations, and private citizens.

IV. Input to Turner Foundation

2016 reinforced the lesson that restoration ecology can be a complex endeavor that requires an adaptive approach to develop reliable field techniques for improving the conservation status of imperiled species. 2016 also reinforced the potential for TESF to be differentially involved in contentious endangered species recovery efforts that are differentially reliant on private land (e.g., Chupadera springsnail project). Continued long-term support from the Turner Foundation will be needed to ensure the Fund's continued success at contributing to the recovery of select threatened and endangered species and illustrating the importance of private land for arresting the extinction crisis.

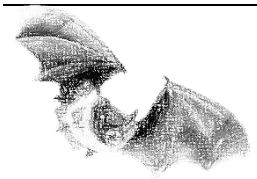
Administrative Summary for 2016

- **Staff:** 5 Biologists, 2 part-time technicians, one contractor
- **Turner Foundation Grant:** $535,000
- **Turner Enterprises' Support:** $126,703 (for worker's compensation insurance, health insurance, retirement, 2.45% of payroll taxes)
- **TESF Emergency Fund:** $25,000
- **TESF Carryover from 2015:** $117,195
- **Non-Turner Sources:** $436,782 (Notably, in 2016 we raised $285,000 from non-Turner sources to support our projects from 2017 thru 2021.)
- **No. of Projects:** 17 projects that targeted 11 imperiled species
- **Area of Work:** eight Turner properties and hundreds of thousands of acres of adjacent public and private land in Florida, Georgia, South Dakota, Kansas, Montana, and New Mexico
- **Focal Species:** black-tailed prairie dog, Gunnison's prairie dog, black-footed ferret, northern gray wolf, Mexican gray wolf, lesser prairie-chicken, red-cockaded woodpecker, Chupadera spring snail, Monarch butterfly, milkweed (spp.), Chiricahua leopard frog, Bolson tortoise, gopher tortoise, bats (spp.)
- **Growth Strategy:** All projects were multi-year efforts that began in 2006 or earlier, excepting the Chupadera spring snail project which began in 2012 and the Monarch butterfly/milkweed projects which began in 2015. The infrequent launch of new projects is consistent with our 2003 decision to strategically restrict TESF's growth.

Summary of Action Plan for 2017

- **Staff:** 5 biologists, 2 seasonal technicians, one contractor
- **Turner Foundation Grant:** $535,000 (same grant amount as 2014, 2015, 2016)
- **Turner Enterprises Support:** $127,151 (worker's compensation insurance, health insurance, $15,000 for Global Landowners Alliance)
- **RET direct support:** $24,981 (for retirement benefits)
- **Non-Turner Sources:** $83,750 (non-Turner sources include federal and state governments, and conservation organization)
- **TESF carry-over from 2016 emergency fund:** $25,000
- **TESF carry-over from 2016 for operations:** $44,268
- **Fundraising:** continue efforts to raise money from non-Turner sources, including efforts to recruit the Orianne Society to collaborate with our efforts to establish the eastern indigo snake at Avalon
- **No. of Projects:** 12 projects to improve conditions for 15 imperiled species
- **Area of Work:** seven Turner properties and hundreds of thousands of acres of adjacent public and private land.
- **Focal Species:** gopher tortoise, eastern indigo snake, black-tailed prairie dog, Gunnison's prairie dog, black-footed ferret, gray wolf, Mexican gray wolf, northern gray wolf, red-cockaded woodpecker, Chiricahua leopard frog, Bolson tortoise, gopher tortoise, Monarch butterfly, Chupadera springsnail, American burying beetle
- **Growth Strategy:** One new project in 2017 – American burying beetle and expansion of gopher tortoise project to accommodate the eastern indigo snake.

1. TESF FIELD PROJECT – BATS



PROJECT STATUS
Ongoing

Principal biologist
Dustin Long

Conservation Problem – Many bat populations in North America have undergone precipitous population declines since the emergence of white-nose syndrome (WNS) in 2006. The WNS epidemic is considered the worst wildlife disease outbreak in recent North American history, and threatens to drive some bat species to extinction. Resident, hibernating bats on Turner western properties may soon be affected by WNS.

Conservation Status

- USFWS Species of Concern: Big brown bat (*Eptesicus fuscus*); Cave myotis (*Myotis velifer*); Allen's big-eared bat (*Idionycteris phyllotis*)
- NMGF Species of Greatest Conservation Need: Allen's big-eared bat (*Idionycteris phyllotis*); Spotted bat (*Euderma maculatum*)
- KDPWT Species of Greatest Conservation Need: Townsend's big-eared bat (*Corynorhinus townsendii*);
- ODWC Species of Greatest Conservation Need: Mexican free-tailed bat (*Tadarida brasiliensis*)

Project Location – Armendaris Ranch, NM; Z Bar Ranch, KS/OK

Project Partners

- Laura Kloepper, St. Mary's College
- Ken Brunson, The Nature Conservancy
- Stan Roth, University of Kansas

Project Funding – TESF

Goal – Improve habitat conditions for bats and monitor resident and migratory bat populations at the Z Bar and Armendaris Ranches.

Objective – Improve bat habitat and implement biennial summer and winter population and species classification surveys of bat populations at the Armendaris and Z Bar Ranches to assess bat community richness and population trends. We will also monitor for the potential arrival of WNS.

Supporting Rationale for Objective – WNS is an emerging epizootic disease caused by the cold-loving fungus *P. destructans* (Fig. 1.1). Most bat species are relatively long lived and produce one offspring a year; consequently, bat population growth depends on high rates of adult survival. The adult life stage of bat populations affected by WNS experience a 95% mortality rate. Documenting the arrival of WNS and its impacts on Turner bat populations will play an important role in a larger nationwide effort to track, study, and ultimately minimize the impacts of the disease.

Mexican free-tailed bats make up the majority of bats on Turner properties and while they apparently are not susceptible to WNS because they migrate rather than hibernate, much remains unknown about the species and its seasonal use of caves on Turner properties. Collaborating with bat researchers at the two ranches will begin to fill in those basic ecological information gaps and offer insight into how best to manage bat populations on Turner lands.

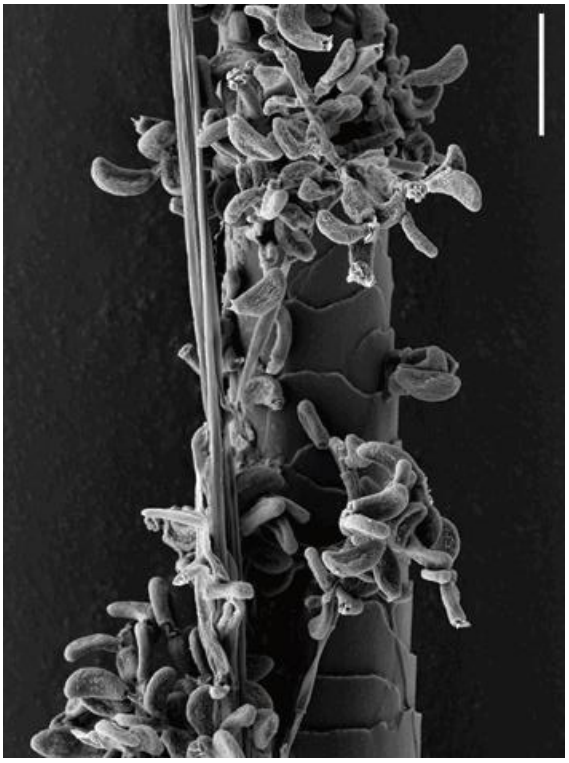


Fig. 1.1. Scanning electron micrograph of a bat hair colonized by *P. destructans*. Scale bar = 10 µm.

Project Background – The Jornada caves are the second largest lava tubes on the North American continent, and provide habitat for eight species of bat: Mexican free-tailed bat, Pallid bat, Allen's big-eared bat, Yuma myotis, Townsend's big-eared bat, spotted bat, California myotis, and fringed myotis. The migratory population of Mexican free-tailed bats at Jornada is the largest in New Mexico, and the fifth largest in North America.

The Merrihew cave (gypsum cave) is occupied by at least four bat species (Mexican free-tailed bat, Townsend's big-eared bat, big brown bat, and cave myotis), three of which are hibernatory and all either USFWS or state listed species of concern. Four caves in the Oklahoma-Kansas Red Hills region where tested for WNS in 2016, and all returned negative results for the disease.

Project Activities in 2016 – Summer bat surveys at the Jornada lava tubes and at Merrihew cave indicated summer bat populations remained stable at 1.4 -1.8 million and ~160,000 bats, respectively. Smaller caves at both ranches were not formally surveyed but additional hibernating, transitory, and maternal populations were observed in those caves. We completed our bat habitat improvement efforts at Merrihew cave by removing all remaining eastern red cedar and elm obstructions from the cave entrance (Fig 1.2). We also continued our collaboration with Dr. Laura Kloepper in her innovative bat acoustic research at both properties.

Proposed Future Activities and Considerations – It is very likely bat populations on all Turner properties will soon be exposed to *P. destructans*. Currently, there is no cure for the disease and limiting exposure of bats on Turner properties to the fungus is impractical since transmission is primarily from bat to bat. What we can do is limit the potential for humans to transmit WNS by enforcing decontamination protocols for those entering Turner caves. We can also ensure human activities around bat caves do not impact bat populations, continue to improve bat habitat, and aid research that will enhance our overall understanding of bat ecology and behavior.

Fig. 1.2. Merrihew Cave before (top) and after (bottom) removal of eastern red cedar and elm to improve cave access for bats.

2. TESF FIELD PROJECT – BLACK-FOOTED FERRET

Mustela nigripes
ESA listing: ENDANGERED

PROJECT STATUS
Ongoing

Principal biologist
Dustin Long

Conservation Problem – The near extinction of the black-footed ferret was a direct result of the decline of prairie dogs (*Cynomys spp*.) across their range. This loss of the black-footed ferrets primary prey species is attributable to sylvatic plague (*Yersinia pestis*), as well as habitat fragmentation and persistent prairie dog eradication programs.

Conservation Status
- Listed as Endangered under the ESA
- Listed as Endangered in SD
- Listed as a Protected Furbearer in NM

Project Locations – Vermejo Park Ranch, NM; Bad River Ranches, SD

Project Partners – USFWS, NMDGF South Dakota Game, Fish and Parks, National Fish and Wildlife Foundation (NFWF)

Project Funding – TESF, NFWF

Goal – We will work with state and federal agencies and other partners to meet black-footed ferret downlisting criteria.

Objective – The USFWS's black-footed ferret recovery plan requires that a recovery site maintain a minimum population of 30 adult ferrets over a 3-year period in order to meet downlisting criteria. Our objective is to restore populations of ferrets to Vermejo, Bad River and Z Bar Ranches that meet or exceed these downlisting criteria.

Supporting Rationale for Objective – Black-footed ferrets are an obligate predator of prairie dogs, and prairie dogs historically required grazing by bison throughout a large portion of their historic range in order to persist. Thus, the black-footed ferret project is a natural fit for many Turner properties and provides the opportunity to complement commodity production with native species restoration.

Project Background – All remaining captive and wild black-footed ferrets can be traced to the last seven wild individuals of the species that were captured in Meeteetse, WY and brought into captivity from 1985-1987. Today, the black-footed ferret remains one of the rarest mammals on the planet with an estimated wild population of less than 300 individuals.

Our efforts to assist the USFWS in black-footed ferret recovery began in 1998 with the construction of an outdoor preconditioning facility at Vermejo. Naïve, cage reared ferrets were placed into outdoor pens where they were exposed to a simulated wild environment. Ferrets in these pens lived in black-tailed prairie dog (*C. ludovicianus*) burrows and were routinely exposed to live prairie dog prey allowing them to hone their natural predatory instincts and prepare for life in the wild. Female ferrets bred, then whelped and weaned kits, in these preconditioning pens. Ferrets preconditioned or born in outdoor pens and exposed to live prey have higher post-release survival rates than those that have not. From 1999-2006 TESF preconditioned 393 ferrets at Vermejo.

From 2005-2007 at Vermejo and 2009-2011 at Bad River Ranches, TESF took the next step in preconditioning ferrets and implemented a wild preconditioning approach at those ranches. At Vermejo, female ferrets and their kits were released into a 1,000 acre prairie dog colony, surrounded by electric netting which served to keep terrestrial predators (e.g. coyotes and badgers) away from the ferrets as they adjusted to life in the wild. At Bad River the same procedures were followed without the use of electric netting. After 1-3 months of wild preconditioning the ferrets were captured and transported to permanent release sites. 48% and 45% of the ferrets released using the wild preconditioning strategy were recaptured at Vermejo and Bad River respectively, and were subsequently sent for permanent release elsewhere. In 2008, TESF began year-round ferret releases on black-tailed prairie dog colonies at Vermejo and in 2009 TESF

documented the first wild born ferret in NM in over 75 years.

Despite our best efforts to establish a self-sustaining ferret population at Vermejo that contributed to federal recovery objectives for the species—an effort which included increasing black-tailed prairie dog acreage from 500 acres to over 10,000 acres—it became obvious, based on ferret survival rates over a 9-year period that it was unlikely that a stable ferret population could be established on black-tailed prairie dog colonies at Vermejo. While ferrets generally thrived and wild ferret reproduction was documented when spring precipitation was sufficient to support a robust prairie dog population, these good years were routinely offset by drought years in which prairie dog pup survival was below 10%, causing the ferret population to collapse. During these drought years we documented the loss of all females and their kits, although male ferrets appeared to be largely unaffected by the drought. Due to the failure of ferrets to survive and reproduce during drought years, and the likelihood that droughts will become more frequent and severe, we decided to withdraw from any future ferret releases on black-tailed prairie dog colonies at Vermejo.

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

The planned ferret release at Bad River in 2013 was derailed by a plague epizootic in late 2012 which decimated the prairie dog population rendering the site unsuitable for a ferret population. However, the Bad River prairie dog population has since made a remarkable recovery and may soon once again be suitable for ferrets.

Project Activities in 2016 – Up through 2016 the only prairie dog colonies on Turner properties that supported a ferret population were the Gunnison's at Vermejo. Unfortunately, that ferret population was impacted by the plague epizootic which swept through the Gunnison's colony during the summer of 2015 and no ferrets were detected in 2016. In order to protect a beachhead of ferret habitat in these plague prone ecosystems, we dusted 750 acres of prairie dog colonies in 2016.

Proposed Future Activities and Considerations – Our ferret recovery efforts have suffered significant setbacks due to plague. Range-wide, ferret population estimates have decreased from around 1,000 animals in 2008 to approximately 200 today. As demonstrated at Vermejo and Bad River, plague remains a constant threat to ferrets on Turner properties.

Ferret recovery is tightly linked to prairie dog conservation and active plague management. Currently, the most viable plague management option is to dust prairie dog burrows with an insecticide that kills the fleas that serve as the disease vector. Predictably, recent studies at chronically dusted ferret release sites indicate that fleas have begun to develop resistance to this insecticide.

However, looking ahead there is reason for optimism. Field trials for an oral plague vaccine for prairie dogs have produced encouraging results, and we have received funding to administer this vaccine to 1,600 acres of prairie dogs at Bad River over the next 3 years. Securing 1,600 acres of ferret habitat will allow us to implement a year-round ferret release at Bad River Ranches in 2017.

Black-footed ferret released onto a Gunnison's prairie dog colony at Vermejo Park Ranch

Associated TESF Project – PRAIRIE DOGS

Black-tailed prairie dog (*Cynomys ludovicianus*)
Gunnison's prairie dog (*C. gunnisoni*)

ESA listing (both species): NOT LISTED

PROJECT STATUS
Ongoing

Principal biologist
Dustin Long

Conservation Problem – Range-wide decline of prairie dogs due to sylvatic plague, loss of habitat, and human persecution.

Project Locations – Vermejo Park Ranch, NM; Bad River Ranches, SD; Z Bar Ranch, KS

Project Funding – TESF, NFWF

Conservation Status – Black-tailed and Gunnison's prairie dogs have, in the past, been a candidate species for listing under the ESA. Neither species are currently listed nor afforded any significant state protection in NM, SD or KS.

Goal – To provide sufficient habitat (i.e., prairie dog colonies) to support black-footed ferrets.

Objective – There are separate short- and long-term objectives for this project at Vermejo and Bad River. The short-term objective (i.e., 2016-2018) at these two ranches is to maintain and protect a core population of 500-1,000 acres of prairie dogs in the best habitat at each ranch through the annual application of a pulicide; the long-term objective at these two ranches is maintain a stable population of 3,000 – 5,000 acres of prairie dogs which will be sufficient to support a minimum population of 30 black-footed ferrets. The objective at the Z Bar is to increase prairie dog acreage to ~1,500 acres.

Supporting Rationale for Objective
Prairie dogs are sensitive to plague and this is the primary conservation concern at most black-footed ferret restoration sites. To mitigate this problem, prairie dog burrows are dusted annually with a pulicide that kills the fleas that are the vectors for the disease. This is generally effective, although there have been instances where dusted colonies have plagued out (e.g., Bad River in 2012) and recent studies in South Dakota suggest that in chronically dusted areas (>10 years) fleas have begun to develop resistance to the most commonly used pulicide. To remedy this most pressing conservation concern, federal and state agencies, in collaboration with NGOs have been working to develop a sylvatic plague vaccine that can be delivered to prairie dogs through small bait pellets. Vaccine field trials have been completed and the results are encouraging; the next step is to apply the vaccine at a landscape scale – which we will do at Bad River in 2017 and at Vermejo in 2019.

Project Background
Few species are as controversial in the American west as prairie dogs. Many landowners view prairie dogs as competitors for a limited grass resource whose presence represents a threat to their livelihood; conservationists view prairie dogs as a key species whose presence acts to provide the habitat requirements of numerous other species. We seek to find that balance where prairie dogs can coexist with for-profit endeavors.

Currently, prairie dogs occupy ~3% of their historical range. This significant range wide decline was largely due to poisoning campaigns in the early and mid-20th century. More recently, the invasive disease sylvatic plague has been the primary range wide conservation challenge.

Prairie dog restoration on Turner properties began in 1997 with the development of a reliable soft-release technique. Using soft-releases, we expanded black-tailed prairie dog acreage at Vermejo from 500 acres to 10,000 acres; the Ash Creek Restoration Area (ACRA; focal area for prairie dog restoration) of Bad Rivers Ranches from 125 acres to 1,650 acres; the Z-Bar from 75 acres to 590 acres; and the Gunnison's at Vermejo from 23 acres to 3,900 acres. In total, prairie dog acreage on Turner properties has grown from 725 acres to a maximum of 16,140 acres.

Project Activities in 2016
The Gunnison's prairie dog complex (black-footed ferret release site) at Vermejo continues to make a quick recovery from the 2014 -2015 plague epizootic. Colonies expanded 9% in 2016

to cover 967 acres of which 343 acres were dusted to mitigate sylvatic plague.

The 12 black-tailed prairie dog colonies that comprise the ACRA complex expanded 4.5% in 2016 to cover 1,529 acres of which 382 were dusted. The TESF was awarded a grant which will support the application of the sylvatic plague vaccine to the entire ACRA complex from 2017-2019 and allow for a ferret release in 2017. To discourage prairie dog colony expansion into unwanted areas, vegetative and visual barriers as well as raptor poles, continue to be maintained in ACRA.

Black-tailed prairie dog colonies at the Z Bar expanded 17.6% in 2016 to cover 458 acres with all colonies realizing good growth. At current growth rates it will take us around 5 years to reach the 1,000 acre mark at which time we will request black-footed ferrets for an experimental release.

Proposed Future Activities and Considerations

Given the recent history of prairie dogs on Turner properties, 2016 ended up being a relatively good year at each of the properties. The Gunnison's at Vermejo and the black-tails at Bad River and the Z Bar experienced stable growth while the Vermejo and Bad River populations continue to recover from recent plague epizootics at those properties. Looking forward, it seems reasonable to assume plague has run its course at Vermejo and until the Gunnison's population increases another epizootic is unlikely to occur. By the time plague again becomes a concern at Vermejo—probably about 2019—we intend to have secured the necessary funding and partners to apply the sylvatic plague vaccine. At Bad River the TESF secured a grant to apply the vaccine to the ACRA complex through 2019 and begin ferret releases. In 2017 we will begin investigating novel ways—including the application of fertilizer—to focus bison grazing on the perimeter of colonies at the Z Bar to stimulate colony growth.

3. TESF FIELD PROJECT – BOLSON TORTOISE

Gopherus flavomarginatus
ESA listing: ENDANGERED

PROJECT STATUS
Ongoing

Principal biologists
Chris Wiese
Scott Hillard

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

Conservation status
- Listed as Endangered under the ESA
- Listed as Endangered in Mexico
- IUCN Red List Status: Vulnerable

Project Locations – Armendaris Ranch, NM and Ladder Ranch, NM

Project Partners
- Living Desert Zoo and Gardens State Park in Carlsbad, NM (LDZG)
- El Paso Zoo, El Paso, TX
- San Antonio Zoo, San Antonio, TX
- Dr. Jim Jarchow, DVM, Tucson, AZ
- Dr. Peter Koplos, DVM, El Paso, TX
- Taylor Edwards, University of Arizona
- The Appleton Family

Project Funding
- TESF
- Funding and in-kind support from: LDZG, El Paso Zoo, San Antonio Zoo, private donations.

