Turner Endangered Species Fund
&
Turner Biodiversity Divisions
Annual Report
2015

A long-tailed skipper (*Urbanus proteus*) on butterfly milkweed (*Asclepias tuberosa*).
Photo: M. McCaffery

Turner Endangered Species Fund & Turner Biodiversity Divisions

Annual Report 2015

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All photos not otherwise marked are TESF/TBD photos.

Cover photo: *Gray wolf on the Flying D Ranch (photo credit: Ronan Donavan)*

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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 – Grim Reaper Jr., 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. ***barbara.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.

2015 REPORT TO THE TURNER FOUNDATION

As required by Turner Foundation grant #201200158, we submit the following information to document the activities of the Turner Endangered Species Fund in 2015.

I. Achievement of Goals

What was accomplished in connection with your projects?
We implemented conservation activities that improved conditions for 14 imperiled taxa across eight properties owned by R.E. Turner and hundreds of thousands of acres of adjacent public and private lands in Florida, Georgia, South Dakota, Montana, Kansas, and New Mexico.

How do you define and measure success of your projects?
We defined 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 measured success by monitoring various metrics that reveal the integrity of (or lack of) a population. Such monitoring included population counts, assessments of mortality rates, juvenile production, and the determination of the areal extent of occupied habitat.

How will you monitor the long-term results of your projects?
We monitored results (both long-term and short-term) by employing five biologists, two part-time technicians, one graduate student, and one contractor to implement fieldwork and document the progress of our restoration projects. Chronic monitoring is a fixed feature of TESF's restoration strategy for all projects.

How are you disseminating the results of your projects with the general public, managers, and the scientific community?
We disseminated our results through print media, broadcast media, activities of graduate students, peer-reviewed publications, participation at professional meetings, as well as Annual 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 2015 we solicited the involvement of experts to review our work and participate in our projects. For example, several outside experts were actively involved in our bolson tortoise, Chiricahua leopard frog, and gopher tortoise projects during the year. Our collaborations with the U.S. Fish and Wildlife Service, state game agencies (Florida Fish and Wildlife Conservation Commission, Montana Fish, Wildlife, and Parks, New Mexico Department of Game and Fish, South Dakota Game, Fish, and Parks), and non-governmental conservation organizations ensured routine evaluation of our field projects.

III. Expenditure of Grant Funds

Our fundraising goal for 2015 of $880,456 was fully met. Funds were used to cover the cost of staff and fieldwork (Table 1). Actual expenses for field projects were managed to retain TESF's $25,000 of emergency funds, which have been in place since 2003, while leaving ~ $100,000 of dedicated funds for expenses in 2016.

Table 1. Use of TESF funds in 2015

Category	Expected Expenses $739,244	Actual Expenses $755,473
Staff	$541,172	$545,555
Field projects	$198,072	199,918

Grant #201500172 from the Turner Foundation was essential for leveraging $133,244 of support from Turner Enterprises and $167,433 from non-Turner entities including federal and state agencies and a nongovernmental conservation organization.

IV. Input to Turner Foundation

TESF is a unique conservation organization that is positioned at the nexus of imperiled species conservation, state and federal agencies, and private lands management. In 2015 we made significant progress on well-established projects with a focus on single-species conservation on private lands owned by R.E. Turner as well as supporting broader efforts to secure these species across their historical ranges (e.g. lesser prairie-chicken, Chiricahua leopard frog captive breeding at the Ladder Ranch and TESF-led development of a programmatic Safe Harbor document for NM). In addition to advancing the conservation and restoration of focal species, 2015 was an important year for the further development of projects with conservation impacts beyond single-species recovery. For instance, we are seeking to understand and guard against emerging epizootic threats that may impact a suite of bat species on Turner properties (e.g. threats of white-nose syndrome to bat populations on the Armendaris and Z-Bar Ranches), and through our newer monarch butterfly and gopher tortoise projects we are attempting to conserve not only the focal species themselves, but also restore habitat associated with these species that support myriad ecological processes that confer benefits to ecosystem functioning and biodiversity (e.g. restoring wildflower habitats for monarch butterflies and other native pollinators, and restoring the ecosystem engineering effects of gopher tortoises that are associated with enhanced overall biodiversity).