Project Goal – Establish free-ranging, minimally managed wild bolson tortoise populations in the northern Chihuahuan Desert.

Objectives

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

Wild Population objective – The captive population will be used to establish and augment

at least two wild bolson tortoise colonies on suitable private and/or public lands in the U.S. Each colony will have at least 250 adults, have a male to female ratio of approximately 1:1, have stable or positive population growth, and exhibit evidence of reproduction.

Project Background –The largest and rarest of the five North American tortoise species, the bolson tortoise once roamed most of the Chihuahuan desert. Its current range comprises a small area in north central Mexico. Due to a suite of political, social, economic, and safety issues, the current status of the bolson tortoise in the wild is largely unknown. The last population survey, conducted in the early 1980s, estimated a population of fewer than 10,000 animals. However, continued habitat degradation and loss since then makes it likely that this number has since decreased significantly.

To prevent the extinction of bolson tortoises in the wild, we are working towards establishing free-ranging populations on the Ladder and Armendaris ranches in New Mexico. Both of these ranches lie at the northern tip of the species' prehistoric range.

Our starting point for the bolson tortoise reintroduction project was a group of 30 bolson tortoises that were collected and bred by Ms. Ariel Appleton over a period of nearly 40 years in Arizona. This private tortoise collection was donated to TESF in 2006, where 26 adult (plus 7 hatchlings) tortoises 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 LDZG, where they are on exhibit.

Successful breeding programs on the Armendaris and at the LDZG have hatched nearly 600 new tortoises since 2006. Hatchlings and juveniles are being 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 ~110 mm shell length).

Tortoise growth rates depend both on the weather and on forage availability. It typically takes between 3 and 7 years for a hatchling bolson tortoise to reach 110 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, as they provide shelter for myriad other species, including mammals, birds, reptiles, and insects.

Project Activities in 2016

Current status of the bolson tortoise project

Our captive bolson tortoise population currently comprises 29 adults (25 on the Armendaris Ranch; 4 at LDZG) that serve as the founder population for all juveniles produced by the project. These adults have produced a cumulative total of 642 hatchlings since 2006 (Fig. 3.1). As of fall 2016, 469 (73%) of these juveniles were confirmed to be alive, 116 had died (18%), and 51 (8%) were unaccounted for (status unknown). From 2012 to 2016, 131 larger juveniles (shell length > 100 mm) were equipped with transmitters and moved from predator-proof enclosures to predator-accessible enclosures. Of these transmittered juveniles, 107 (82%) were confirmed to be alive in 2016.

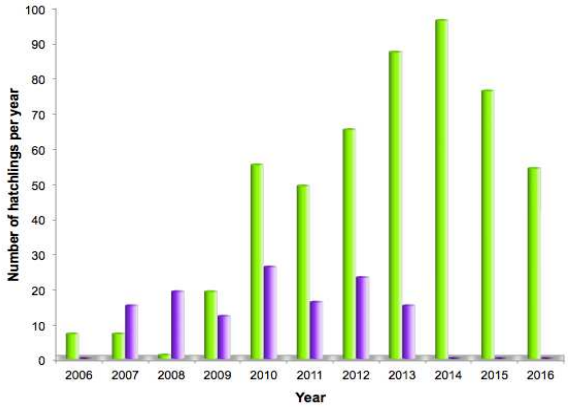


Figure 3.1. Number of hatchlings produced in Arizona (2006, green bar), at the Armendaris Ranch (2007-2016, green bars, and at LDZG (purple bars).

2016 successes and milestones

- We added 54 hatchlings to our population in 2016 (Fig. 3.1), for a total of 642 hatchlings born to date. All 13 adult female tortoises laid eggs in 2016, but only 11 of the 13 successfully produced at least one hatchling.
- We initiated a study to assess natural nesting success on the Armendaris Ranch. 24 of the 54 hatchlings emerged from natural nests that were left in the ground (rather than being moved to an incubator). Hatchling emergence did not occur from five natural nests (24 eggs) by the fall of 2016, and these nests will be monitored for hatchling emergence in spring 2017.

Captive Breeding Program

Captive adults and subadults

The captive bolson tortoise population on the Turner Ranches consists of 25 adults: 13 females and 12 males (Table 3.1). An additional 4 adult tortoises (2 males, 2 females) reside at the LDZG. An additional large male (EP, found feral in El Paso in 2011) is housed separately at the El Paso Zoo, and is not yet part of the breeding program. Nor are two subadults (1 female, 1 male) that were transferred to the El Paso Zoo from the Turner Ranches in 2010. All adult and subadult tortoises appeared in excellent health in 2016, with two exceptions: (1) Tortoise Y suffers from bone degeneration in his hip joints. However, he is able to move around quite well despite a pronounced limp. (2) One of two subadult females that had been housed at the El Paso Zoo met an untimely death in the summer of 2016 due to human error. The other subadult female is doing well.

Table 3.1. Adult and subadult bolson tortoises in the 2016 captive population.

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,E,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	Male	EP
El Paso Zoo	Female	07-CB12
El Paso Zoo	Male	09-F1

Husbandry strategies: adult tortoises

Our approach to managing adults in the captive population is to be as hands off as possible. We survey these adults twice a year, in the spring and in the fall, with the exception of the adult females, who we monitor intensively during nesting season (April – July) to collect eggs. We provide water only during severe drought years, which has happened only once in spring 2013. Supplemental irrigation was not necessary in 2016.

Hatchling production

To produce hatchlings in 2016, we:

- Monitored female tortoises and collected the eggs near their due date by induced oviposition, or from natural nests.
- Monitored natural nests and collected hatchlings that emerged naturally.
- Incubated eggs in temperature-controlled environments that are safe from predators
- Collected hatchlings, marked them with a unique code, and banked blood for genetic studies and paternity testing.

2016 Egg collection

As in previous years, we used a combination of radiography, weight monitoring, and direct observations to determine number and maturity of eggs carried by each female tortoise. This work was also key to timing the transfer of females to either a smaller enclosure (to increase the chance of finding the nest) and/or to the "Turtle House" on the Armendaris to induce egg-laying.

Not all of the adult females contribute equally to the offspring pool (Fig. 3.2). To ensure that female tortoises contributed to the next generation more evenly, we focused our egg collection efforts more intensely on those individuals that are relatively underrepresented (X, 2, 4, F, and P). We allowed the more highly represented females to nest in a protected area and left their nests in place rather than moving eggs to incubators. We were able to locate, leave in place, and mark 24 eggs (in 5 clutches) that were laid in the protected area, and we moved another 18 clutches (89 eggs) into the incubators. 31 eggs (in 7 clutches) were not located.

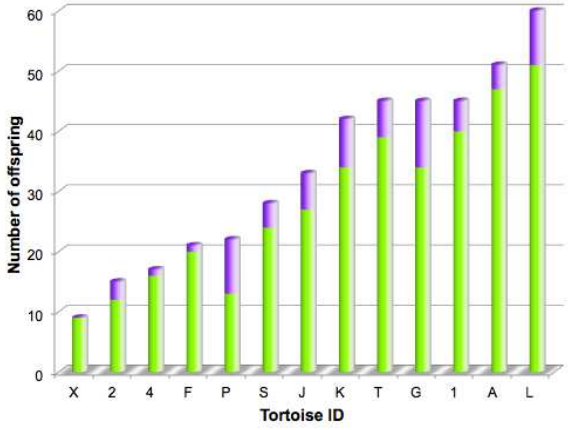


Figure 3.2. Number of offspring in the population at the end of 2015 from each breeding female. Green bars = number of hatchlings alive at the end of 2015; purple bars = number of hatchlings dead at the end of 2015.

This new approach in 2016, where we left several natural nests in place for part or all of the incubation period, gave us a better sense of the outcome of natural nesting this far north in prehistoric bolson tortoise habitat. In 2017, we will use endoscopy to assess the gender of hatchlings that emerged from natural nests to determine the ratio of male to female offspring. This is the beginning of a larger study to develop a better understanding of bolson tortoise nesting parameters on Turner ranches.

Interestingly, eggs that are artificially incubated in constant-temperature incubators hatch out after about 70-85 days, whereas eggs incubated in the ground were much slower to hatch (if at all): two hatchlings emerged after about 107 days from a nest with 4 eggs, and when we investigated the fate of the other two eggs, we found that they had hatched but had remained underground. When we investigated another nest after 132 days in the ground, we found all four eggs had hatched but the hatchlings remained in the ground. To see if hatchlings would emerge on their own, we left 5 other nests in the ground without investigating the presence of hatchlings. These nests had not hatched by the time temperatures cooled off in the fall, and remained in the ground over winter.

Egg incubation

With the exception of the eggs left to incubate in the ground, eggs were distributed into 6 incubators and held at constant temperatures to generate male (cooler temperatures) and female (warmer temperatures) offspring. Eggs remained in the incubators until shortly before hatching, at which point they were placed into labeled trays and transferred to another incubator (the "pipping chamber") in which they stayed for up to two weeks to finish hatching and absorb residual yolk.

Hatchlings

Following complete yolk absorption, hatchlings were weighed, measured, and marked with a unique tag attached to the shell with epoxy. We also generated a photographic record and drew a drop of blood for banking from each hatchling. As soon as possible, processed hatchlings were placed in outdoor holding tanks where they remained until the middle of October. They were then moved to an indoor overwintering facility for the winter (see below).

A total of 54 tortoises hatched on the Armendaris in 2016, bringing the total number of tortoises produced by our captive adults to 642 (Fig. 3.1).

Hatching success rates

Overall hatching success rates varied widely amongst females, and for a given female from year to year. However, overall hatching success has remained relatively consistent for the last 7 years (Table 3.2), and ranges from 53% to 69%. The 2016 hatching success rate was average.

Table 3.2. Hatching success of Turner group tortoises since 2010. Hatching success 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.

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
2016	54	89	55	61
Mean	68.1	113.6	18.9	61

Over the past few years, we were mainly concerned with maximizing the number of juveniles to enable us to move onto the next step in the reintroduction program, namely to begin to establish wild populations. A number of 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 (Fig. 3.2). For 2017, we therefore plan to again focus our egg-collection efforts on females that are relatively underrepresented in the population.

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.
- Provisioning tortoises with supplemental food (mostly native forage) and water as needed.
- Surveying juvenile tortoises twice a year (spring/fall) to monitor growth rates and health.

Management of juveniles in headstart enclosures in 2016 was performed in two stages: (1) keeping hatchlings "up" during their first winter while providing summer-like conditions inside a specially constructed overwinter shed, and (2) supplemental feeding and watering of juvenile tortoises (those at least one year of age and not yet large enough to release) in outdoor headstart pens. Headstart pen maintenance includes managing forage plants (grass, small forbs) and occasional weeding to remove non-forage plants from the enclosures. Supplemental feeding was facilitated by ample growth of wild globemallow plants, which were harvested and broadcast in the enclosures 2-3 times a week. While individual growth rates vary between animals, all tortoises appeared to be growing at acceptable rates.

Tortoise Surveys and Health Checks

We surveyed tortoises in the spring and in the fall of 2016. During these two surveys, we measured tortoise weight, shell length, width, and height. These measurements allowed the calculation of growth rates, which can alert us to problems such as malnutrition, dehydration, and disease.

During the 2016 fall surveys and health checks we surveyed 469 juvenile tortoises, but could not locate 51 individuals (26 of whom we have not seen in over a year). This is not unusual as the tortoises are rather elusive. We consider tortoises "missing" until we either find the individual, find evidence of its demise, or have not seen it for three consecutive years (in which case we consider it "fate unknown"). Unfortunately, we documented 17 mortalities in 2016, bringing the total number of juvenile deaths since 2006 to 116.

Release studies

In fall 2012, we began outfitting large juveniles (> 100 mm shell length) with transmitters and moving them from the predator-proof headstart enclosures to the predator-accessible fenced areas that also house the adults. Although the ultimate goal is to establish unfenced wild populations, the fenced releases provide important information regarding the behavior and predation pressures for released tortoise juveniles until all of the required state and federal permits are in place to allow unfenced releases. For example, the release studies thus far revealed that in most years, the juvenile tortoises do not travel long distances from their point of release. To date, we have transferred a total of 131 juvenile tortoises to two fenced locations on the Armendaris and Ladder ranches. Of these, we found 107 (82%) to be alive at the end of 2016. This constitutes a surprisingly high survivorship. We did not release any new juvenile tortoises in 2016.

These release studies also revealed that we lost tortoises for a number of reasons, but not due to one specific predator over others.

For 2017, we obtained a small grant from the Mohamed bin Zayed Species Conservation Fund to outfit ten juvenile tortoises smaller than 100 mm shell length (70 mm - 90 mm) with transmitters and release them in predator-accessible pens to begin to understand predation pressures on smaller tortoises.

Outreach and other activities

We hosted a graduate student from Mexico, Sara Valenzuela, for three weeks in June of 2016. Sara was interested in learning how we collect and incubate eggs so she can potentially apply these techniques towards headstarting bolson tortoises in Mexico.

In November 2016, we were invited to serve on a panel of experts to help prepare a PACE (Programa de Acción para la Conservación de la Especie) for the bolson tortoise. A PACE is the Mexican equivalent of a recovery plan. It is assembled by CONANP (the Mexican equivalent of the National Park Service) and serves as a guide for recovery efforts.

Future Activities and Considerations

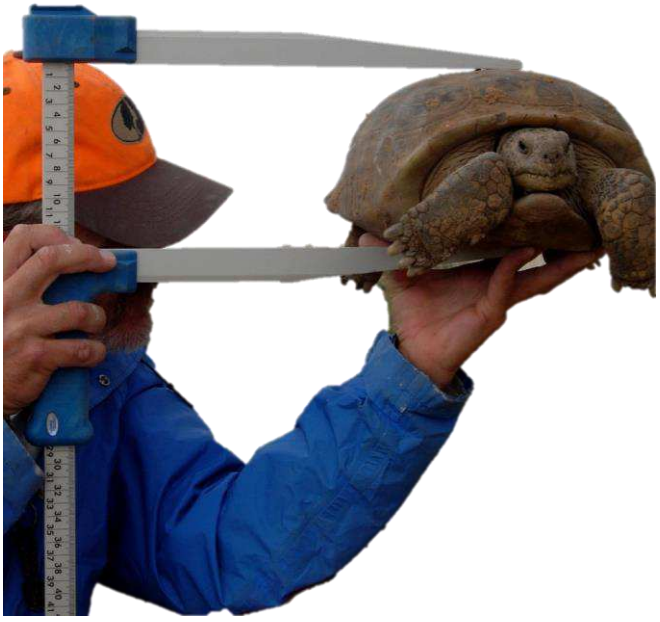
Our major objectives for 2017 will be to:

- Continue building a robust captive population of tortoises as a source for wild releases.

- Initiate releases of juvenile tortoises within potential permanent locations so we can begin to build strong, repatriated, minimally managed wild populations.
- Continue to seek and collaborate with additional partners to expand the scope of the bolson tortoise project.

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

- Collecting the eggs of currently underrepresented females and incubating them to ensure continued robust hatchling production.
- Surveying the tortoise population at least twice a year.
- Increasing forage availability in headstart pens by harvesting plants from the environment.
- Enhancing available forage.
- Transferring juveniles to predator-accessible enclosures to free up space in the headstart pens.
- Monitoring released juveniles to track survivorship and movements.



An adult bolson tortoise's shell height being measured during a regular survey of the captive population

4. TESF FIELD PROJECT – CHIRICAHUA LEOPARD FROG (CLF)

Lithobates chiricahuensis
ESA listing: THREATENED

PROJECT STATUS
Ongoing

Principal Biologists
Magnus McCaffery
Cassidi Cobos
Carter Kruse

Conservation Problem – Range-wide decline of CLF due to a suite of factors, including:

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

Conservation Status

- Listed as Threatened under the ESA in 2002
- NM Species of Greatest Conservation Concern

Project Location – Ladder Ranch, NM

Project Partners

- USFWS
- NMDGF
- Dr. Colleen Caldwell (NMSU)
- Dr. Andrea Litt/Ross Hinderer (MSU)

Project Funding – TBD/TESF

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 - To indefinitely 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 to 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 that will conserve genetically or geographically unique stocks of CLFs in peril (i.e., habitat destruction and disease), but may also be desirable as a holding facility for 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.

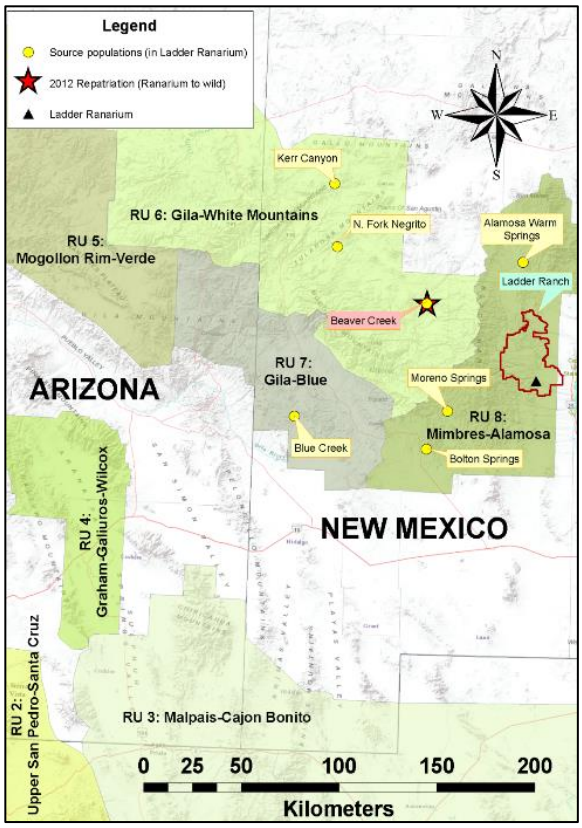


Fig. 4.1. The Ladder Ranch (red outline) is a CLF Management Area within Recovery Unit (RU) 8.

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. 4.1.).

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.

Project Activities in 2016

Wild population monitoring

We monitored all known sites occupied by wild CLF during 2016. Minimum count data from this survey work suggests that the Ladder Ranch population remains robust (Table 4.1). 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. We are planning to study the interactions between Plains leopard frogs and Chiricahua leopard frogs starting in 2017.

Table 4.1. Minimum CLF counts at wild Ladder Ranch sites in 2016.

	Minimum Counts			
Site Name	**EM**	**TP**	**MM**	**AD**
[a]Circle 7	4	20	15	9
[a]Emrick Spring	4	>100	9	13
[b]Davis (Lower)	0	0	15	34
[b]Davis (Upper)	3	21-50	1	9
[b]N. Seco	82	>100	110	105
[b]Pague	48	>100	32	271
[b]LM Bar	3	>100	50	35
[b]Fish	1	50	37	49
[b]Johnson	102	21-50	200	192
[b]S. Seco	1	100	0	3
[c]Ash Canyon	0	10	0	18
[c]Artesia	9	0	17	25
[d]Cave Creek	0	20	17	6
KEY: a=Las Palomas drainage b=Seco drainage c=Ash Canyon drainage d=Las Animas drainage		EM=egg mass TP=tadpole MM=metamorph AD=adult		

Habitat actions on the Ladder Ranch:

- Removed cattails at LM Bar to maintain habitat quality for CLF.
- Removed cattails at Artesia to maintain habitat quality for CLF.
- Planted native grasses at Bear Canyon.
- Reinforced the dam at Bear Canyon.

Captive refugia program

During 2016, we translocated CLFs into one of the captive refugia tanks designated for use by the USFWS (Table 4.2).

Table 4.2. Number of egg masses stocked into USFWS designated captive refugia tanks on the Ladder Ranch in 2016.

Refugia	**Source Population**	**No. Egg mass**
Antelope	Seco Creek	-
No. 2	Seco Creek	-
Avant	Beaver Creek	2

Refugia tanks designated for both Ladder Ranch and USFWS use produced 49 viable egg masses in 2016 (Table 4.3).

Table 4.3. Egg masses laid in captive refugia in 2016.

Refugia	**No. Egg Masses**	**No. Viable**
Antelope	6	6
Seco Well	19	19
Wildhorse	0	0
South	0	0
Fox	8	8
No. 2	16	16
Avant	0	0
No. 16	0	0

A wild Chiricahua leopard frog in a steel tank on the Ladder Ranch

Captive breeding – ranarium program

In 2016, the ranarium housed adults from eight off-ranch source populations, spanning three CLF Recovery Units, as well as adults from three on-ranch populations (Table 4.4). Egg masses produced in adult cages were transferred to the integrated tadpole rearing facility.

Table 4.4. Adult CLFs in ranarium cages during 2016.

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

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

There are ten tadpole rearing tanks in the ranarium, which can hold around 1,000 tadpoles each. In 2016, 45 viable egg masses were transferred from adult cages to tadpole tanks (Table 4.5). Tadpoles (Fig. 4.2) and/or metamorphs (Fig. 4.3) from these masses were released into the wild, or into captive refugia holding tanks in consultation with the USFWS (Tables 4.5 & 4.6).

Chiricahua leopard frog mud print on the Ladder Ranch

Table 4.5. 2016 Ranarium: Egg mass production/management.

Cage No.	**Source Pop.**	**No. Egg Masses**	**Egg Mass Lay Date**	**TP Exit Date**	**TP dest.**
2	Alamosa W.S.	2	3/16/16	3/19/16	Middle Well (JER)
3	Beaver Creek	1	3/17/16	5/24/16	Terry Tank Upper Middle fork, Feedlot
		1	4/6/16	5/24/16	
		1	5/8/16	7/4/16	
		1	6/1/16	7/4/16	
		2	6/1616	6/18/16	
		1	7/10/16	10/4/16	
		1	7/14/16	10/4/16	
		1	7/27/16	10/4/16	
		1	8/15/16	10/4/16	
4	San Francisco Haplotype	1	3/21/16	5/13/16	Reserve, NM
		1	4/26/16	7/8/16	
		1	5/10/16	7/8/16	
		1	6/14/16	8/11/16	
		1	6/28/16	8/11/16	
		1	7/18/16	8/11/16	
5	Diamond Creek	1	4/9/16	6/13/16	Diamond Creek, Pot Hole tank
		1	5/17/16	7/1/16	
		2	6/19/16	8/15/16	
		1	6/27/16	10/4/16	
		1	7/18/16	10/4/16	
6	Blue Creek	1	6/5/16	6/8/16	Garcia Tank (JER)
		1	6/23/16	6/27/16	
7	Moreno Spr	2	5/7/16	7/1/16	Upper Mimbres Bear Mountain Lodge
		1	5/8/16	7/1/16	
		1	7/24/16	10/7/16	
8	Bolton Spr.	-	-	-	
9	Las Animas	3	4/23/16	6/3/16	Cave Creek
		1	4/24/16	6/3/16	
		1	6/5/16	8/1/16	
		1	6/15/16	8/1/16	
		1	7/19/16	8/1/16	
		1	7/2/16	9/25/16	
		1	7/6/16	9/25/16	
		1	7/8/16	9/25/16	
		1	7/19/16	9/25/16	
		1	7/30/16	9/25/16	
		1	7/30/16	11/2/16	
		1	8/22/16	11/2/16	
		1	8/24/16	11/2/16	

KEY
W.S.=Warm Springs
Spr.=Spring
Pop.=Population
TP=Tadpole

In 2016, the Ladder ranarium produced over 12,000 tadpoles. These tadpoles were released to wild or captive sites across New Mexico on both public and private lands.

Fig. 4.2. Tadpoles released in Cave Creek

Fig. 4.3. Metamorph released in Cave Creek

A wild Chiricahua leopard frog on the Ladder Ranch

Table 4.6. Production and disposition of offspring produced at the ranarium in 2016.

Date	Source	No. EM	No. TP	No. Adult/Meta	Release type
3/19/16	Alamosa W.S.	2		3	C
5/13/16	San Fran Haplo	1	166		W
5/24/16	Beaver Cr.	2	1,200		W
6/3/16	Animas	4	1,074		W
6/8/16	Blue Cr.	1			C
6/13/16	Diamond Cr.	1	365		W
6/18/16	Beaver Cr.	2			C
6/27/16	Blue Cr.	1			C
7/1/16	Moreno Spr,	3	107		W
7/1/16	Diamond Creek	1	313		W
7/4/16	Beaver Cr.	2	1,015		W
7/8/16	San Fran Haplo	2	633		W
8/1/16	Animas	4	788	27	W
8/11/16	San Fran Haplo	3	976		W
8/15/16	Diamond Cr.	2	486		W
9/25/16	Animas	4	1,611	33	W
10/4/16	Beaver Cr.	4	1,204		W
10/4/16	Diamond Cr.	2	735		W
10/7/16	Moreno Spr.	1	253		W
11/2/16	Animas	3	1,456		W

KEY:
Cr. = Creek
W.S. = Warm Springs
Spr. = Springs
Haplo = Haplotype
Meta = Metamorph
TP = Tadpole
EM = Egg mass
W = Wild
C = Captive

Spot recognition and tagging

The spot pattern arrangement on the dorsal surface of CLFs is putatively unique to an individual frog. We are testing this assumption in an attempt to validate a novel method of individual identification of CLF. In 2017 we are planning on continuing the study to determine whether spot-pattern identification (SPI) methods provided comparable results to the commonly used PIT tagging method (which involves the subcutaneous injection of a small Passive Integrated Transponder chip). To do this, we selected two captive refugia tanks (Fox

and No. 2) on the Ladder Ranch in which to perform PIT tagging and SPI techniques. We conducted this work in 2013, 2014, and 2015 to increase our sample size and build stronger analysis, with great success.

In addition to our own analysis, we have partnered with USGS to help create software unique to leopard frog spot identification. For this study, we submitted our database of photographs from our fieldwork, both PIT tagging and simple photographs. In addition, we raised 10 tadpoles through metamorphosis to small juveniles in captivity, photographing them each month. By photographing regularly, we are studying how spots on the dorsal side of a frog change as the individual grows and ages. Data analysis is ongoing.

Chiricahua leopard frogs have a unique spot pattern that may allow us to identify individual frogs during survey work

5. TESF FIELD PROJECT – CHUPADERA SPRINGSNAIL (CSS)

Pyrgulopsis chupaderae
ESA listing: ENDANGERED

PROJECT STATUS
Ongoing

Principal biologists
Dustin Long
Cassidi Cobos

Conservation Problem – This species is endemic to one spring system and the potential for habitat loss and degradation is very high.

Conservation Status
- Listed as Endangered under the ESA in 2012
- NM Species of Greatest Conservation Concern

Project Location – Willow Spring on Highland Springs Ranch (approximately 1.6 km north of the Armendaris Ranch, NM).

Project Partners
- Highland Springs Ranch, LLC
- USFWS
- NMDGF

Project Funding – TESF

Goal – To mitigate threats of extinction and assist USFWS in developing a Recovery Plan.

Objective – We will convene a conservation working group to collect basic ecological information regarding the species to inform development of a Recovery Plan. This will include collecting water quality measurements, determining population abundance and population trends, developing a more complete understanding of the springsnails' life history, and the establishment of captive populations.

Supporting Rationale for Objective

The CSS is extremely rare and highly endemic and the potential for extinction is greater than with many other imperiled species (Fig. 5.1). Furthermore, very little is known about the species and currently there is no Recovery Plan to guide conservation efforts or provide downlisting/delisting criteria. The Recovery Plan for two similar species found in New Mexico, the Alamosa (*Tryonia alamosae*) and Socorro (*Pyrgulopsis newmexicana*) springsnail, provide downlisting/delisting criteria which might also be applicable to CSS. If the Alamosa and Socorro springsnail recovery plan is a guide, then downlisting CSS may require (1) a habitat management plan that provides protection for the springsnail and its habitat, and (2) the habitat management plan has been in place for 5 years and demonstrated that the continued existence of the springsnail is assured. Delisting may require (1) protection of the springsnails' habitat in perpetuity and (2) the establishment of additional populations as evidenced by recruitment and persistence over a 5 year period.

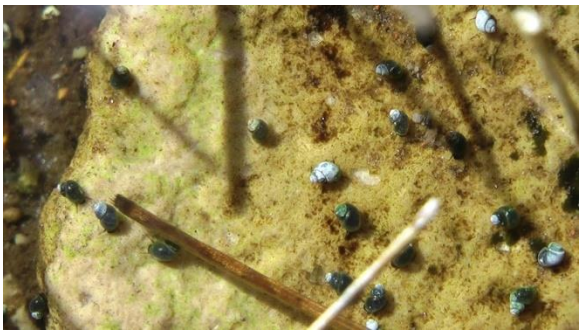


Figure 5.1. The Chupadera Springsnail lives in a single small spring in south-central New Mexico.

Project Background – The Chupadera springsnail is a small (1-2 mm) freshwater snail that is endemic to Willow Spring (Fig. 5.2). The snail was also found in a nearby unnamed spring but habitat degradation resulted in the extirpation of that population (Fig. 5.3). The springsnail is considered highly susceptible to extinction given the limited extent of and potential threats to available habitat (1 to 6 feet wide x 115 feet long).

Fig.5.2. In 2016 TESF erected a barb wire fence around Willow Spring to prevent livestock degradation of the site. Native ungulates will still have access.

Fig. 5.3. Unnamed spring where habitat degradation resulted in the extirpation of the Chupadera Springsnail. Preventing this from happening at Willow Spring is a primary objective of this project.

In 2014 TESF executed an agreement with Highland Springs Ranch which allows access to the Willow Spring site—an exciting development considering access to the site by biologists last occurred in 1998. A site visit in early 2015 by the last biologist to visit Willow Spring in 1998 was encouraging--CSS densities appeared similar to those last observed, however, CSS had colonized previously unoccupied habitat further up the spring and water flow appeared to have increased. Water physiochemical properties remain similar to those collected in 1998.

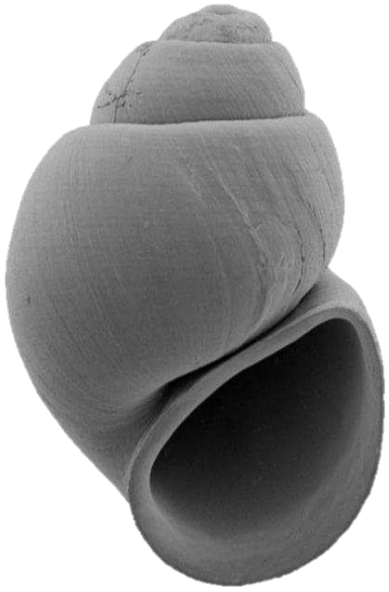
Project Activities in 2016

In 2016 TESF continued to collect habitat and physiochemical data at Willow Spring, mitigated threats posed by livestock loafing, began shoring up administrative requirements, and began efforts to secure a long-term future for CSS through the establishment of a refuge population. USFWS permitting requirements, which included 40 hours of training with aquatic invertebrate specialists, were met and a CSS recovery permit was requested; this permit will allow TESF personnel to handle CSS and perform population surveys and collect specimens for genetic evaluation. An ad hoc conservation working group was convened and met for several days for surveys and paid a visit to the Phoenix Zoo Conservation Center where the group observed and received information on the Zoo's captive springsnail population which recently documented reproduction.

Proposed Future Activities and Considerations

In 2017 the CSS conservation working group (TESF, NMDGF and USFWS) will continue to collect physiochemical and habitat data and begin to collect detailed CSS demographic information; these data will need to be gathered frequently if we are to glean reliable information regarding the CSS's life history. We will also begin the process of establishing and maintaining a CSS refuge population at the Ladder Ranch; a process which will begin with moving a non-imperiled springsnail species into captivity to ensure the aquarium system and husbandry protocols are suitable for springsnail persistence.

Willow Spring is the only known location inhabited by Chupadera springsnails



Pyrgulopsis chupaderae

6. TESF FIELD PROJECT – GOPHER TORTOISE

Gopherus polyphemus
ESA listing: CANDIDATE

PROJECT STATUS
Ongoing

Principal biologist
Magnus McCaffery

Conservation Problem – The primary threats to gopher tortoises are habitat destruction, fragmentation, and degradation.

Conservation Status – State listed as threatened in Georgia and Florida, and a candidate for listing under the ESA. In the western part of its range, it is listed as threatened under the ESA.

Project Locations – Avalon Plantation, FL

Project Partners
- FWC
- Saving Florida's Gopher tortoises (SFGT)
- Nokuse Plantation

Project Funding – TESF

Goal – Restore viable gopher tortoise population levels to the Avalon Plantation.

Objective – In 5 to 10 years, TESF will restore (1) at least two viable gopher tortoise populations to suitable habitat (100 ha minimum size) on the Avalon Plantation (a minimum of one population on the Avalon Annex and one population on Avalon Proper) to advance species recovery and serve as a model for conservation on private lands. These restored populations will ideally exhibit densities of 1 to 2 tortoises/ha (minimum of 0.4 tortoises/ha), will have positive population growth rates ($\lambda > 1.0$), and comprise: a minimum of 250 adults (> 235 mm MCL), variability in size and age structure, a male to female ratio of approximately 1:1, and evidence of juvenile recruitment.

Background Information and Supporting Rationale for Objective

Avalon Plantation (composed of two discrete property units: Avalon Proper = 11,445 ha, Avalon Annex = 1,018 ha; in Jefferson County, FL) is principally managed for northern bobwhite quail recreational hunting as well as for ecological conservation. The property has an extensive area (~ 1,600 ha) of suitable gopher tortoise habitat, which is composed of well-drained sandy soils and a pine/grassland vegetation structure that is maintained by frequent prescribed burns and mid-story hardwood management. Extant gopher tortoise population levels on this property are low but it is likely that the species was historically distributed here far more widely and at greater densities. Reductions in both range and numbers of this species are probably due to anthropogenic pressures such as direct consumption of tortoises as food, 'gassing' of burrows for rattlesnake control, and tortoise collection, as well as habitat loss through historical and current land management.

The overall estimated density of tortoises at Avalon is 0.07 tortoises/ha. This is based on the number of potentially occupied burrows (i.e., active and inactive burrows: n = 248) located by TESF surveys within Avalon's 1,600 ha of suitable habitat, and assumes a burrow occupancy rate of 50 %. The expert consensus minimum viable population size for the gopher tortoise is 250 adults (The Gopher Tortoise Council 2013) of no less than 0.4 tortoises/ha (Guyer, Johnson & Hermann 2012), with: (i) a male-female ratio of 1:1; (ii) evidence of recruitment into the population; (iii) variability in size and age class; (iv) contiguous tortoise habitat of at least 100 ha with no major barriers to tortoise movement (The Gopher Tortoise Council 2013). Other viable tortoise populations in the vicinity of Avalon can exhibit densities from 0.7 tortoises/ha to > 2 tortoises/ha, and gopher tortoise experts with working knowledge of the area suggest that a goal of 1 – 2 tortoises/ha (and at minimum 0.4 tortoises/ha) is appropriate for Avalon and Nonami (Lora Smith & Matt Elliott, pers. comm.).

Restoring viable tortoise populations to Nonami and Avalon is supported by ecological and conservation considerations. The gopher

tortoise is a dominant ecosystem engineer in Sandhill, longleaf pine, and shrub ecosystems. Their deep burrows provide habitat for numerous other species. Thus, higher tortoise densities could enhance local biodiversity. Furthermore, gopher tortoises are state listed as threatened in GA and FL, and a candidate for listing under the ESA.

Project Activities in 2016

Avalon Plantation

Burrow surveys & recipient site development

To restore Avalon's gopher tortoise populations, we are using a translocation approach that moves tortoises from lands under development in Florida and relocates them to state-approved recipient areas (e.g. *Unprotected Recipient Site*, *Short-* or *Long-term Protected Recipient Site*). The *Unprotected* Recipient *Sites* accept rescued gopher tortoises from across Florida in need of rescue relocation (due to human development of their habitat) under FWC's obsolete incidental take permitting (ITP) mechanism which ended in 2007. Alternatively, the current permitting framework for development on tortoise-occupied habitat requires a developer to move all resident tortoises from the development area and relocate them to a designated *Long- or Short-term Protected Recipient Site* (see summary report on page 32 for a description of recipient site types).

We carried out 100% burrow surveys across an area of around 800 acres near Avalon Proper's utility pipeline easement to determine extant gopher tortoise population levels. This area is being considered as a potential recipient site for translocated tortoises (Avalon Pipeline Recipient Site). This entailed two TESF biologists walking approximately 60,000 m of transects with a transect spacing of 50 m (Fig. 6.1). In this area, we detected 23 abandoned burrows and 20 potentially occupied burrows.

In preparation for designating a new 50-acre *Unprotected Recipient Site* on Avalon Proper, we conducted a 100% burrow survey of this proposed Nursery ITP recipient site (Fig. 6.1). During this survey 3,450 m of transects were walked to identify and map evidence of gopher tortoise occupation. Upon detection of a gopher tortoise burrow, a thorough search of the surrounding area was made to identify and map the extent of potentially occupied gopher tortoise burrows as well as abandoned burrows (i.e., burrows of tortoise origin, but exhibiting signs of disuse by tortoises either through collapse or having been taken over by another species). The surveyed area had received prescribed fire several days prior to surveys, and transects were spaced 50 m apart. We detected 24 potentially occupied, and 3 abandoned tortoise burrows within the Nursery ITP recipient site area. Thus, the estimated resident tortoise population at this site was 12 tortoises (i.e. 24 x 0.5 = 12). The capacity of this site (at 3 tortoises/acre) was 150 tortoises (i.e. 50 x 3 = 150), and the maximum number of ITP tortoises (> 129mm) that the proposed Nursery site could accept through translocations was 138 tortoises (i.e. 150 – 12 = 138).

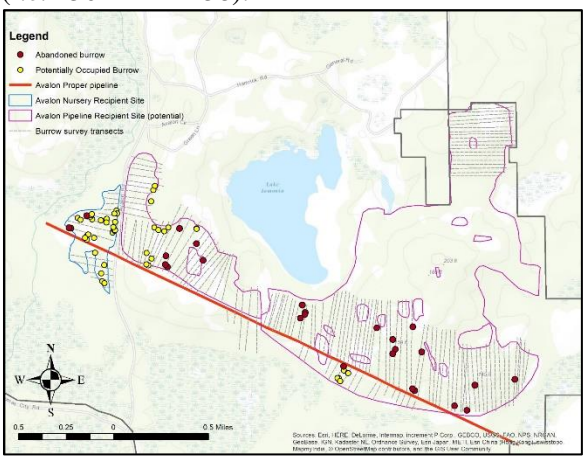


Figure 6.1. The southern portion of Avalon Proper showing the newly designated (in 2016) 50-acre Avalon Nursery Recipient Site, and a potential area for another recipient site (i.e. Avalon Pipeline Recipient Site). 100% burrow surveys were undertaken in these areas during 2016 and all potentiall occupied and abandoned burrows were mapped.

ITP tortoise program

2016 ITP tortoise translocations

In 2016, we continued with ITP tortoise translocations to the 52-acre acclimation pen on the Avalon Annex recipient site, and initiated translocations to a 7-acre pen in the newly designated Avalon Nursery recipient site. We worked collaboratively with Carissa Kent (Saving Florida's Gopher Tortoises) to translocate 170 gopher tortoises to the 2015 Pen, and 12 tortoises to the Nursery acclimation pen (Fig. 6.2).

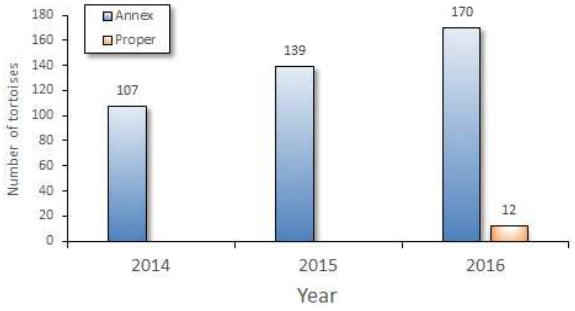


Fig. 6.2. Number of gopher tortoises translocated to the Avalon Annex (blue bars) and Avalon Proper (orange bar) since project inception in 2014.

Prior to release, we examined and measured (maximum carapace length, maximum plastron length, mass, plastron concavity, annuli count, examination for parasites and injury) each translocated tortoise. Tortoises with hardened carapaces and sufficient space on their marginal scutes were given an individual identification number by drilling a unique combination of small holes in the marginal scutes using a standardized marking system (Fig. 6.3). Measurement data from translocated animals are summarized in Table 6.1.