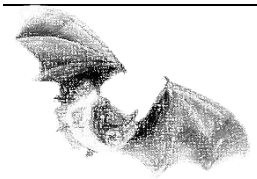
Administrative Summary for 2015

- Staff: 5 Biologists, 2 part-time technicians and one contractor
- Turner Foundation Grant: $535,000
- Turner Enterprises Support: $133,244 (for worker's compensation insurance, health insurance, retirement, 2.45% of payroll taxes)
- TESF Emergency Fund: $25,000
- TESF Carryover from 2014: $9,779
- Non-Turner Sources: $167,433
- No. of Projects: 14 that targeted 10 imperiled species
- Area of Work: 8 Turner properties and hundreds of thousands of acres of adjacent public and private land
- Focal Projects: (1) black-tailed prairie dog, (2) Gunnison's prairie dog, (3) black-footed ferret, (4) gray wolf, (5) Mexican gray wolf, (6) red-cockaded woodpecker, (7) Chiricahua leopard frog, (8) bolson tortoise, (9) bats, (10) Chupadera springsnail, (11) eastern indigo snake, (12) lesser prairie chicken, (13) monarch butterfly, (14) gopher tortoise.
- Growth Strategy: All projects were multi-year efforts that began prior to 2015. Consistent with our decision to carefully manage TESF's growth, the only new project initiated in 2015 concerned the imperiled Monarch butterfly.

2015 TESF Project Highlights

See Sections 1 – 13.

1. TESF FIELD PROJECT – BATS



PROJECT STATUS
Ongoing

Principal biologist
Dustin Long

Conservation Problem: Many North American bat populations have exhibited precipitous population declines since the arrival of white-nose syndrome (WNS) in 2006. This epidemic is arguably the worst wildlife disease outbreak in North American history, and threatens to drive some bat species to extinction. Resident, hibernating bats on Turner's western properties, are likely to be affected by WNS (WNS has been documented ~250 miles east of the Z Bar).

Conservation Status:

- USFWS species of concern: Big brown bat (*Eptesicus fuscus*); Cave myotis (*Myotis velifer*); Allen's big-eared bat (*Idionycteris phyllotis*)
- NMDGF species of greatest conservation need: Allen's big-eared bat (*I. 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, South Bend, IN

Project Funding: TESF

Goal: Monitor bats at the Z Bar and Armendaris Ranch to determine species richness, population trends, document the arrival and impacts of WNS, improve bat habitat, and determine the effects of human activity on bat populations.

Objective: We will perform annual summer and biennial winter population surveys at the Armendaris and Z Bar ranches to monitor population fluctuations. By 2016, we will remove all cave entrance obstructions (e.g., invasive red cedar) at Merrihew Cave which will serve to improve the suitability of the cave for bat occupation, improve habitat, and limit the cave's exposure to catastrophic fire.

Supporting Rationale for Objective: WNS is an emerging epizootic disease caused by the cold-loving fungus *Pseudogymnoascus destructans* (Fig. 1.1) and is the only known disease of concern for bats on Turner ranches. Most bat species are relatively long lived and produce one offspring a year; consequently, bat population growth depends on high rates of adult survival. Bat populations affected by WNS experience a ~95% loss of the adult population. 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 comprise 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 Turner properties. Collaborating with bat researchers at the 2 ranches will begin to fill in basic ecological information gaps and offer insight into how best to manage bat populations on Turner lands.

Project Background: The Jornada caves are the second largest known lava tubes on the North American continent, and provide habitat for 8 species of bat [Mexican free-tailed bat, Pallid bat (*Antrozous pallidus*), Allen's big-eared bat, Yuma myotis (*M. yumanensis*), Townsend's big-eared bat, spotted bat, California myotis (*M. californicus*), and fringed myotis (*M. thysanodes*)]. The migratory population of Mexican free-tailed bats at Jornada is the largest in New Mexico, and the fifth largest in North America and the caves reportedly have the largest known winter hibernaculum population of Townsend's big-eared bats.

The Merrihew cave is occupied by a minimum of 4 bat species [Mexican free-tailed bat, Townsend's big-eared bat, big brown bat, and cave myotis], 3 of which are hibernatory and all of which are either USFWS or state listed species of concern. All hibernatory bats sampled in 2014 for WNS at Merrihew, and more widely throughout the Oklahoma-Kansas Red Hills region, were negative for the disease.

Project Activities in 2015: Summer bat surveys at the Jornada and Merrihew sites indicated summer bat populations to be ~2,000,000 and ~160,000 bats, respectively. Smaller caves at both ranches were not formally surveyed, but additional populations were observed in those caves during visits. No hibernating bat surveys were performed in 2015. We continued efforts to remove eastern red cedar and elm (*Ulmus spp*.) obstructions from the Merrihew cave entrance.

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 not practical since transmission is primarily from bat to bat. What we can do for bats living on Turner properties is limit the potential for humans to transmit WNS by enforcing decontamination protocols for those entering caves, ensure human activities around bat caves are not detrimental to bat populations, and improve existing bat habitat.

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

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 range-wide decline of their primary prey item — prairie dogs (*Cynomys spp*.). The range-wide loss of prairie dogs, and by extension the black-footed ferret, is attributable to sylvatic plague and loss of habitat and habitat fragmentation

Conservation Status: The black-footed ferret was first listed as endangered throughout its historical range in 1967 under the Endangered Species Preservation Act—the predecessor to the more robust ESA. Upon passage of the ESA in 1973 the species was moved to that list. The black-footed ferret was listed as an endangered species under the New Mexico Wildlife Conservation Act in 1975 but was removed from this list in 1988 after surveys indicated that the species was likely extirpated in the state. Today the species is categorized as a protected furbearer, although no legal harvest has been allowed since the 1960's.

Project Locations: Vermejo Park Ranch, NM; Bad River Ranches, SD; Z Bar Ranch, KS/OK

Project Partners: USFWS, NMDGF

Project Funding: TESF

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 release site maintain a minimum population of 30 adults ferrets over a 3 year period to meet downlisting criteria. Our objective is to restore ferret populations to Vermejo, Bad River and Z Bar Ranches that meet or exceed these criteria.

Supporting Rationale for Objective: Black-footed ferrets are an obligate predator of prairie dogs. Prairie dogs historically required grazing by bison throughout a large portion of their historical range in order to persist; hence, the black-footed ferret project is a natural fit for many Turner properties with extant prairie dog and bison populations. The project also provides the opportunity to merge commodity production and native species conservation and restoration toward a single cause. Complete black-footed ferret downlisting criteria can accessed online at: www.fws.gov/mountainprairie/species/mammals/blackfootedferret/2013DraftRevisedRecoveryPlan.pdf

Project Background: All remaining captive and wild black-footed ferrets can be traced to seven founding individuals 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 <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 the outdoor pens where they were exposed to as wild an environment as possible while still being safely maintained in captivity. Ferrets in the outdoor 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 initiated wild preconditioning projects 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 (i.e. coyotes (*Canis latrans*) and badgers (*Taxidea taxus*)) 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. In general, ferrets did very well and we documented wild reproduction when early spring precipitation was sufficient to support a robust prairie dog population. However, these good years were routinely offset by drought years in which prairie dog pup survival was <10%, and the ferret population collapsed. 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. It is because of the failure of ferrets to reproduce and survive during drought years and the likelihood that droughts will become more frequent and severe in the southwest that TESF has decided to withdraw from any future ferret releases on colonies of black-tailed prairie dogs 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 can be established provided sylvatic plague can be managed.

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. Since that time the Bad River prairie dog population made a remarkable recovery and may soon once again be suitable for ferrets.

Project Activities in 2015: Currently, only one prairie dog population on Turner properties supports ferrets—the Gunnison's prairie dogs at Vermejo. Unfortunately, this ferret population was impacted by a plague epizootic that swept through the Gunnison's colony during the summer of 2015 (see next section). Subsequent ferret surveys indicated a minimum surviving ferret population of 2 individuals, a significant decline from 2014's population.

Proposed Future Activities and Considerations: Range-wide ferret recovery efforts have suffered significant setbacks over the last several years largely due to plague. Ferret populations have decreased from an estimated 1,000 animals in 2008 to less than 300 today. As demonstrated at Vermejo this year and Bad River in 2012 plague remains a constant threat to ferrets on Turner properties.

Ferret recovery is inextricably linked to prairie dog conservation and active plague management. Currently the only viable plague management option is to dust prairie dog burrows with an insecticide which kills the fleas that serve as the vector for the disease. Predictably, recent studies at ferret release sites that have received chronic dusting over the years indicate that fleas have begun to develop resistance to this insecticide—yet another blow to ferret recovery efforts.

However, looking forward there is optimism. Ongoing field trials of an oral plague vaccine for prairie dogs have returned encouraging results and the vaccine may be available for use at ferret release sites as soon as 2017. Until then, TESF will continue to maintain a beachhead of ferret recovery on Turner properties and protect the best ferret habitat at Vermejo and Bad River.