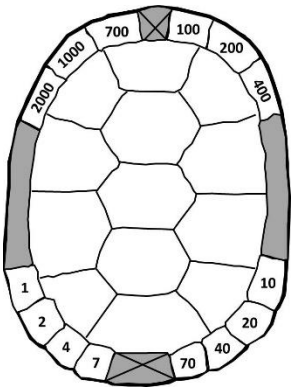


Fig. 6.3. The marking scheme used to give each translocated gopher tortoise (with sufficient carapace hardness and space on marginal scutes) a unique identification number

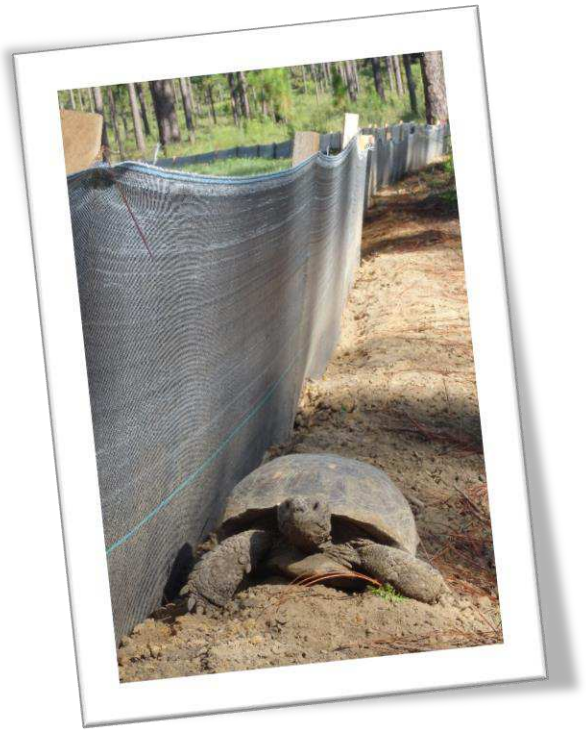
Proposed Future Activities and Considerations

- We will complete gopher tortoise translocations to the Avalon Nursery Recipient Site in 2017.
- In 2017, we will work towards designating a larger acreage on Avalon Proper as a gopher tortoise recipient site (e.g. the proposed Avalon Pipeline Recipient Site). This recipient site may take the form of another *Unprotected Recipient Site,* or we may take a *Long-term Protected Recipient Site* approach.

Table 6.1. Summary data for gopher tortoises translocated to the Avalon Plantation in 2016.

Permit #	♀	♂	Lge. J	Sm. J
BRE-135$^{\alpha}$	–	n=1 $\bar{x}$CL=323	–	–
CHA-027*	n=9 $\bar{x}$CL=244	n=4 $\bar{x}$CL=281	–	n=1 $\bar{x}$CL=100
CLA-035$^{\alpha}$	n=2 $\bar{x}$CL=304	n=1 $\bar{x}$CL=258	–	n=2 $\bar{x}$CL=59
CLA-036$^{\alpha}$	–	n=1 $\bar{x}$CL=277	n=1 $\bar{x}$CL=173	n=1 $\bar{x}$CL=89
DUV-038*	n=2 $\bar{x}$CL=292	n=4 $\bar{x}$CL=272	n=9 $\bar{x}$CL=164	n=17 $\bar{x}$CL=86
FLG-042*	n=7 $\bar{x}$CL=306	n=5 $\bar{x}$CL=273	–	–
LAK-199*	n=2 $\bar{x}$CL=300	n=9 $\bar{x}$CL=274	–	n=9 $\bar{x}$CL=46
OSC-030*	n=28 $\bar{x}$CL=254	n=35 $\bar{x}$CL=266	n=5 $\bar{x}$CL=148	n=24 $\bar{x}$CL=100
STJ-018$^{\alpha}$	n=1 $\bar{x}$CL=301	n=1 $\bar{x}$CL=259	–	n=1 $\bar{x}$CL=90

KEY:
n = number of tortoises translocated to recipient site
$\bar{x}$CL = ave. Max. Carapace Length (MCL in mm)
♀ = female; ♂ = male
Lge. J = large juvenile (> 130 mm MCL). Sex unknown
Sm. J = small juvenile (< 130 mm MCL). Sex unknown
* = Released at Avalon Annex Recipient Site
α = Released at Avalon Proper – Nursery Recipient Site



This gopher tortoise was saved from being entombed as its habitat was developed in Osceola County. She found a new home on the Avalon Annex in 2016

SUMMARY REPORT ON RECIPIENT SITE TYPES FOR GOPHER TORTOISES TRANSLOCATED DUE TO DEVELOPMENT OF THEIR HABITAT

Prior to June 2007, the Florida Fish and Wildlife Conservation Commission (FWC) did not require relocation or removal of gopher tortoises prior to construction activities, and landowners seeking to develop land in Florida could obtain an incidental take permit (ITP) to authorize take (e.g. through entombment in burrows) of gopher tortoises. Since 1991, FWC's ITP program allowed the destruction of around 100,000 gopher tortoises. A developer that obtained an ITP prior to June 2007, but delayed development activities, is not required by law to relocate tortoises. The private group, "Saving Florida's Gopher Tortoises", headed up by Carissa Kent, works to rescue gopher tortoises from these development sites that have grandfathered-in ITPs.

New regulations were adopted in June 2007, whereby gopher tortoises in Florida are now relocated from occupied habitat that is slated for development, and translocated to FWC-certified recipient sites. These recipient sites generally charge a market-driven fee for accepting tortoises, creating an opportunity for private landowners to establish a gopher tortoise conservation bank. This is particularly attractive to conservation-minded landowners with no plans for development. There are three recipient site categories that offer potential avenues for relocating gopher tortoises to private lands, such as the Avalon Plantation:

OPTION 1 – Long-term Protected Recipient Sites: Must have a ***habitat management plan***, and be protected by a perpetual ***easement***. In addition, long-term recipient sites must have a ***financial assurance*** that generates adequate funds for the long-term management of gopher tortoise habitat within the recipient site (acceptable forms of financial assurance include: trust fund, performance bond, irrevocable letter of credit).

OPTION 2 – Short-term Protected Recipient Sites: These are less stringent requirements in terms of easement placement, financial assurances, and minimum recipient site acreage. However, there are some enforceable protection commitments. FWC mitigation fees provide a ten-fold economic incentive for developers to use Long-term Recipient Sites.

OPTION 3 – Unprotected Recipient Sites: Provide relocated tortoises protection for at least two years and require landowners to maintain suitable gopher tortoise habitat for the duration of the recipient site permit (i.e. 2 years). They do not require a conservations easement, financial assurances, a management plan, or place additional restrictions upon the landowner.

Gopher tortoise burrows are typically around 10' deep and 30' long. Gopher tortoises are unable to dig upwards, and when they are entombed by development it can take over a year for them to die in their burrows due to their low basal metabolic rate

7. TESF FIELD PROJECT – INDIGO SNAKE

Drymarchon couperi
ESA listing: THREATENED

PROJECT STATUS
Under development

Principal biologist
Magnus McCaffery

Conservation Problem – Eastern indigo snake populations are declining throughout their range. Factors implicated in this decline include:

- Reduction in both distribution and number of gopher tortoise burrows.
- Habitat destruction through construction, logging, and agricultural activities.
- Incidental mortality as a result of being gassed in their burrows by rattlesnake poachers.
- Illegal collection for the pet trade.

Conservation Status – Listed as federally threatened under the ESA in 1971. The species is also state listed as threatened in FL and GA.

Project Location – Avalon Plantation, FL.

Project Partners

- USFWS
- Central Florida Zoo's Orianne Center for Indigo Conservation (OCIC)
- The Orianne Society
- FWC

Project Funding – TESF

Project Goals & Objectives – To contribute to recovery efforts by establishing a viable eastern indigo snake population through snake reintroductions to the Avalon Plantation. To achieve this, our major objectives include:

- Delineate a reintroduction site of at least 5,000 hectares in size.
- Establish a minimum viable population of gopher tortoises within the reintroduction site to satisfy the eastern indigo snake's winter habitat requirements.
- Work with partners to reintroduce eastern indigo snakes at Avalon Plantation.

Project Background: The eastern indigo snake is North America's longest snake with males and females reaching sizes of up to 8.5 ft. (2.6 m) and 6.5 ft. (2 m) respectively. The species is nonvenomous, with prey that includes small tortoises and all venomous snake species native to the Southeastern U.S. In the northerly portions of their historical range (north of Gainesville, FL), indigo snakes require sandhill habitat during the winter, and are reliant on gopher tortoise burrows as a refuge from cold temperatures. In the warmer months, snakes move to shaded bottomland wetland habitats to forage. Increasing pressures on Indigo snake populations include habitat loss, habitat fragmentation and the decline of gopher tortoise communities. Reductions in prey species and an increase in predators (e.g. feral hogs, coyotes, raccoons and fire ants destroying their eggs) also impact their survival.

In 2008 The Orianne Society built a multidisciplinary approach to eastern indigo snake recovery: using a combination of scientific studies, a lands program focused on habitat restoration, and the creation of the Orianne Center for Indigo Conservation (OCIC).

The OCIC opened in 2012, and is the only captive breeding facility for the eastern indigo snake. Originally established by The Orianne Society for the purpose of breeding eastern indigo snakes for reintroduction programs, the OCIC is now operated by the Central Florida Zoo and Botanical Gardens. Currently a colony of over 100 indigo snakes is managed for genetic and demographic diversity. Snakes produced at the OCIC are available for use as reintroduction stock in regions where historical populations have disappeared.

The largest challenge to captive breeding programs for imperiled species is genetic diversity. Often populations of wild animals become genetically "bottle-necked" as their numbers drop and populations become isolated. To overcome this problem, the OCIC collaborated with a developing eastern indigo snake reintroduction project at Conecuh National Forest in southern Alabama. Permitted by the Georgia Department of Natural Resources (GADNR), eastern indigo snake field collections took place in southern Georgia over a four year period (2008 to 2012) as a joint partnership of

The Orianne Society, Auburn University and the Alabama Heritage Program. Following capture, females were maintained at Auburn University until oviposition, and then returned to the wild at their point of capture. The OCIC received offspring from 18 clutches produced during this time, improving the genetic diversity of their captive indigo snake colony. These captive-hatched indigos snakes were raised at the OCIC and integrated into the captive breeding colony.

The Avalon Plantation, located in the Florida panhandle, and north of Gainesville, FL, is within the historical range of the eastern indigo snake, and is in the vicinity of where indigo snakes were last sighted in the area over two decades ago (Fig. 7.1).

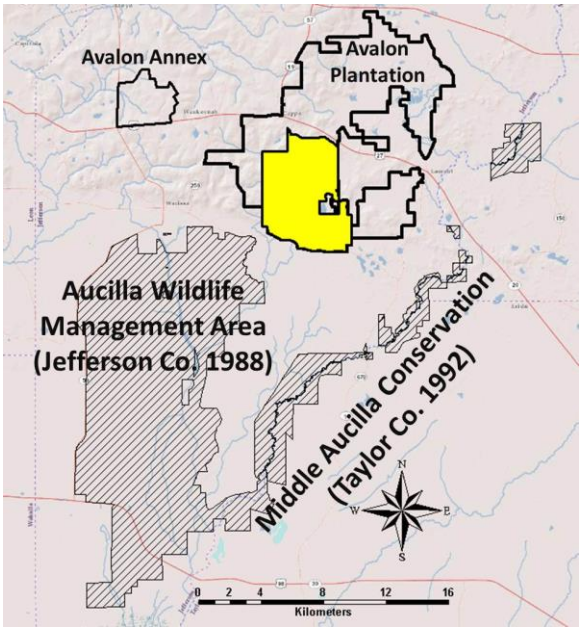


Fig. 7.1. The Avalon property in relation to surrounding protected lands where the most recent eastern indigo snake sightings occurred in 1988 and 1992. Yellow polygon indicates area of Avalon with a TNC conservation easement.

A lack of recent sightings from the panhandle area (Fig. 7.2) could be due to low gopher tortoise densities, where tortoise populations were heavily impacted by past human harvest for food and by habitat degradation resulting from fire exclusion as well as silvicultural and agricultural practices. In conjunction with our gopher tortoise recovery program (see Section 6), we aim to work with the OCIC and other partners to reintroduce eastern indigo snakes to the Avalon Plantation. Recently, the *Eastern Indigo Snake Reintroduction Committee* drafted criteria for potential reintroduction sites. A major habitat feature identified by the committee was that an indigo snake reintroduction site should support, within its boundaries, a minimum viable population of gopher tortoises.

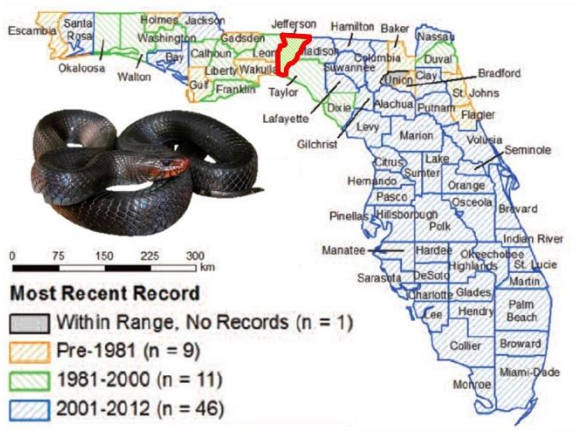


Fig. 7.2. The most recent sighting records for eastern indigo snakes in Florida for each county by time period: pre-1981, 1981–2000, and post-2000. Avalon is located in Jefferson County (red polygon). Source: Enge et al. 2013.

In 2014, we hosted Dr. Christopher Jenkins, Chief Executive Officer of The Orianne Society, at the Avalon and Nonami plantations to evaluate the potential of these properties to contribute towards eastern indigo snake recovery. Based on an appraisal of available habitat, Dr. Jenkins's recommendation was that only Avalon Proper had sufficient potential to serve as an indigo snake recipient site – both Nonami Plantation and the Avalon Annex were considered too small with limited availability of indigo snake summer habitat.

Focusing on Avalon Proper, we implemented a GIS analysis to delineate an indigo snake recipient site and to quantify winter and summer habitat that would be important for a reintroduced population (Fig. 7.3). We identified a potential indigo snake recipient site of around 6,000 ha, with lowland wetlands comprising around 20% of the total area, thus meeting indigo snake recipient site criteria in these regards. However, with very low gopher tortoise burrow densities on Avalon Proper, this property falls short of perhaps the most important reintroduction site criteria – the presence of a viable population of gopher tortoises to fulfil the indigo snake's overwintering requirements. As

part of our GIS analysis, we identified areas of upland pine habitat that would be suitable to serve as gopher tortoise recipient sites. We calculated that around 900 ha of indigo snake winter habitat could be restored with reintroduction of a viable population of gopher tortoises to these areas (Fig. 7.3).

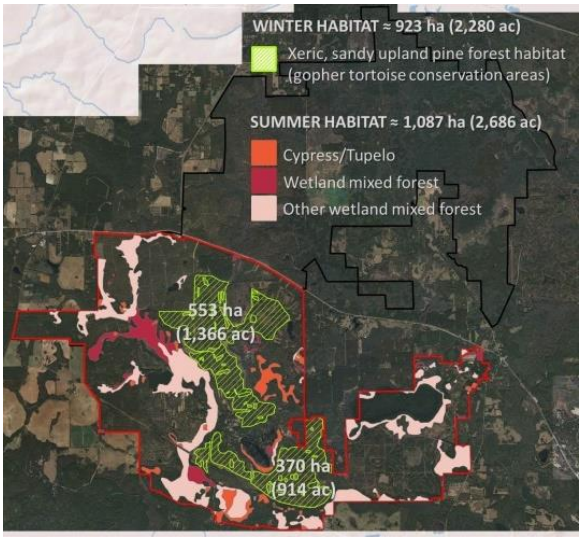


Fig. 7.3. The potential eastern indigo snake recipient site (red outline) comprising around 6,000ha of the Avalon Plantation. Areas that could be populated with gopher tortoises, thereby restoring indigo snake winter habitat are shown as green hatched polygons. Indigo snake summer foraging habitat is indicated by solid polygons.

Project Activities in 2016

In 2016, we began the restoration of eastern indigo snake overwinter habitat (i.e. gopher tortoise burrows) on Avalon Proper. We first implemented 100% gopher tortoise burrow surveys to establish extant tortoise densities within the 50-acre Nursery area of Avalon Proper (Fig. 7.4). We detected 24 potentially occupied, and 3 abandoned tortoise burrows, and estimated the resident tortoise population of 12 tortoises (i.e. 24 x 0.5 = 12). The capacity of this site (at 3 tortoises/acre) was 150 tortoises (i.e. 50 x 3 = 150), and the maximum number of ITP tortoises (> 129mm) that the proposed Nursery site could accept through translocations was 138 tortoises (i.e. 150 – 12 = 138). We then worked with FWC to designate the Nursery Recipient Site as an *Unprotected Recipient Site*, and by the end of 2016 had translocated 12 tortoises to this area to begin augmenting the extant population.

We also carried out 100% burrow surveys across a broader area, incorporating around 800 acres near Avalon Proper's utility pipeline easement to determine extant gopher tortoise population levels (Fig. 7.4). This area is being considered as a potential recipient site for translocated tortoises (Avalon Pipeline Recipient Site). In this area, we detected 23 abandoned burrows and 20 potentially occupied burrows. If fully implemented, restoring a robust gopher tortoise population to this large area will create sufficient burrow habitat for the reintroduction of eastern indigo snakes to commence at Avalon.

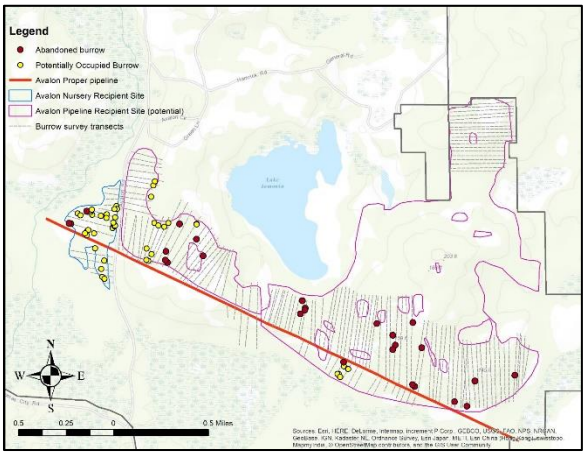


Figure 7.4. The southern portion of Avalon Proper showing the newly designated (in 2016) 50-acre Avalon Nursery Recipient Site, and a potential area for another recipient site (i.e. Avalon Pipeline Recipient Site). 100% burrow surveys were undertaken in these areas during 2016 and all potentiall occupied and abandoned burrows were mapped.

Proposed Future Activities and Considerations

- We will complete gopher tortoise translocations to the Avalon Nursery Recipient Site in 2017.
- In 2017, we will work towards designating a larger acreage on Avalon Proper as a gopher tortoise recipient site (e.g. the proposed Avalon Pipeline Recipient Site), that would satisfy the overwintering requirements of a reintroduced indigo snake population. This recipient site may take the form of another *Unprotected Recipient Site,* or we may take a *Long-term Protected Recipient Site* approach.

8. TESF FIELD PROJECT – LESSER PRAIRIE-CHICKEN

Tympanuchus pallidicinctus
ESA listing: THREATENED

PROJECT STATUS
Ongoing

Principal biologists
Dustin Long
Carter Kruse

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

Conservation Status – Listed as federally threatened in 2014. This listing determination was vacated by a federal court in 2015, and the species' status is currently under review.

Project Locations – Z Bar Ranch, KS

Project Partners – Western Association of Fish and Wildlife Agencies (WAFWA)

Project Funding
- TESF/TEI
- WAFWA

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

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

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

Supporting Rationale for Objective

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

Project Background

The TESF and TEI finalized a10-year lesser prairie-chicken Conservation Plan with WAFWA to manage 32,525 acres of the ranch specifically for lesser prairie-chicken habitat.

Project Activities in 2016

In March 2016, 96% of the Z Bar Ranch burned in a wildfire. The grasslands at the Z Bar evolved with fire and, apart from significant ranch infrastructure losses, the Z Bar largely benefitted from the fire as it served to freshen the vegetation, increase ecosystem heterogeneity, and eliminate invasive woody brush and trees from the uplands; all timely responses since all benefit lesser prairie-chickens. In this, the second year of our 10-year lesser prairie chicken conservation plan, we completed all restoration practices, such as clearing 1,827 acres of woody vegetation from the uplands. While several lesser prairie-chickens were observed by ranch personnel, we did not detect any lesser prairie-chickens during our 2016 spring lek surveys.

Proposed Future Activities and Considerations

In 2016, we completed all of the habitat restoration conditions necessary to support a lesser prairie-chicken population at the Z Bar. While there will continue to be habitat restoration efforts in the future, the lesser prairie-chicken project is now shifting towards habitat management in which we will strategically manipulate bison grazing and prescribed fire to improve habitat for the lesser prairie-chicken. Given the time and effort dedicated to improving lesser prairie-chicken habitat at the Z Bar over the last several years, if leks fail to recover on the ranch naturally we will begin to evaluate the practicality of lesser prairie-chicken translocations to the ranch.

9. TESF FIELD PROJECT – MONARCH BUTTERFLY

Danaus plexippus

ESA listing: STATUS REVIEW

PROJECT STATUS
Ongoing

Principal biologist
Dustin Long

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

Conservation Status

- Under USFWS Status Review
- KS: Species of Greatest Conservation Need
- GA: High Priority Species of Greatest Conservation Need

Project Location – Z Bar Ranch, KS; Avalon Plantation, FL; Nonami Plantation, GA

Project Partners

- Kansas Department of Game, Fish and Parks
- United States Fish & Wildlife Service
- Georgia Department of Natural Resources

Goal – Restore native milkweed and other wildflower communities to Turner properties.

Objective – Increase suitable habitat for monarch butterflies and other native pollinators through milkweed (*Asclepias spp.*) and native wildflower plantings. Within 5 years we will double the milkweed plant density at the Z Bar and establish milkweed populations of not less than 500 plants at both the Avalon and Nonami Plantations. We will expand this project over the next 3 years to include 2 additional properties.

Supporting Rationale for Objective

Most Turner properties lie within the migration routes (Fig. 9.1.) of the monarch butterfly and it is likely that these properties could contribute to monarch conservation through expanding milkweed and other wildflower acreage. The Z Bar and Avalon are particularly well placed because they lie within the region where the first generation of monarchs migrating north from Mexico lay eggs, thus forming the foundation for 2nd and 3rd generations to continue the species' northward migration.

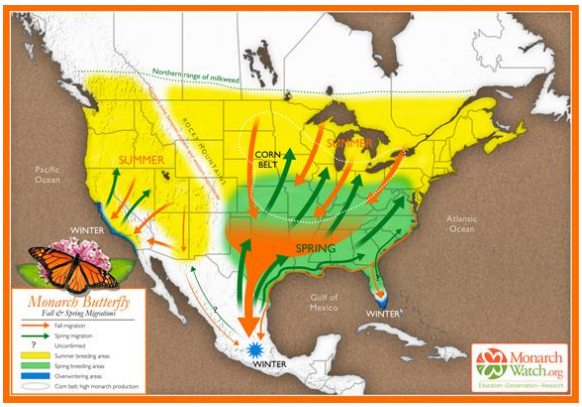


Fig. 9.1. Monarch butterfly migration routes.

Most Turner properties have extant populations of milkweed, although these are scattered, homogenous, and persist at low densities. Without active management, species richness and densities are unlikely to naturally increase.

Project Background

In response to the loss of such an iconic, trans-national insect, we teamed up with federal, state and non-profit partners, and secured funding to begin a monarch butterfly habitat recovery project on Turner properties in early 2015. Central to this effort is planting native milkweed and wildflowers. These plantings will benefit other wildlife species, and as the project matures we will include rare and endangered milkweed species (e.g., *A. meadii*) as part of the project.

Project Activities in 2016

In 2016, our efforts included milkweed and monarch butterfly surveys and planting of milkweed and other wildflower on four properties:

Z Bar Ranch, KS – Transect surveys in 2015 documented four milkweed species on the ranch, with an estimated overall density of 0.005 stems m^{-2} (830,869 milkweed stems on the Z Bar). Milkweed surveys in 2016 found 91 stems encompassing 6 species (*A. latifolia, A. asperula, A. pumila, A. viridis, A. stenophylla* and, *A. viridiflora*), suggesting an overall milkweed density of 0.03 stems m^{-2} (5,374,687 milkweed stems on the Z Bar). Additional milkweed species identified on the ranch but not located within transects in 2016 were *A. speciosa* (some very robust populations), *A tuberosa* and *A. verticillata*. Spring and fall

monarch butterfly surveys indicated the Z Bar was used more by monarchs in the fall than in the spring.

<u>*Nonami Plantation, GA*</u> – The TESF and the USFWS partnered to plant 658 milkweed plugs representing 5 species (*A. tuberosa*, *A. incarnata*, *A. humistrata*, *A. verticillata*, *A. amplexicaulis*) at several locations on the Nonami golf course.

<u>*Avalon Plantation, FL*</u> – The TESF and the USFWS partnered to plant 512 milkweed plugs representing 3 species (*A. incarnata* (Fig. 9.2)*, A. perennis, A. tuberosa*) and 12 plugs of a related species (*Gonolobus suberosus*) at various locations on the plantation.

<u>*Bad River Ranches, SD –*</u> We planted 457 milkweed plugs (*A. incarnata, A. syriaca* (Fig. 9.3)*, A. speciosa* (Fig. 9.4) and *A. verticillata*).

Figure 9.2. Swamp milkweed (*A. incarnata)* established through plug plantings at Lake Iamonia, Avalon Plantation, FL .

Fig. 9.3. Two monarch butterfly caterpillars on common milkweed (*A. syriaca)* at Blue Creek Ranch, NE.

Fig. 9.4. Monarch butterfly caterpillar on showy milkweed (*A. speciosa)* at Bad River Ranches, SD.

Proposed Future Activities and Considerations

We will expand our efforts to other Turner properties and will focus on developing land management practices that promote milkweed and native wildflower establishment. We will also begin reintroductions of rare and extirpated milkweed species to Turner properties. At the four properties, currently the focus of this project, we will conduct surveys to determine milkweed species richness and population density, survey for monarch butterfly eggs and larvae, and assess the success of the 2015-2016 milkweed/wildflower plantings.

10. TESF ADMINISTRATIVE PROJECT – PRIVATE LANDS INITIATIVES

10(a) Western Landowners Alliance (WLA)

PROJECT STATUS
Ongoing

Principal biologist
Mike Phillips

10(b) Global Landowners Initiative for Conserving Imperiled Species (GLI)

PROJECT STATUS
Ongoing

Principal biologist
Mike Phillips

Conservation Problem – Lack of involvement by private landowners **(a)** in the U.S., and **(b)** at the global scale, to recover imperiled species.

Conservation Status – Threatened and endangered species on private lands.

Project Location – (a) Western U.S. **(b)** Earth

Project Partners –
- **(a)** Members of WLA
- **(b)** Tom Kaplan Recanati-Kaplan Foundation
- **(b)** Panthera
- **(b)** Orianne Society
- **(b)** Mohammed bin Zayed Species Conservation Fund
- **(b)** E.O. Wilson Biodiversity Foundation

Project Goals & Objectives – To recruit and assist owners of large land tracts to join the fight to save vanishing species through active support of imperiled species conservation on their land.

Project Background – By the end of each day, two or three species will have been wiped from the face of the earth, leaving humanity slightly more impoverished. From food to medicines to important ecological services that are provided free of charge (e.g., soil formation, flood control, water purification, pollination), it is the wondrous diversity of life that sustains humans.

To illustrate the global scale of this issue, the IUCN Red List contains 55,926 species, of which at least 18,351 are threatened. Of these, over 1,000 occur in the U.S. Almost 2,000 species are listed under the ESA as threatened or endangered and several hundred others are being considered for this federal listing. For Mexico, the IUCN Red List identifies 943 threatened species.

Species extinctions are thus one of humanity's most pressing problems, with habitat loss on private lands at the core of the issue. Vast tracts of such land are owned by relatively few individuals, families, foundations, and other private entities, and in the case of the U.S., it is unlikely that most imperiled species will recover without the cooperation of private landowners. This is because over 60% of the continental U.S. is privately owned, and at least 80% of federally listed species occur either partially or solely on private lands (only ~ 12% of listed species are found almost exclusively on public lands).

Unfortunately, many private landowners in the U.S. and around the world are wary of the possible consequences of harboring imperiled species on their properties. Mounting evidence suggests that governmental regulatory actions, while well-intentioned and required by law, can have unintended and negative consequences for species conservation on private lands. Many landowners fear a decline in their property value due to real or perceived restrictions on land-use options where listed species are found. Consequently, imperiled species are perceived by some landowners as an unacceptable liability. This perception can result in anti-conservation activities despite the frequent inclusion of mechanisms in conservation-oriented laws to minimize negative impacts on landowners. For example, the ESA contains many common sense components to promote the participation of private landowners (e.g., Safe Harbor Agreements or Candidate Conservation Agreements). Unfortunately, these components are not well known or understood given the misinformation that surrounds endangered species recovery efforts.

In 1995, we initiated an historic effort with the aim of replacing fear and misinformation with hope and facts drawn from success stories that told of the importance of private lands for

conserving imperiled species. The proof of concept was the formation of the Turner Endangered Species Fund and Turner Biodiversity Divisions, which developed from a visit by Ted Turner to Yellowstone National Park in 1995. At this time, Yellowstone was a pivotal setting for endangered species conservation, playing host to the landmark effort to actively restore gray wolves to their former range in the Rocky Mountains, a project that Phillips was honored to lead. During his visit, Turner and Phillips ruminated on one overarching question: Could private land be purposefully managed to provide cardinal benefits to imperiled species?

At the time, Turner was the largest owner of land in the U.S. with fee title authority to around 8,000 km^2 that included a diverse array of ecoregions across the U.S. Turner and Phillips surmised that taking advantage of the habitats and security of Turner properties could advance conservation and illustrate that proactive endorsement of the ESA need not burden private land management. Since inception, we have achieved notable successes on these lands, and demonstrated that economically focused management and species conservation can co-exist together.

Our successes notwithstanding, the need for large private land tracts to serve as beachheads of security for imperiled species, and as strategic components of large scale conservation initiatives, have only grown more acute since TESF and TBD formed in 1997. Anthropogenic pressures on wild places and species have increased and the need greatly exceeds the capacity of solitary efforts or small-scale collaborations amongst landowners. Recruiting other owners of large land tracts or convincing high net worth individuals to acquire land to save species is an urgent task. Only by growing the ranks of the engaged can we hope to arrest the extinction crisis. Team Turner is ideally suited to play an active role in such an effort and to that end we have worked with landowners and conservation scientists to help found the WLA and GLI for Conserving Imperiled Species.

In 2013, Mike Phillips joined the Board of Directors of the WLA, and has since worked with this group on issues related to species conservation and improvement of restoration activities on federal lands.

We realized that the ongoing work and successes of the WLA could be replicated at a global level, leading to the establishment of the GLI. In 2014, Phillips worked to enlist the Renanti Recanati-Kaplan Foundation, Panthera, Orianne Society, Mohammed Bin Zayed Species Conservation Fund, and the E.O. Wilson Biodiversity Foundation into the GLI.

TESF joined E.O. Wilson's Half-Earth project: A collaborative effort to save our imperiled biosphere by devoting half the surface of the Earth to nature

Project Activities in 2016

For the WLA, Phillips served on the Board of Directors and participated in efforts to provide the Western Governors Association with options for improving the ESA. For the GLI, Phillips worked with members of the Recanati-Kaplan Foundation to develop sufficient administrative capacity to support future efforts.

TESF's major effort in 2016 was partnering with the E.O. Wilson Biodiversity Foundation's Half-Earth Project, where we provided important support for the private lands component of the endeavor. In this capacity, TESF was a featured aspect of the Half-Earth Project proposal that was submitted to the MacArthur Foundation's 100&Change initiative, an audacious plan to provide $100 M in support of measurable progress toward solving a significant problem. TESF's role on the Half-Earth team focused on assembling private capacity to redress the extinction crisis. Specifically, we proposed that imperiled species conservation on private land be the focus of

several pioneering gatherings that aim to create a community of owners, scientists, governmental and non-governmental organizations, and inspiring leaders committed to redressing the extinction crisis by fully exploiting the potential of private land. These gatherings would aim to identify and assemble support for those willing to commit their land holdings and their social and financial influence to conserve the wondrous diversity of life upon which humanity depends. The work of TESF and TBD across the 2,000,000 acres owned by Ted Turner would be offered as evidence of the potential that exists and a practical template for new endeavors.

The gatherings could produce measurable outcomes. For example, the proceedings could be assembled as the seminal document on the issue. During the gatherings we could enroll landowners in forward thinking, concrete projects on behalf of imperiled species. If enough enrolled, unprecedented progress conserving imperiled species could be achieved.

It is easy to imagine that over time this incipient effort could be evolved into an independent self-directed network of private landowners, conservation scientists and administrators, federal and state agencies, corporate and non-profit partners, educators, artists, philosophers, and students to continue to advance conservation on private land to benefit imperiled species and their habitats. Such a network would ensure the continued successful completion of projects and the development of new endeavors by providing a forum for fellowship and sharing best practices and lessons learned to save vanishing species. With time, the network could be extended to address the profound need to conserve nature in every corner of the world. Perhaps a fitting name for the effort would be *A Network of Arks*.

Landowners who join the fight to save vanishing species would find, as Team Turner has, that the task is daunting because emphasizing private stewardship of biodiversity is new, attendant problems are complex, and effective solutions require broad-based socio-political, biologic, geographic, and fiscal considerations. Willing landowners would realize that restoration projects can be controversial, slow to succeed, and fraught with uncertainty. They would realize that some can fail.

We believe, however, that the difficulties they might encounter should not be sufficient to diminish their resolve which ultimately would be based on the inspiring notion that any real solution to the extinction crisis will rely on new answers to old questions and the genius and determination of at least a few visionaries. They would find chronic inspiration in the knowledge that they were contributing in a unique and meaningful way to the conservation of the wondrous diversity of life on Earth.

Strategic investments can pay notable dividends. Such returns are most likely if an investment involves a powerful and inspiring message that promotes hope and action in this age of cynicism and delay. The work of recruiting owners of large tracts of private land to benefit imperiled species is just such an investment.

Failing to recruit landowners to the cause of imperiled species conservation is not an option. To avoid the ultimate transgression of passing an impoverished planet to future generations, we must succeed in drawing more attention to the extinction crisis and one of humanity's most pressing and least attended problems. Sadly, even less attention is paid to the unarguable fact that extinction is not conditional, it is absolute: another heaven and earth must pass before an extinct species can arise anew. Fortunately, restoration is an alternative to extinction.

By advancing the usefulness of private land for imperiled species restoration projects, owners can respond favorably to a seminal observation offered by E. O. Wilson: *"there can be no purpose more enspiriting that to begin the age of restoration, reweaving the wondrous diversity of life that still surrounds us."*

Sadly, the Half-Earth Project proposal was not chosen for the MacArthur Foundation's $100 M award. (The projects that we selected as semi-finalists were uniformly focused on health and human services initiatives). Overall, the Half-Earth proposal was judged to be bold, ambitious, and extremely relevant. With those words of encouragement, it is beyond prudent for Team Turner to continue effort to recruit landowners to join the fight to save vanishing species.

11. TESF FIELD PROJECT – RED-COCKADED WOODPECKER

Picoides borealis
ESA listing: ENDANGERED

PROJECT STATUS
Ongoing

Principal biologists
Greg Hagan
Mike Phillips

Conservation Problem – Population decline due to habitat destruction and degradation.

Conservation Status
Listed as endangered under the ESA in 1973.

Project Location – Avalon Plantation is located in Jefferson County, FL. It is the southern-most plantation in the Red Hills physiographic region of north Florida and South Georgia.

Project Partners
- USFWS
- FWC

Project Funding
- TESF
- USFWS Cooperative Enhancement Agreement

Project Goals & Objectives – To restore at least 20 breeding groups to the Avalon Plantation that can persist with minimal management. Once this is achieved, Avalon will become a donor site for translocations to other recovery sites.

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

Project Background

RCWs depend on habitat provided by mature pine forests—specifically those with longleaf pines averaging 80 to 120 years old and loblolly pines averaging 70 to 100 years old. Over the last century, RCWs have declined rapidly as their mature pine forest habitat was altered, principally for timber harvest and agriculture. Pine savannahs and open woodlands once dominated the southeastern United States and may have encompassed over 200 million acres at the time of European colonization. Longleaf pine communities may have covered 60 to 92 million of those acres. Today, fewer than 3 million acres remain. RCWs once ranged from Florida to Maryland and New Jersey, as far west as 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 March 1998, we worked with the USFWS to reintroduce RCWs to the Avalon Plantation in north Florida. This effort was the first by a private landowner, state or federal agency to reintroduce a population of woodpeckers into an area where there was no extant population.

While the population expanded steadily during the first decade of the project, by 2007 there were signs growth was slowing. An assessment of cluster status was undertaken in December 2011 and January 2012. It was determined the population comprised 13 active groups, 2 inactive groups, and 7 abandoned groups (i.e., showing no evidence of RCW activity for 3+ years). However, by November 2014 the population had expanded to 15 active groups.

Project Activities in 2016:

Systematic Property and Cluster Surveys

Suitable RCW habitat was surveyed (outside of known cluster locations) in February and

October 2016 for the presence or absence of RCW cavity trees. Surveys were conducted by running line transects through stands and visually inspecting trees for evidence of cavity excavation by RCWs. Transects were run north to south and spacing varied depending upon stand structure as set forth in Appendix 4 of the Red-cockaded Woodpecker Recovery Plan. No new clusters were located on the property.

Comprehensive cluster surveys were completed in October 2016. A total of 23 RCW clusters were located throughout the property (see Fig. 11.1). Eighteen active groups, 3 inactive groups, and 2 abandoned groups are currently established on the property. This represents the highest active group total recorded on the property. Moreover, numerous new natural cavity trees (active and inactive), as well as, several start cavities were discovered throughout the clusters. This is a positive sign demonstrating Avalon's pine overstory is suitable for the species.

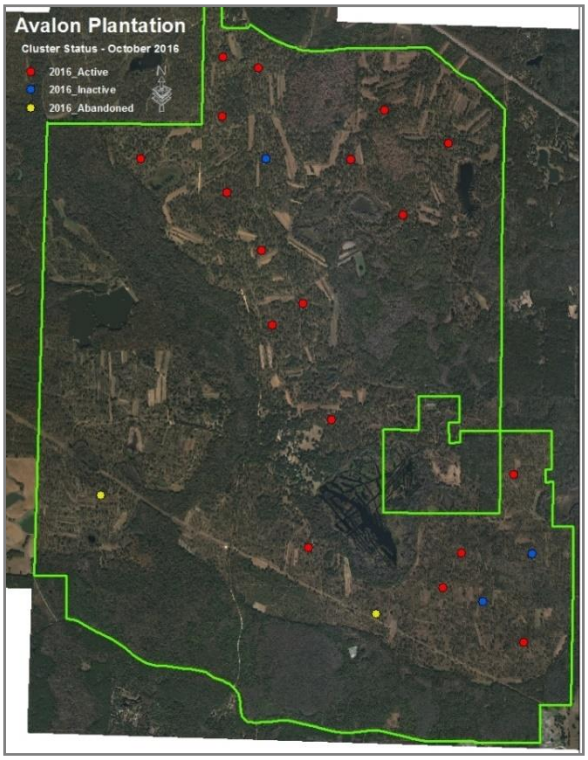


Fig. 11.1. Results of 2016 RCW cluster surveys at Avalon Plantation.

Cavity and habitat Management

All clusters (active, inactive and abandoned) were mowed in late January/early February in advance of the burning season. All cavity trees were marked throughout the property prior to mowing and the burn season. Approximately 48 acres were mowed (2 acres/cluster). No cavity tree mortality or scorch was experienced throughout the entire burning season. Moreover, prior to any activity within or near cluster sites, operators are typically reminded of the location of cavity trees.

Prescribed Fire

Approximately 60 - 65% of the entire property was burned during March and early April 2016.

Cluster Monitoring

Each cluster was monitored throughout the year, usually in March, June, and October. Monitoring checks were used to ensure each cluster had a minimum of 4 suitable cavities and to evaluate activity status (active or inactive).

12. TBD FIELD PROJECT – CUTTHROAT TROUT

Westslope cutthroat (*Oncorhynchus clarkii lewisi*)
Rio Grande cutthroat (*O. c. virginalis*)

ESA listing (both species): NOT LISTED

PROJECT STATUS
Ongoing
Principal biologists
Carter Kruse
Eric Leinonen

Conservation Problem – Range-wide declines due to competition and introgression with introduced salmonids, but also from habitat degradation and exploitation. Westslope cutthroat trout (WCT) were historically the most widespread cutthroat subspecies, occupying around 90,800 km of streams and rivers of the upper Columbia and Missouri basins of Montana, Wyoming and Idaho. The historical range of genetically pure populations has been reduced by 76%. On the east side of the Continental Divide range reduction has been most dramatic, exceeding 95%. Rio Grande cutthroat trout (RGCT) were historically found in about 10,700 km of habitat in the upper Rio Grande basin of Colorado and New Mexico. The distribution of genetically pure populations of this subspecies has been reduced by 92%.

Conservation Status
- RGCT are considered a Species of Greatest Conservation Need by the New Mexico Department of Game and Fish and Colorado Parks and Wildlife.
- WCT are considered a Species of Greatest Conservation Need by Montana Department of Fish, Wildlife and Parks.
- Both subspecies have been petitioned for listing under ESA, but found not warranted for listing.

Project Locations (Table 12.1)
Costilla Creek, Vermejo Park Ranch – RGCT
Cherry Creek, Flying D Ranch – WCT
Las Animas Creek, Ladder Ranch – RGCT
Greenhorn Creek, Snowcrest Ranch – WCT
Vermejo River, Vermejo Park Ranch – RGCT
NF Spanish Creek, Flying D Ranch – WCT
Green Hollow Creek, Flying D Ranch – WCT

Project Partners (integral to success)
- New Mexico Department of Game and Fish
- Colorado Parks and Wildlife
- Montana Fish Wildlife and Parks
- US Forest Service
- US Fish and Wildlife Service
- Bureau of Land Management
- Trout Unlimited

Grant Funding
- 1999 Partners for Fish and Wildlife ($20,000)
- 2003 TU Embrace-A-Stream ($5,000)
- 2005 USFW Private Stewardship ($31,300)
- 2006 Nat. Fish and Wildlife Fnd. ($100,000)
- 2008 MT AFS Resource Action Fund ($2,000)
- 2009 Partners for Fish and Wildlife ($35,000)
- 2009 NM State Wildlife Grant ($100,000)
- 2010 NM State Wildlife Grant ($100,000)
- 2010 MT FWP ($5,000)
- 2010 US Forest Service ($2,500)
- 2011 USFS Res. Advisory Council ($20,000)
- 2011 MT FWP Future Fisheries ($81,983)
- 2013 Partners for Fish and Wildlife ($24,900)
- 2014 Partners for Fish and Wildlife ($50,000)
- 2015 MT FWP Future Fisheries ($7,080)
- 2015 Partners for Fish and Wildlife ($66,000)
- 2016 MT FWP Future Fisheries ($60,000)
- 2016 National Fish and Wildlife Fund. ($90,000)
- 2017 US Forest Service ($25,000)
- 2017 Western Native Trout Initiative ($15,000)

Project Recognition
- 2005 MT AFS – Collaborative Group Award
- 2010 USFS – Collaborative Aquatic Stewardship Award
- 2011 Western Division AFS – Conservation Achievement Award
- 2012 American Fisheries Society – President's Fishery Conservation Award
- 2015 Governor's (NM) Environmental Excellence Award for Wildlife Conservation
- 2016 Sustaining Forest and Grassland Award, US Forest Service Region 1

Table 12.1. 2016 Turner Biodiversity Native Cutthroat Trout Initiative

Goal - to catalyze cutthroat trout restoration or conservation activities on 400 km of stream.

Stream	Ranch	Species	Partners	km	Type	Status
Costilla Creek	Vermejo	RGCT	NMDGF, CDOW, TU, USFS, USFWS	175	Piscicide	Treatment complete (2016) Restocking underway
Cherry Creek	Flying D	WCT	MT FWP, USFS, WCS, USFWS	100	Piscicide	Treatment complete (2010) Restocking complete (2012) Research and monitoring ongoing
Las Animas Creek	Ladder	RGCT	NMDGF, USFS	48	Natural Disaster	2013 Silver Fire killed non-native trout; monitoring habitat recovery
Greenhorn Creek	Snowcrest	WCT	MT FWP, USFS, BLM	32	Piscicide	Treatment complete (2014) Restocking underway
Vermejo River	Vermejo	RGCT	NMDGF, USFWS	32	Electrofishing Piscicide	4- yr removal effort complete, chronic maintenance required
NF Spanish Creek	Flying D	WCT	MT FWP, USFS	30	Piscicide	Planning and development Barrier construction 2018
Green Hollow Creek	Flying D	WCT	MT FWP	4	Electrofishing	1-2 yr from complete eradication (95%)

Project Goal – Restore or enhance self-sustaining populations of native cutthroat trout on Turner Ranches and surrounding landscapes to improve conservation status of subspecies.

Project 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 12.1) 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.

Project 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. This is by far the most comprehensive and ambitious private effort on behalf of native cutthroat trout. Efforts to restore or conserve cutthroat trout are in underway in seven streams on four ranches. The overall goal is to improve the range-wide status of RGCT and WCT and prevent listing under ESA using the following strategy:

- Selection of reintroduction sites encompassing a large geographic area with high quality and diverse habitats to support robust cutthroat trout populations with diverse life-history strategies that are able to resist threats such as climate change, catastrophic events, and invasive species.
- Elimination of non-native competitors in the reintroduction site through physical and/or chemical renovation, and prevent their recolonization.
- Establishment of a self-sustaining population of cutthroat trout large enough to withstand environmental and demographic stochasticity and likely to persist over the long-term (>100 years) with little or no human intervention.
- Establishment of a monitoring strategy, including relevant research partnerships, that evaluates key project aspects and allows adaptive management of all strategies and methods as the project unfolds, and to improve and guide future efforts.

The cutthroat trout is native to the Rocky Mountains 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.

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 U.S. The Cherry Creek Native WCT Project on the Flying D Ranch in Montana encompasses approximately 100 km of stream habitat and 3 ha of lake suitable for cutthroat trout, and is the largest piscicide renovation project ever completed to date for the purpose of cutthroat trout conservation. The Cherry Creek project is a significant conservation achievement for WCT on the east side of the continental divide. This project increased 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%. Perhaps more importantly, the success of the Cherry Creek project, and lessons learned from it, has catalyzed other cutthroat trout re-introduction projects in southwestern MT. The Costilla Creek Native RGCT Project on Vermejo Park ranch in New Mexico and Colorado is the most ambitious watershed renovation project ever initiated to date on behalf of any cutthroat trout, encompassing approximately 175 km of stream habitat (60% on Vermejo Park Ranch) and 18 lakes (all on Vermejo). When fully implemented by 2020 it will represent 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 NM Department of

Game and Fish. 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 the Department's native cutthroat trout hatchery broodstock; both important steps for range-wide conservation of the species. A Candidate Conservation Agreement with Assurances (CCAA) has been developed with the US Fish and Wildlife Service for both these projects. These documents recognize the conservation actions implemented by TBD and provide operational assurances to the ranches should the species' become listed under ESA.

Figure 12.1. Terminal fish migration barrier on Costilla Creek in the Carson National Forest.

Project Activities in 2016:

Cherry Creek – Electrofishing monitoring in 2016 indicated cutthroat trout numbers and average size continue to exceed that of the pretreatment nonnative trout population (Fig. 12.2). These numbers are moderating and will likely more closely align with pretreatment averages within the next few years. No non-native trout have been captured in the project area since piscicide treatments were completed in 2010. Environmental DNA samples from several Cherry Creek tributaries also did not detect any non-native trout DNA. Monitoring and recapture of tagged fish continues to provide data on survival, movement, growth, and genetic fitness of the population. TBD partnered with University of Idaho to assist with genetic analyses. A fish passage structure completed in early 2016 now allows cutthroat trout the freedom to move upstream over the irrigation weir in Cowboy Canyon. Montana Fish Wildlife and Parks Future Fisheries Program provided 50% cost share for the structure. Turner family, friends, and guests report that their angling experience on Cherry Creek is excellent. Public anglers continue to report catch of native cutthroat trout in the Madison River in the vicinity of Cherry Creek, and cutthroat trout are now present in measurable numbers in MT Fish Wildlife and Parks annual surveys of the Madison River.

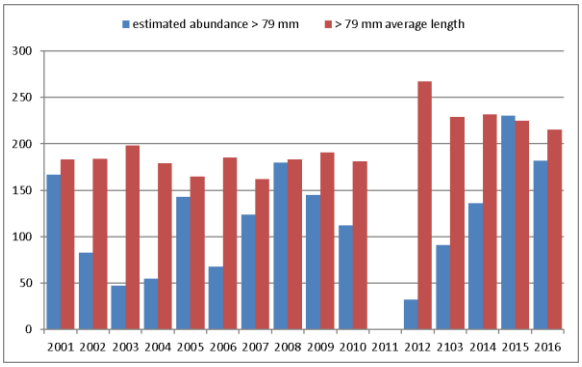


Fig. 12.2. Average number (blue) and size (mm, red) of trout per 100 m reach of Cherry Creek before (2001-10) and after (2012-16) WCT restoration. 200 mm = 8 inches.

Costilla Creek – A terminal fish migration barrier (Fig. 12.1) was constructed on Costilla Creek in the Carson National Forest in October 2016 to protect 175 km of restored RGCT, including fish on Vermejo Park Ranch.

The final piscicide applications in the Costilla watershed on Vermejo Park Ranch were completed in 2016 (Fig. 12.3). This included July and August retreatments of over 50 km of stream initially treated in 2015, as well as a second treatment of Costilla Reservoir in October. Only a few remaining brook trout were removed during the July treatment in 2016. Subsequent treatment and monitoring did not find any fish, giving us confidence that the effort was successful. Efforts will now focus on RGCT population recovery in the reservoir and lower portions of streams. Population monitoring continued in the upper portions of the watershed where RGCT have already been restocked and suggest that numbers have recovered to pre-project levels in some cases (upper Costilla) and continue to recover in others (upper Casias). An informational brochure regarding the project was prepared for distribution to Vermejo Park Ranch guests.

Fig. 12.3. Preparing for final rotenone treatment of Costilla Reservoir at Vermejo Park Ranch, October 2016.

Vermejo River **–** This is the only project in the *Cutthroat Trout Initiative* where aboriginal cutthroat trout are known to remain on Turner Ranches. This conservation population of RGCT is threatened by competition with nonnative brook trout (BKT), hybridization with rainbow trout, and declining habitat quality (e.g., increased stream temperatures and turbidity). In an effort to maintain the population TBD has removed approximately 25,000 BKT from the upper 36 km of the Vermejo River (2010-16). More importantly, 20 confirmed rainbow x cutthroat trout hybrids and 1 rainbow trout (from Leandro Creek) were removed from the watershed from 2010-15. Removal of these hybrids has helped keep the genetic status of Vermejo River RGCT at least 99% pure. Effort in 2016 focused on population monitoring and searching for additional hybrid fish. Unfortunately, six rainbow trout and 15 confirmed hybrids were found in the Vermejo River watershed in 2016, mostly in Leandro Creek. These fish are almost certainly the result of hatchery rainbow trout escaping from guest fishing lakes. Vermejo Park Ranch has been encouraged to monitor lake water levels more closely and screen lake outlets to prevent escape. 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.

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 will occur 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 in 2016 included vegetative photo points, water temperature measurements, fisheries surveys, and macroinvertebrate collections.

Las Animas Creek **–** This project was undertaken to restore the native fish community (i.e. RGCT, Rio Grande chub (*Gila pandora*), and Rio Grande sucker (*Catastomus plebeius*)) 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 has experienced administrative and political delays since its conception in 1998; however, recent momentum lead to a draft environmental assessment (DEA) by the U.S. Forest Service for the project in early 2014. The DEA concluded a rotenone treatment to remove non-native longfin dace (*Agosia chrysogaster*) and hybridized rainbow x cutthroat trout from the project area was the best option to restore the native fish community. However, while the DEA was under development the 138,000 acre Silver Fire burned the entire Gila National Forest portion of the watershed in summer 2013. Subsequent monsoon rains resulted in multiple, significant debris, sediment, and ash flows, drastically changing the instream habitat. Population surveys in 2014, 2015, and early

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 such as small springs and tributaries not impacted by the debris flows and are repopulating the project area. Limited numbers of Rio Grande chub were also observed for the first time post fire in 2016. Hybrid trout and Rio Grande sucker appear extirpated by the effects of the fire. Subsequently, NM Department of Game and Fish and TBD have decided not to conduct a rotenone treatment to remove the longfin dace. A 2016 watershed assessment indicated that instream habitat is sufficiently recovered to support a small population of RGCT. Stocking of RGCT from Canones Creek will occur in May 2017, providing an important replicate of and genetic reservoir for that population. Repatriation of Rio Grande sucker to Las Animas Creek may also occur in 2017.

NF Spanish Creek – WCT are nearly extinct in the Gallatin River watershed. Restoring WCT to approximately 30 stream km in upper NF Spanish Creek would be a significant conservation gain and establish an important beachhead for additional WCT restoration in the Gallatin watershed. The majority of this project is on public land, thus Montana Fish Wildlife and Parks and the U.S. Forest Service are leading the public scoping and environmental assessment process. A public scoping letter for the project was published in early 2016 and an environmental analysis was drafted. Design of the fish barrier necessary to protect the restored WCT population was completed in 2016. Fundraising for the fish barrier construction was initiated with $190,000 committed to the project by the National Fish and Wildlife Foundation, MT Future Fisheries Program, the Western Native Trout Initiative, and the U.S. Forest Service. Several planning meetings were held to discuss the project timeline. If funds can be raised, barrier construction is planned for 2018, while piscicide application may occur in headwater lakes as early as 2017. TBD continued to gather pre-treatment baseline information in 2016 with electrofishing surveys at standard sampling sites and mapping fish of distributions throughout the watershed.

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 315 adult fish (Fig. 12.4) from six remnant populations of WCT in the upper Missouri River Basin. The same stocking effort is scheduled for 2017. When completed, this project will represent a significant conservation gain for WCT in the Ruby River drainage (Fig. 12.5). An annual inspection was conducted on the Greenhorn fish migration barrier.

Fig. 12.4. Aaron Paulson, Snowcrest Ranch Manager, transporting WCT to upper NF Greenhorn Creek.

Fig. 12.5. Restored WCT in Greenhorn Creek.

Green Hollow Creek – In an effort to reduce disease and competitive pressures on the Green Hollow II arctic grayling (*Thymallus arcticus*) conservation broodstock, 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 #2). Removal activities are conducted opportunistically as scheduling allows. In 2016 only 42 additional BKT were removed from upper Green Hollow Creek. This is probably due both to limited removal effort in 2016 and the low number of fish remaining in the stream. The total number of fish removed to date is 14,827 (Fig. 12.6). With a concerted effort in 2017, extirpation above the fish barrier could occur within the next year or two. Montana Fish Wildlife and Parks is exploring upper Green Hollow as a potential refugia site for Gallatin Drainage WCT stocks.

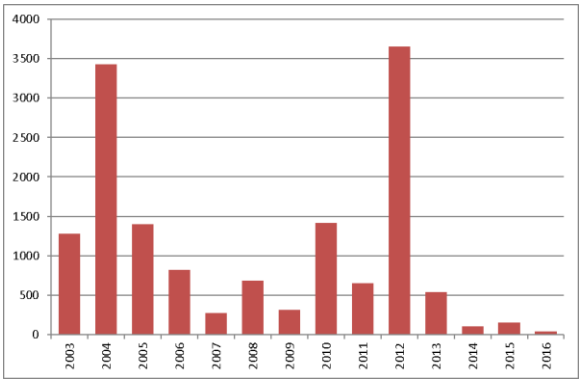


Fig. 12.6. Trout removed from Greenhollow Creek, Flying D Ranch since 2003.

Proposed Future Activities and Considerations – Over the past decade, TBD has developed both capable partnerships and considerable field expertise that, with a little luck, should drive the *Cutthroat Trout Initiative* to a successful conclusion. All the cutthroat trout restoration and conservation projects described herein have substantial momentum, and with the exception of work in the Vermejo River, should be completed by 2020. No additional cutthroat trout restoration projects are planned for Turner properties. With exception of the Bear Trap Creek project, which was removed from consideration for native trout restoration in 2015, TBD has remained committed to the vision established by the *Cutthroat Trout Initiative* over 17 years ago. Our partners appreciate the resources, commitment, experience, and steady hand the Turner organization brings to a project. Successful conclusion of the *Cutthroat Trout Initiative* establishes a legacy the Turner organization can be proud of.

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

13. TBD FIELD PROJECT – ARCTIC GRAYLING

Thymallus arcticus

ESA listing: NOT LISTED

PROJECT STATUS
Ongoing
Principal biologists
Carter Kruse
Eric Leinonen

Conservation Problem – Arctic grayling are widespread throughout drainages of the Arctic and northern Pacific oceans; however distinct populations in Michigan (now extinct) and southwestern Montana have experienced significant declines due to competition from non-native trout, and habitat alterations. The fluvial (river-dwelling) Arctic grayling population in Montana was once widespread in the Missouri River basin above Great Falls. Over the past 100 years, populations have declined in both range and abundance and currently occupy approximately 4% of historic range. Prior to restoration efforts, fluvial arctic grayling in Montana could only be found at very low densities in an 80 km reach of the Big Hole River.

Conservation Status –Arctic Grayling are considered a Species of Greatest Conservation Need by Montana Fish Wildlife and Parks.

In 2010 the U.S. Fish and Wildlife Service (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 of 2014 the USFWS determined that conservation efforts by federal, state, and private organizations had helped bring the species to a point where listing was no longer warranted.

Project Locations
Green Hollow Reservoir II, Flying D Ranch
Willow Creek, Snowcrest Ranch
Cherry Creek, Flying D Ranch
Spanish Creek, Flying D Ranch

Project Partners
- Montana Fish, Wildlife & Parks
- US Fish and Wildlife Service

Project Recognition
- 2014 MTFWP and USFWS – Arctic Grayling Conservation Award

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 250 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., $\geq$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.

Project 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 to establish a brood stock. The brood stock was intended to serve as a source of grayling eggs for restoration projects across southwestern Montana. Over the past 20 years, TBD has provided invaluable assistance towards the grayling restoration by managing the reservoir and brood stock population. In 2002 a fish barrier was constructed on Green Hollow Creek to prevent grayling from moving into and spawning in the channel (Fig. 13.1). Since 2003 TBD has worked to remove non-native trout from the reservoir and inflowing creek (see Cutthroat Trout for summary of non-native trout removal in Green Hollow Creek). Each spring TBD staff assist MTFWP with disease sampling and spawning of grayling. Over the past three years (2015-2017), Green Hollow II grayling have provided approximately

750,000 viable eggs (Fig. 13.2) for restoration projects in southwest Montana, including Yellowstone National Park.

Fig. 13.1. Newly constructed fish movement barrier on Green Hollow Creek in fall 2002.

Fig. 13.2. Grayling egg take at Green Hollow II.

Unusually high spring runoff in 2011 deposited large amounts of gravel in the Green Hollow Reservoir II inlet, allowing grayling to spawn naturally in 2012-15, despite efforts to disrupt spawning activity. In 2016 a bypass system (Fig. 13.3) was installed for about 4 weeks to prevent spawning. These wild born progeny overpopulated the brood pond and resulted in smaller average adult sizes. In 2015 a decision was made to transfer some of the wild born fish to lower Green Hollow Creek (below Green Hollow Reservoir). Over 1,000 juvenile grayling were captured and moved during spring trapping activity in 2015 and 2016 (Fig. 13.4). These fish have unrestricted movement into the NF 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. Anglers have reported catching grayling within Spanish Creek and the Gallatin River, although there is no evidence as yet that the fish are naturally reproducing in either location. Grayling have escaped from Green Hollow II and established a self-sustaining population in Green Hollow Reservoir I. Fish from this population likely have and will continue to escape into NF Spanish Creek, providing a chronic, soft introduction of grayling to the Spanish Creek watershed.

Fig.13.3. Bypass pipes installed at Green Hollow Creek inlet to prevent grayling from spawning in 2016. Note barrier (Fig. 13.1) in background.

Fig. 13.4. TBD staff collect grayling from Green Hollow II reservoir for spawning.

Project Activities in 2016

TBD coordinated two separate spring spawns of the Green Hollow grayling in 2016. Adverse weather (Fig. 13.4) and small average adult female size (i.e.., smaller fish reduces fecundity or number of eggs per female) impacted overall egg take but still yielded 149,380 eggs. These fertilized eggs were stocked across southwestern Montana, including Yellowstone National Park, and supported a research project in Michigan.

The eggs gathered at Green Hollow in 2016 represented the entire egg source for Montana's arctic grayling restoration efforts for the second consecutive year due to spawning difficulties at the other grayling brood pond - Axolotl Lakes.

During the capture of brood fish for spawning, 536 wild-born juvenile grayling were collected and translocated to the lowest reaches of Green Hollow Creek.

A system of pipes was installed at the Green Hollow Creek inlet to bypass water around a short section of spawning gravels naturally deposited by high flows in 2011. The bypass system successfully prevented natural spawning by Green Hollow II grayling in 2016 (Fig. 13.3).

For the first time TBD staff introduced grayling into lower Cherry Creek (below Cherry Falls and outside of WCT restoration project area) in 2016 (Figs 13.5 & 13.6). A total of 10,000 fertilized eggs were hatched in remote stream-side incubation (RSI) devices. RSI's improve hatching success and allow larval grayling to volitionally leave the incubator and enter the stream habitat.

Modest electrofishing monitoring efforts in the spring and fall of 2016 failed to capture grayling in lower Green Hollow, NF Spanish, or lower Cherry creeks. Nevertheless, Flying D fishing guides and guests reported catching numerous grayling in the beaver ponds along the mainstream of Spanish Creek. MTFWP also confirmed angler reports of grayling caught in the Gallatin River below the Spanish Creek confluence.

Proposed Future Activities and Considerations

TBD will continue to maintain the Green Hollow II grayling brood stock and assist MTWP with egg takes each spring. RSI stocking of grayling will continue in lower Cherry Creek until a population is successfully established or such outcome is considered unfeasible. Grayling introductions will be considered in upper Cherry Creek once the recently introduced native westslope cutthroat trout population stabilizes. Annual monitoring will occur in waters where grayling have been introduced.

Fig. 13.5. Approximately 1500 fertilized grayling eggs ready for placement into an RSI.


Fig. 13.6. TBD staff placing fertilized grayling eggs into an RSI battery along lower Cherry Creek.

14. TESF FIELD PROJECT – WOLVES

14(a) Mexican gray wolf *(Canis lupus baileyi)*
ESA listing: ENDANGERED

PROJECT STATUS
Ongoing

Principal biologists
Chris Wiese
Mike Phillips

Conservation problem – Once common in parts of Arizona, New Mexico, Texas, and Mexico, human persecution resulted in the extirpation of the Mexican wolf in the wild. Current threats include illegal shootings, lack of space for population expansion, and a small founder population.

Conservation Status
- Listed as endangered in 1976

Project Location – Ladder Ranch, NM

Project Partners
- USFWS
- Mexican Gray Wolf Species Survival Plan

Project Funding
- TESF
- USFWS Cooperative Agreement

Project Goal – Participate in Mexican gray wolf recovery in southern New Mexico and Arizona.

Objective – During the next ten years, we will continue to support Mexican gray wolf recovery by maintaining a captive facility on the Ladder Ranch that houses up to 25 wolves, including breeding pairs, family packs, and wolves transitioning between the wild population and captivity. We will respond to the needs and overall project goals set by the USFWS and the Species Survival Plan on an annual basis.

Supporting Rationale for Objective – Mexican gray wolves (MGW) are a subspecies of gray wolves that roamed most of the southwestern US and portions of Mexico until they were eradicated in the wild through government-sponsored predator control. By the time the MGW was listed under the ESA it was on the verge of extinction. Biologists captured the last five wolves remaining in the wild and began a captive breeding program.

Reintroductions of MGWs into the Blue Range Wolf Management Area (BRWMA) that spans portions of eastern Arizona and western New Mexico began in 1998. About 110 wolves were free-ranging in the BRWMA in 2015.

The Ladder Ranch became involved in MGW recovery in 1997 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 by providing care and acclimatization for animals eligible for release to the wild. The LRWMF also assists with specific needs associated with reintroductions to the BRWMA by serving as a "halfway house" between the wild and traditional holding facilities (i.e., 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 100 individual wolves have passed through the LRWMF facility.

As a member of the Mexican wolf Species Survival Plan (SSP), we adhere to the guidelines that standardize captive management in both the U.S. 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: 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 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.

Project Activities in 2016

Wolves held at LRWMF in 2016

Sixteen wolves were housed at the LRWMF during 2016 (Table 14a.1). There was a maximum of 15 wolves at the LRWMF at any one time. Six wolves were born at the facility (Fig. 14a.1), and there were no mortalities.

Following a year without wolves at the LRWMF in 2015 due to permit issues (see 2015 Annual Report), our wolf holding permits were re-instated in early 2016 and we began to accept wolves into the facility shortly thereafter. The LRWMF is one of only two facilities (the other being the USFWS-run facility at the Sevilleta National Wildlife Refuge (SWMF)) that can initially accept wolves that are removed from the wild. Three such wolves were housed at the LRWMF in 2016. This freed up the SWMF to house wolves that were chosen to breed in 2016.

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. Because the Mexican wolf holding facilities are currently at capacity, not all captive wolves are allowed to breed. Breeding pairs are carefully chosen using several criteria, including genetics, compatibility, and need.

Table 14a.1. Wolves at the LRWMF in 2016.

Wolf ID (Studbook number)	Arrived at LRWFM from:	Left LRWMF to:
M1384	BRWMA, then SWMF	Still at LRWMF
F1031	WWNP	Still at LRWMF
F1034	WWNP	Still at LRWMF
M1067	Wolf Haven	Mexico
F1222	Wolf Haven	Mexico
M1425	Wolf Haven	Mexico
M1426	Wolf Haven	Mexico
M1427	Wolf Haven	Mexico
mp1498	Born at LRWMF in 2016	Mexico
mp1499	Born at LRWMF in 2016	Mexico
mp1500	Born at LRWMF in 2016	Mexico
fp1501	Born at LRWMF in 2016	Mexico
fp1502	Born at LRWMF in 2016	Mexico
fp1503	Born at LRWMF in 2016	Mexico
M1396	BRWMA	Fossil Rim
M1564	BRWMA, then SWMF	Still at LRWMA

The last time a pair of wolves bred at the LRWMF was in 2007, but TESF and the LRWMF have played important roles in the management of the breeding program in other ways: as a holding facility for non-breeding wolves that need to be separated during breeding season, and as a receiving facility for wolves that were removed from the wild due to livestock conflicts or nuisance behavior. Many removals take place during the annual population count, which takes place in January and coincides with breeding season. TESF also contributed to the breeding program in 2016 by participating in breeding season observations at the SWMF to determine wolf compatibility and potential whelping dates.

Moreover, in April 2016, the LRWMF received a family group of five wolves from Wolf Haven International that included a pregnant female, her mate, and three of their offspring from 2015. On April 30th 2016, F1222 gave birth to 6 healthy pups (Fig. 14a.1), three male and three female (studbook #s 1498-1503). The pups received their first check-ups and the first round of vaccines in late June, at 8 weeks of age (Fig. 14a.2).

Fig. 14a.1. A whole lot'a little lobos! Still blind and deaf and not yet very mobile, 1-week old Mexican wolf pups huddle together in the den while Mom takes a break (top panel). At 3.5 weeks (bottom panel), the pups have opened their eyes and are a lot more wriggly.

The Turner family was on hand to help with the 10.5-week check-up and second round of vaccines in mid-July. A third round of vaccines was administered at 14 weeks of age. Following a quarantine period to treat the puppies for an outbreak of coccidiosis, which is a common parasite in canids, the whole family of 11 was captured for health checks and final vaccinations and anti-parasitic treatments in early November, when they received a clean bill of health and the go-ahead for their transfer to Mexico. Finally, on November 30, 2016, all 11 wolves were captured and crated and transported to a temporary holding pen at their release site in Mexico. All went well, and within a few days the wolf family enjoyed life as the "Ladder Pack" in the wild in Mexico (see http://www.gob.mx/conanp/galerias/la-conanp-libero-once-ejemplares-de-lobo-gris-mexicano-provenientes-de-nuevo-mexico-85710). Thus, in 2016, the LRWMF made an important contribution to the growing Mexican wolf release program south of the border in Mexico.

Another "first" in conjunction with the Ladder Pack Mexico release was the participation of all but one member of the NM Game Commission as well as the Director of NMDGF and several of her staff, in the capture of the wolf family on the Ladder Ranch.

Former LRWMF residents in the wild

A pair of wolves (M1215/F1033; see the 2013 TESF annual report) that resided at the LRWMF in 2013 became famous in 2014 as well because they were the first wolf pair living in the wild in Mexico to produce pups in over 30 years (see http://phys.org/news/2014-07-mexico-litter-wolf-cubs-wild.html and http://www.conanp.gob.mx/difusion/comunicado.php?id_subcontenido=710). M1215 and F1033 produced yet another litter in 2016 (http://www.gob.mx/conanp/galerias/nacen-cuatro-crias-de-lobo-mexicano?idiom=es) and are thus major contributors to the wild wolf population in Mexico.

Food & feeding

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. Native prey animals (mule deer, oryx, elk, and bison) are mainly provided as meat scraps and/or bones salvaged from hunts on the Armendaris and Ladder Ranches and are sporadically fed as supplemental food.

Fig. 14a.2. TESF biologist Chris Wiese is ready to return one of pups to the holding crate following its 8-week health check-up.

Observations

We observed LRWMF animals on a regular basis to ensure their health and wellbeing. Informal observations took place during scheduled feedings, where we obtained a visual of most animals in the facility and checked for signs of injury or illness.

Formal observations were made frequently in 2016 from a blind positioned near the facility to monitor the family pack and watch pups. In

addition, we made regular use of trail cameras to get close-up views of individual wolves.

Health assessments & medical care

All wolves received thorough health checks, vaccinations, and anti-parasite medication before arriving at the LRWMF. Similarly, all wolves removed from the LRWMF in 2016 received deworming and anti-parasite medication (ivermectin, revolution, and/or praziquantel) before leaving 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 2016 are current on their vaccinations and treatments.

Off-site Activities and Outreach

We participated in several off-site activities in 2016 that included helping with wolf captures and health checks at the SWMF, transferring wolves to Mexico or from the BRWMA to captivity, participating in a Drug Immobilization workshop, and serving on the MGW recovery team (MP). Outreach activities included presentations about the Mexican Gray wolf program to ranch guests.

Proposed Future Activities and Considerations

As one of only three pre-release facilities in the country, and the only pre-release facility adjacent to the wild wolf population in the Blue Range Wolf management area and close to 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. We will therefore continue our efforts to restore full functionality to the LRWMF by requesting that our NM State permits to hold wolves at the facility be granted for a three-year period. For 2016 and 2017, we were granted one-year permits. However, since the decisions regarding wolf holdings for the following year are made at the annual SSP meeting in July and our permits follow the calendar year, we are unable to commit to wolf breeding or other planning activities for the following year. Thus, the LRWMF is not currently used to its full potential.

We hope to be able to participate in any cross-fostering efforts in the future. This process, in which very young pups from genetically desirable captive wolf pairings are swapped or introduced to denning wild wolf parents, has been used successfully to increase the genetic diversity of red wolves in North Carolina, and has also been tested in European gray wolves. Moreover, it has been used successfully in 2014 to place two Mexican Gray Wolf pups into the den of a wild wolf pack that was known to rear young that avoid conflict with humans (see http://www.santafenewmexican.com/news/local_news/feds-report-success-in-introducing-wolf-pups-to-wild-litters/article_df1a74da-ebd7-5024-b21a-df324e3fedd8.html).

In this way, we propose to continue our strong support of the USFWS-led efforts to recover the Mexican gray wolf in the Southwest. 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). Moreover, the LRWMF is well situated to serve as potential host for hands-on wolf handling sessions, and to serve as a Mexican wolf breeding facility in the future.

14(b) Rocky Mountain gray wolf *(C. lupus)*
ESA listing: DELISTED

PROJECT STATUS
Ongoing

Principal biologists
Val Asher
Mike Phillips

Conservation Problem – Wolves a polarizing issue limiting expansion in its historical range.

Conservation Status – Delisted in 2011. In MT listing: "species in need of management".

Project Location – Flying D Ranch, MT.

Project Funding – TESF/TBD

Goal – To understand the ecology of wolves on a wild, working landscape of the Flying D ranch and inform wolf 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 resident 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 and utility of living with wolves on a wild, working landscape will be shared by conducting wildlife tours to visiting guests on the Flying D.

Supporting Rationale for Objective

Uncertainty over the ecosystem impacts of wolves continues to foster intolerance for wolves in the west. An abundant prey base on the Flying D allowed the ranch to support the largest pack in MT (24 individuals) in 2011, before they 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 a ranch.

Project 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 make 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 a native elk herd, 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, as well as, a direct effect of a declining prey population due to disease. We continue to assist our Mexican wolf recovery counterparts in the trapping and handling of wolves in Chihuahua, Mexico and offer technical support to the Mexican Wolf/Livestock Council for Arizona and New Mexico.

Project Activities in 2016

Wolf population

Even with the loss of the Tanner Pass pack this fall, the wolf population has remained relatively stable. (Fig. 14b.1). 350M, who was the original breeder for the Beartrap pack and later the breeding male of the Tanner Pass pack, was found dead east of Cameron, Montana from natural causes. It is unknown the fate of his gray, almost white mate. Due to the age of the Tanner Pass breeding pair (~13+ years) and lack of pups over the last two years, the pack dissolved with the loss of the two adults. Because of their distinct coat colors, this pair has been recognized and enjoyed by ranch staff and guest over the years and 350M's laid back personality will certainly be missed. The larger Beartrap pack produced 6 pups this year. They use the

entire ranch and occasionally travel through neighboring properties to the north. Ten known wolf mortalities occurred in 2016. Seven wolves were legally harvested, one hit by a car, one legally killed by a landowner while in cattle (717M), and one naturally occurring death (350M).

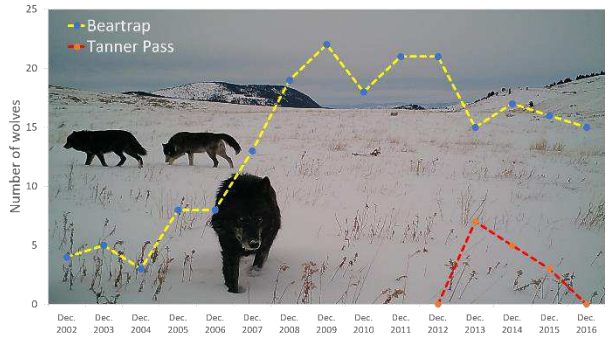


Fig. 14b.1. Number of wolves in the Beartrap and Tanner Pass packs from 2002 to 2016.

Food habits

Of the 1,089 carcasses investigated since monitoring began in 2010, 335 were documented as predator kills. 242 were attributed to wolves, with the remainder categorized as coyote (59), mountain lion (8), bobcat (2), bear (6), and 17 unknown.

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. 14b.2).

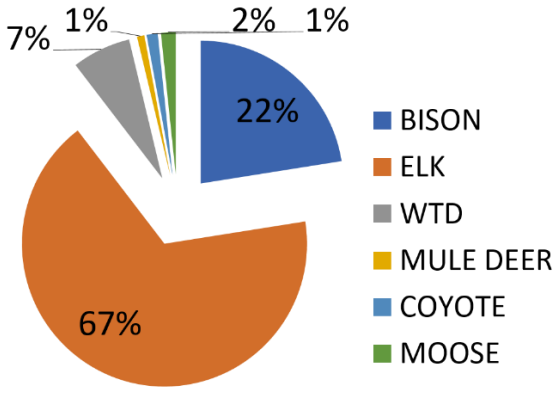


Fig. 14b.2. Percentage of wolf kills by prey species.

Four years of scat data was analyzed in 2014. Elk were the main food source for wolves, which was consistent with our kill data (Fig. 14b.3). Deer were also an important food source but because of their small size, are much harder to find. Bison red calf hair was detected in only 1% of wolf scats, suggesting that this livestock type is not readily predated by wolves. Three years of newly collected wolf scat has been washed in 2016 for further analysis.

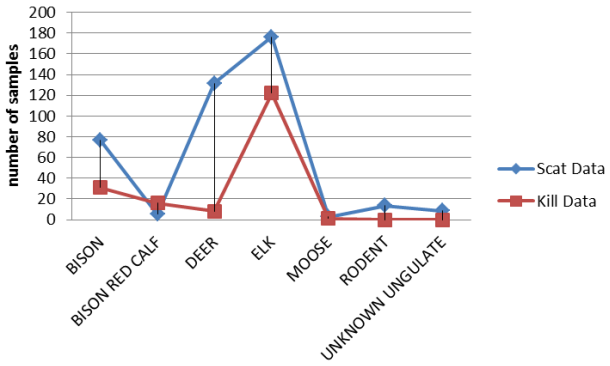


Fig. 14b.3. Comparison of wolf scat data to observed verified wolf kills.

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.14b.4).

Marrow was collected from 159 elk, deer and moose kills showing 71% in marginal to poor health condition.

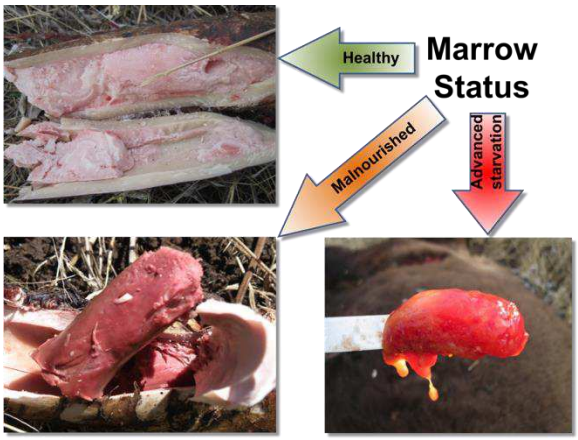


Fig. 14b.4. Femur marrow helps determine the condition of prey species.

A second dramatic vulnerability has been disfigured/injured hooves and legs. Of the 265 elk carcasses investigated of varying cause of death, 30 had visible deformities. Interestingly, all 30 were killed by wolves (Fig. 14b.5). Wolves have an acute ability to recognize even the slightest lameness and it would make sense that they would test these individuals over one that shows heartiness. Once legs have been boiled we can see in more detail the calcification and arthritis that has developed (Fig. 14b.6)


Fig. 14b.5. Examples of elk legs with visible and varying deformities.


Fig. 14b.6. Abnormal front left hoof from bull elk and normal front right from same individual.

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

Education

Information dissemination is important as we learn more about wolves on the ranch. In 2016, we conducted over 16 tours and talks on the Flying D totaling ~76 since 2010. We also share our population estimates with MTFWP and data with both the Anthrax and Brucella projects. Finally, we continue to produce monthly and annual reports on wolf activities and food habits. 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.

Research

Stress hormones in bison - It is thought the stress of predators interacting or near livestock can result in low calf crops and weight loss on both adults and calves. While we have seen wolves in the bison herd, not all interactions lead to testing or a predation event. In 2014/2015, we participated in a bison fecal cortisol level hormone study led by Dr. Dave Hunter. Cortisol is a stress hormone and for this discussion, we measured bison that were exposed to wolves vs no wolves. In short, bison did not show any

significant elevation in cortisol when wolves were present vs a non-wolf area.

Side projects

American Kestrel Partnership – 2016 is our third year that nesting boxes have been placed on the ranch. Of the nine boxes deployed we continue to have a 33% average of occupation and fledgling success. Five natural cavities have been confirmed in 2016 with three of the five producing chicks.

Wolf Recovery in Mexico – We assisted in the capture and handling of reintroduced wolves in Chihuahua Mexico in 2014 and 2015. Unfortunately, 2016 proved to be too dangerous to work in the mountains of the Sierra Madres due to cartel conflicts. We hope 2017 brings quieter times to our Mexican wolf recovery teammates.

Carcass-Camera Trap Pilot Study – We are working with the University of Florida's Anthrax project using cameras on carcasses to understand ungulate/scavenger visitations over the long term and that relationship for disease transmittal. One advantage of trail cameras is picking up less common visitors to the ranch. We identified two and possibly three individual male Grizzly bears in 2016, one of which was ear tagged by MFWP during a previous research study. Wolf/Grizzly bear interactions have also been documented with the cameras (Fig. 14b.7). In these interactions, grizzlies typically claim the carcass.

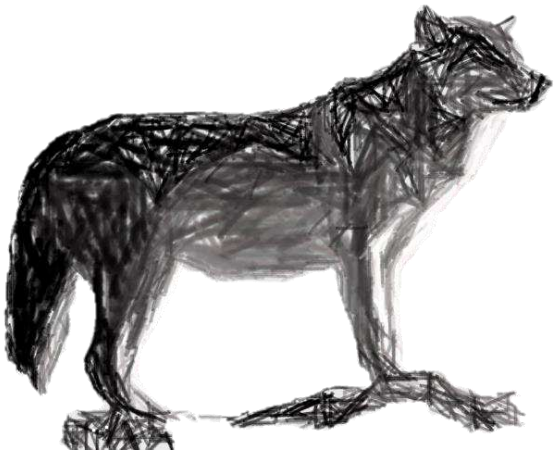


Fig. 14b.7. Wolf-grizzly bear interactions have been observed on the Flying D during a carcass-camera trap pilot study. In this series of images, the grizzly bear takes the carcass from Beartrap pack wolves.

14(c) Rocky Mountain Wolf Project
ESA listing: ENDANGERED

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

Conservation Status
- Listed under ESA in 1976

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

Project Partners
The Rocky Mountain Wolf Project is comprised of individuals and organizations—from wildlife biologists to Colorado landowners to conservationists—dedicated to returning wolves to Colorado. The following conservation organizations actively support the Project:

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

Project Funding – TESF

Goal – Restore viable gray wolf population levels to the Southern Rockies Ecoregion of western Colorado.

Objective – Over the next 15 years we will have catalyzed a process to restore a viable gray wolf population to suitable habitat in the Southern Rockies Ecoregion of western Colorado to advance species recovery and serve as a model for the conservation of other wide-ranging, controversial imperiled species. The population will 1) include a minimum of 500 adult wolves, 2) exhibit an overall population trend that is stable or increasing over 8 years as measured by a statistically reliable monitoring effort, 3) be naturally connected with a wolf population elsewhere at a rate not less than 0.5 genetically effective migrants per generation averaged over a period of 2 successive generations (8 successive years) as measured by a statistically reliable monitoring effort, and 4) be monitored and managed per a science-based conservation plan implemented by Colorado Parks and Wildlife with oversight provided by a citizen's advisory committee appointed by the Governor.

Project Background – Historically wolves occurred throughout the U.S. As recently as the mid-19th century they were common in Colorado. However as settlers moved in, wolves were exterminated. In 1945 the last remaining wolf in Colorado was killed near the New Mexico border, and the state has been effectively wolfless ever since.

Over the last few decades wolves have returned to portions of their historical range. By the end of 2016, recovery actions had resulted in the re-establishment of wolf populations in Minnesota, Michigan, Wisconsin and Montana, Idaho, and northwestern Wyoming. However, there still is much work to be done, particularly in the public lands of suitable habitat in western Colorado where the wolf remains extirpated. Fulfilling that work is the focus of this project.

Despite the gray wolf's improved conservation status in the Great Lakes states and the northern Rocky Mountains, species recovery is not complete. No convincing argument about wolf recovery can be put forth until there has been a serious discussion about restoring the species to the SRE. Why? Because of widespread public support for the notion, because no other region in the U.S. offers the same vast expanse of suitable public land not already occupied by the species, and because of the sweeping recovery mandate of the ESA.

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 studies that suggest potential for gray wolves to occupy the ecoregion in numbers and with a distribution that would satisfy the spirit and intent of the federal and Colorado endangered species acts.

The SRE is the best remaining area for gray wolves in the U.S. Stretching from north central Wyoming, through western Colorado, and into north central New Mexico (Fig. 14c.1), it includes nearly 25 million acres of public lands with large native prey populations. This is twice as large as that available to wolves in the Yellowstone area and central Idaho, and five times as large as that available to for Mexican wolf recovery. This massive base of public land and robust populations of native ungulates support the claim that the ecoregion is a mother lode of opportunity for wolf restoration.

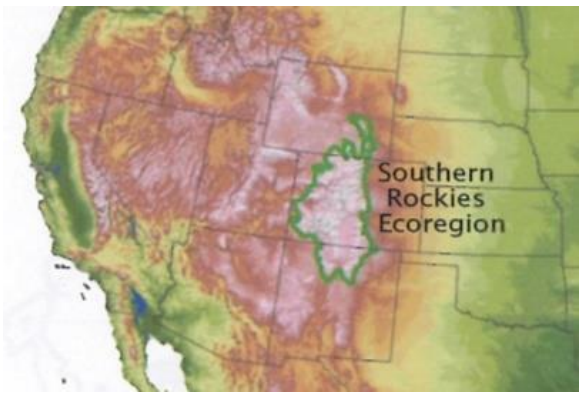


Fig. 14c.1. The Southern Rockies Ecoregion represents a vast refugia of high quality habitat for gray wolves.

Two studies have estimated the SRE's wolf carrying capacity. The first, conducted in 1994, estimated that the SRE's Colorado portion alone could support > 1,000 wolves, while the second used sophisticated modeling to estimate that the entire SRE could support 2,000 wolves.

The public is supportive of restoring wolves to the SRE. A 2001 poll revealed that 71% of Coloradans supported restoration (Fig. 14c.2), 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. 14c.3).

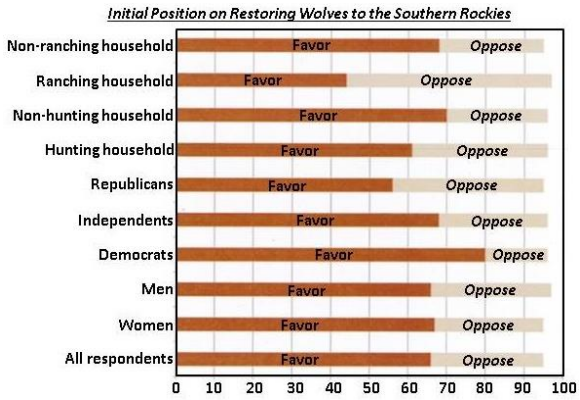


Fig. 14c.2. Results of a 2001 public opinion survey revealed widespread support for restoring wolves to the Southern Rockies. Source: Decision Research, 2001.

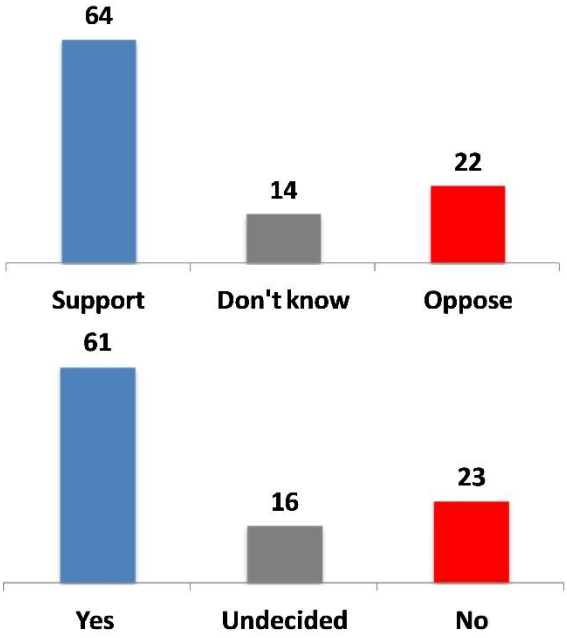


Fig. 14c.3. Results of a 2014 poll measuring level of support/opposition for re-establishing wolves in western Colorado (top panel), and support (i.e., yes) or opposition (i.e., no) for a combined wolf restoration ballot measure (bottom panel)

The SRE 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 the SRE would provide nature with grist for recreating a wolf population that stretches from the arctic to Mexico. Nowhere else in the world does such a viable opportunity exist to achieve large carnivore conservation over such an extensive landscape. Noted wolf biologist Dr. L. D. Mech concluded the following when considering such a vision:

"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."

We have a rare opportunity to restore the evolutionary potential of wolves, as well as reestablish the role of wolves as a keystone species with strong ecological interactions throughout the Rocky Mountain west. Evolutionary and ecological restoration will be hindered if we limit wolf recovery to the northern Rocky Mountain and the Great Lakes states. Additional reintroductions in the SRE are clearly called for as important steps in returning the gray wolf to its rightful place as an important and fascinating part of our nation's ecological past and future.

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

Project Activities in 2016

In March 2016 a group of forward-thinking conservationists, wildlife biologists, and non-governmental conservation organizations (including the TESF) launched the Colorado Wolf Restoration Project.

During the inaugural meeting, the Project settled on a simple and yet durable foundation relative to approach, architecture, and objective.

Approach: Disseminate science-based information about wolves, engage Coloradans about the reality of co-existing with wolves, and use both to encourage thoughtful, public conversation about wolf restoration with all stakeholders, including ranchers and sportsmen.

Architecture: Broad and growing coalition with sufficient intellectual, logistical, fiscal, and administrative capacity to advance the Project's prospects.

Objective: Wolves again roaming the snow-capped peaks, rim rock canyons, and primeval forests of the vast public wildlands of western Colorado.

By May, following comprehensive internal discussions and intensive in-person and online focus group surveys conducted in Denver and the "West Slope" of Colorado, the Colorado Wolf Restoration Project changed its name to the Rocky Mountain Wolf Project (RMWP) and settled on an artistic and characteristic logo and a memorable tagline (Fig. 14c.2).

Fig. 14c.2. The carefully designed logo and tagline for the Rocky Mountain Wolf Project advances brand recognition, and, in turn, the wolf's return.

The surveys revealed that Coloradans seem to innately understand the importance of wolf restoration. Consistent with that understanding, they consider the historic and wildly successful Yellowstone National Park wolf restoration effort as a touchstone for the future for the

western half of their state. This vision is altogether fitting.

Re-establishing the wolf in western Colorado will not only restore a semblance of ecological balance to the area, it will stand as the last action to connect wolves from the High Arctic to the Mexican border. There is no other region in the world where one can imagine the restoration of an imperiled and grossly misunderstood species across such a dramatic continental landscape. By August, the RMWP had issued contracts to experienced organizations to manage specific aspects of its work.

- Tides Center (www.tides.org) – administration (RMWP has been organized as a fiscally-sponsored project of the Tides Center)
- RBI Strategies (www.rbistrategies.com) – strategic advice
- Boulder Strategies (www.boulderstategiesllc.com) – website and social media.
- Grizzly Creek Films (www.grizzlycreekfilms.com) – films
- Living With Wolves (www.livingwithwolves.org) – education exhibit

RMWP debuted as a public entity at the 26th Annual Rocky Mountain Folks Festival held August 19 - 21 in Lyons, Colorado, which drew thousands. In addition to collecting signatures and passing out materials, RMWP worked with the Colorado Wolf and Wildlife Center to provide an opportunity to interact with two ambassador wolves (Figs. 14c.3).

For the rest of 2016, from September through December, the TESF assisted the RMWP with developing science-based background material for use by Boulder Strategies, Grizzly Creek Films, and Living with Wolves in anticipation of the public launch of the coalition's digital offerings (i.e., website and social media), films, and educational exhibit in 2017.

With TESF's assistance on the scientific aspects of wolf restoration, during 2016 the RMWP developed into a capable, strategic, and durable force for promoting and participating in educational and outreach efforts that advance productive, respectful conversations about re-establishing the wolf in the great public wildlands of western Colorado. RMWP's commitment to engaging and educating Coloradans about the reality of wolves will help to ensure that the wolf is re-established in manner that is respectful of the needs and concerns of affected Coloradans.

Successful return of the wolf to western Colorado will represent the last action in a 40+ year effort to restore the species to the western US, and thus serve as the arch stone for our country's greatest wildlife conservation achievement: restoration of a much maligned species from the High Arctic to the northern border of Mexico.

Figs. 14c.3. Rocky Mountain Folks Festival (Lyons, CO) attendees, especially children and their parents were enamored with ambassador wolves from the Wolf and Wildlife Conservation Center (RMWP photo).

PRESENTATIONS IN 2016

Phillips, M. K. 2016. From Delay to Wrongheadedness: Mexican Wolf Recovery. Continuing Legal Education – New Mexico State Bar. Invited oral Presentation. Albuquerque, New Mexico, September 9, 2016.

Phillips, M. K. 2016**.** Wolves, tortoises, and trout: the world's most significant private effort to save creation. Wildlife Biology Department, Humboldt State University, March 25, 2016.

Phillips, M.K. 2016**.** Wolf Recovery: Past, Present and Future with a focus on Western Colorado. Aspen Center for Environmental Studies, Aspen Colorado. December 6, 2016.

Phillips, M. K. 2016**.** An Effort to Redress the Extinction Crisis: The Turner Endangered Species Fund. East-West Sustainability Summit, Invited Oral Presentation, August 30, 2016. Kahala Hotel, Honolulu, Hawaii.

Wiese, C., and Milne, V. Sept 24, 2016. Restoring the Bolson Tortoise to Southern New Mexico. Oral presentation at the AZA Docent Conference in El Paso, TX.

Wiese, C., and L. S. Hillard, April 10, 2016. Restoration of a Pleistocene Relict: The Bolson Tortoise in Southern New Mexico. Oral presentation to the Rio Grande Turtle and Tortoise Club.

EXTERNAL SERVICE IN 2016

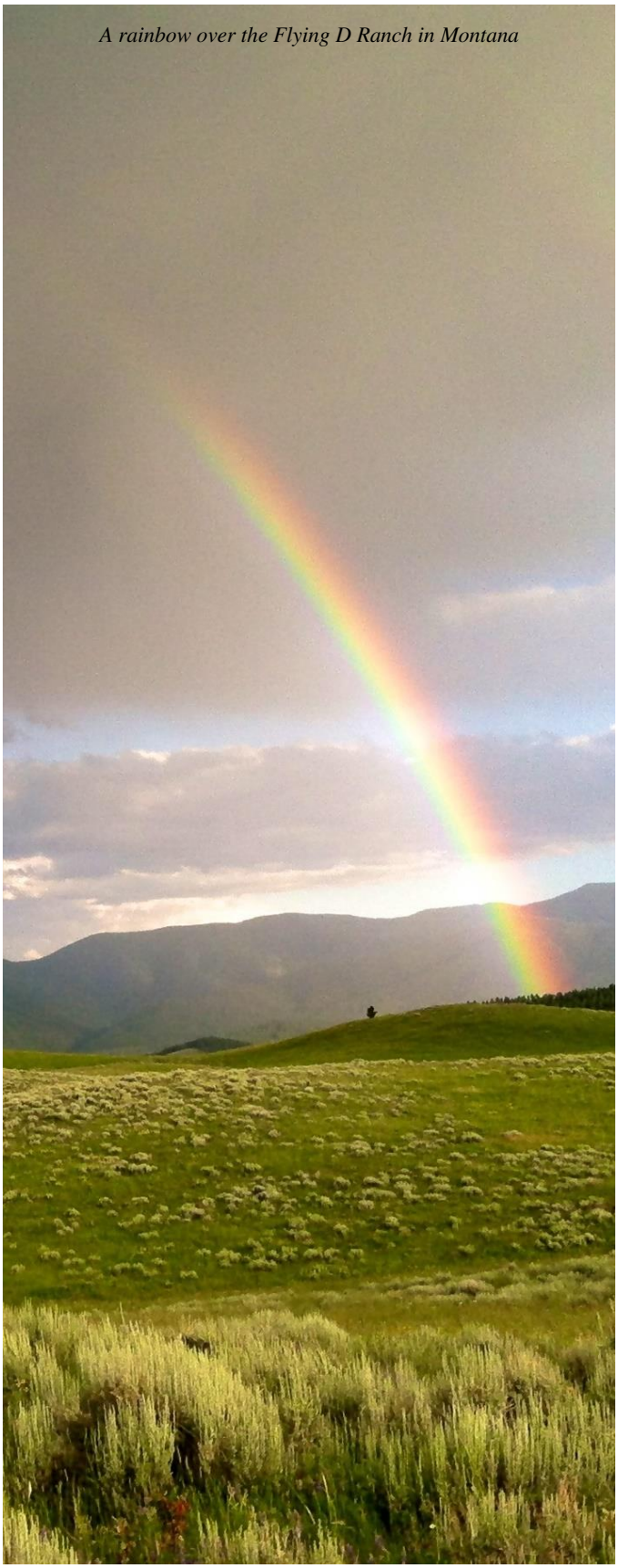
Phillips, M. K. Board, Western Landowners Alliance
Phillips, M. K. Board, International Wolf Center
Phillips, M. K. Science Advisory Council, Panthera,
Phillips, M. K. Mexican wolf recovery team member
Phillips, M. K. Member, Red wolf recovery team
Phillips, M. K. Member, IUCN Canid Specialist Group (Leader, North American wolf group)

APPOINTMENTS IN 2016

Phillips, M. K. Accepted an invitation to join the IUCN Private Protected Areas Specialist Group.

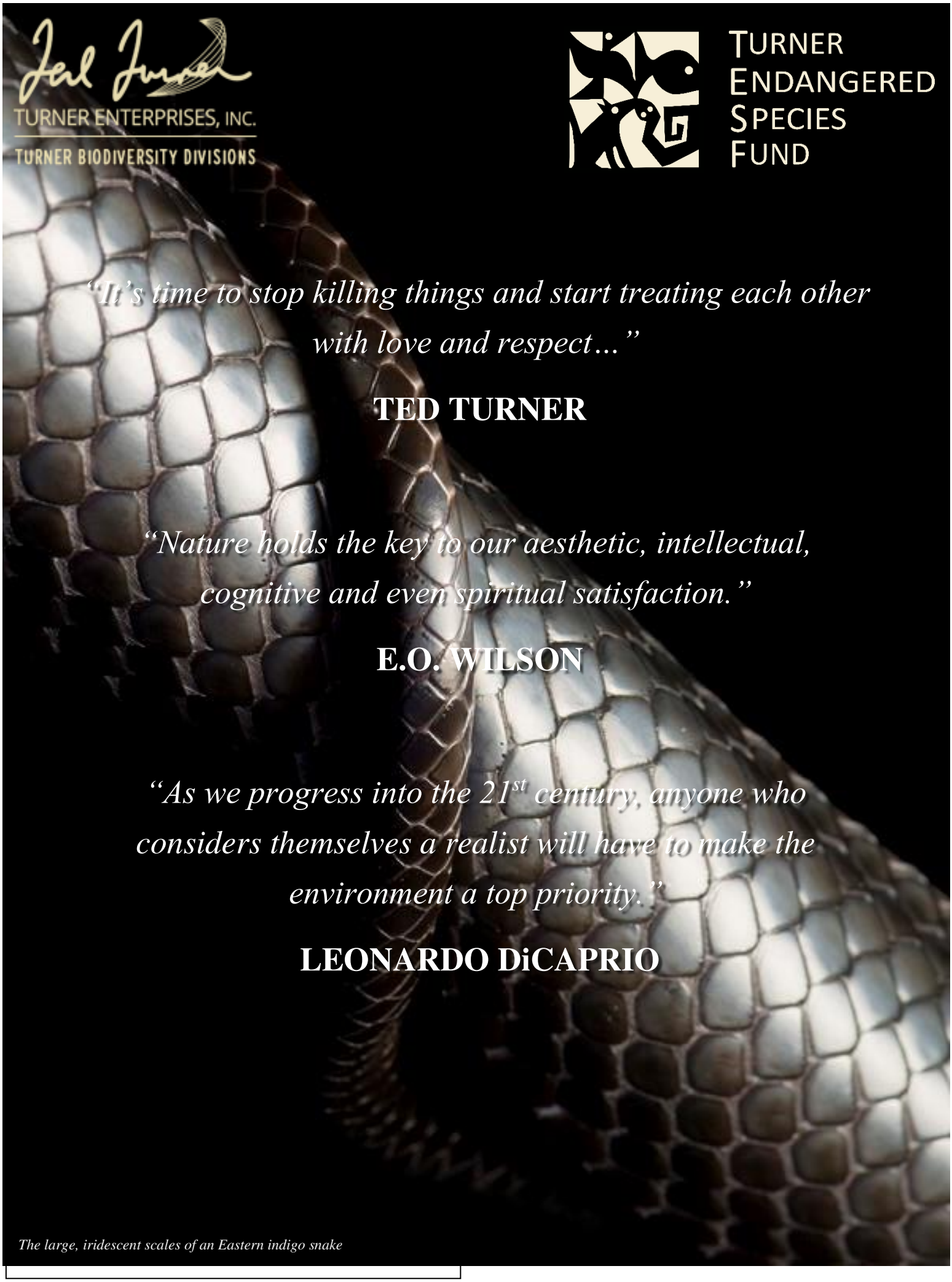
Phillips, M. K. Accepted a position on E. O. Wilson's Half-Earth Council.

A rainbow over the Flying D Ranch in Montana



ACRONYMS/ABBREVIATIONS

ACRA = Ash Creek Restoration Area
AFS = American Fisheries Society
ATP = Armendaris Truett Pen
AZ = Arizona
BKT = Brook trout
BLM = Bureau of Land Management
BRR = Bad River Ranches
BRWMA = Blue Range Wolf Management Area
CA = Conservation Area
CCAA = Candidate Conservation Agreement with Assurances
CLF = Chiricahua leopard frog
CSS = Chupadera springsnail
CT = Cedar Tank
DNR = Department of Natural Resources
ESA = Endangered Species Act
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
ID = Idaho
ITP = Incidental Take Permit
IUCN = International Union for the Conservation of Nature and Natural Resources
KS = Kansas
LBP = Ladder Big Pen
LDZG = Living Desert Zoo and Gardens State Park in Carlsbad, NM
LHS = Ladder Headstart Pen
LRWMF = Ladder Ranch Wolf Management Facility
LTDS = Line Transect Distance Sampling
MGW = Mexican Gray Wolf
MOU = Memorandum of Understanding
LRWMF = Ladder Ranch Wolf Management Facility
MI = Michigan
MN = Minnesota
MSU = Montana State University
MT = Montana
MTFWP = Montana Fish Wildlife & Parks
MVP = Minimum Viable Population
NE = Nebraska
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
NWR = National Wildlife Refuge
OCIC = Orianne Center for Indigo Conservation
PIT = Passive Integrated Transponder
RCW = Red-cockaded woodpecker
RGCT = Rio Grande cutthroat trout
RU = Recovery Unit
SD = South Dakota
SFGT = Saving Florida's Gopher Tortoises
SGCN = Species of Greatest Conservation Need
SRE = Southern Rockies Ecoregion
SSC = Species Survival Commission
SSP = Species Survival Plan
SWMF = Sevilleta Wolf Management Facility
TBD = Turner Biodiversity Divisions
TEI = Turner Enterprises, Inc.
TESF = Turner Endangered Species Fund
TU = Trout Unlimited
TX = Texas
U.S. = United States
USFS = U.S. Forest Service
USFWS = U.S. Fish & Wildlife Service
VPR = Vermejo Park Ranch
WAFWA = Western Association of Fish and Wildlife Agencies
WCT = Westslope cutthroat trout
WI = Wisconsin
WLA = Western Landowners Alliance
WMA = Wildlife Management Area
WNS = White-nose syndrome
WPM = Western pearlshell mussel
WWF = World Wildlife Fund
WY = Wyoming



The large, iridescent scales of an Eastern indigo snake