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 all prairie dog species, 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 been candidate species for listing under the ESA. Neither species is 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: *Short Term:* 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. So while dusting is not a fail-safe or permanent solution to the plague problem it is currently the only option and we will continue to use it to maintain a core population until other more permanent options become available.

Long Term : The USGS and USFWS have been developing an oral plague vaccine which would be administered to prairie dogs through bait pellets. Up to this point, lab and field trials have been encouraging. Assuming the oral vaccine is effective and affordable we will begin administering the vaccine baits as soon it is made available and begin efforts to expand prairie dog colonies at Vermejo and Bad River to a size suitable for ferret habitation.

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 2015: Plague impacted the Castle Rock Gunnison's prairie dog complex (black-footed ferret release site) at Vermejo in 2015 reducing coverage from 2,840 acres to 425 acres (we dusted 430 acres in 2014) and we dusted 300 acres of the remaining colony. Sylvatic plague epizootics are cyclical in nature and the last documented epizootic in Gunnison's at Castle Rock was in 2006; so, the epizootic was not unexpected. Ranch-wide Gunnison's acreage decreased by 77% from 3,800 acres in 2014 to 887 in 2015. Gunnison's populations living in the high elevation Costilla Basin stabilized and began to show signs of recovery from 2014's plague epizootic. No prairie dog density surveys were performed at Vermejo.

Black-tailed prairie dogs on the mixed grass prairie at Bad River Ranches continue to recover well from 2012's plague epizootic. Population densities and coverage were greatly reduced throughout the entire ACRA complex, although several small pockets of prairie dogs persisted. The 12 prairie dog colonies that comprise ACRA expanded by 23% in 2015 to cover 1,463 acres and prairie dog densities were at least 13.2/acre. With the additional support provided by NFWF we were able to increase by 26% the acreage dusted in 2015 to cover 347 acres over 8 plots on the 3 largest colonies. To discourage prairie dog colony expansion into unwanted areas, 3 vegetative barriers encompassing 68 acres, 300 feet of snow fence and 4 raptor poles continue to be maintained in ACRA.

Proposed Future Activities and Considerations: 2015 was a mixed bag: We documented a plague epizootic and loss of acreage in the Gunnison's at Vermejo, but also recorded population growth at Bad River. Through our experience with plague events, we predict that the Gunnison's at Vermejo are unlikely to suffer a severe plague epizootic within the next several years. However, an epizootic at Bad River is probably inevitable. For the foreseeable future managing prairie dogs at Vermejo and Bad River will require constant plague management. In 2016 we plan to dust 350 and 500 acres of prairie dogs at Vermejo and Bad River, respectively, and will incrementally increase that acreage to cover 750 and 1,000 acres at the two ranches by 2018.

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. Our bolson tortoise recovery efforts have produced ~500 new bolson tortoises to date, thus contributing a significant boost to worldwide bolson tortoise numbers.

Conservation status:
- Listed as Endangered under the ESA
- Listed as Endangered under Mexican Wildlife Law (SEMARNAT, 2010)
- IUCN Red List Status: Vulnerable (van Dijk and Flores-Villela, 2007); TFTSG Draft 2011, [Critically] Endangered (Rhodin et al, 2011; van Dijk et al., 2014)

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, TESF 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: 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. The largest and rarest of the five North American tortoise species, the bolson tortoise is thought to have once roamed within most of the Chihuahuan desert, but its current range comprises a small area in north central Mexico where the states of Durango, Chihuahua, and Coahuila meet. Due to a suite of political, social, economic, and safety issues, the 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.

Our starting point for the bolson tortoise reintroduction project was a group of 30 bolson tortoises that were collected and bred over a period of nearly 40 years by a private individual in Arizona. Ms. Appleton's collection was donated to TESF in 2006, and 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 2015:

Current status of the bolson tortoise project

As of October 2015, the bolson tortoise project has 29 adult bolson tortoises that serve as the founder population for all juveniles produced by the project. To date, we have produced 588 hatchlings (Fig. 3.1), and as of fall 2015, 383 of these juvenile tortoises were confirmed to be alive, 98 had died, and 71 were unaccounted for and their status unknown. During the period 2012-2015, a total of 131 larger juveniles (shell length > 100 mm) have been equipped with transmitters and moved from predator-proof enclosures to predator-accessible enclosures. 113 (86%) of these transmittered juveniles were confirmed to be alive at the end of 2015.

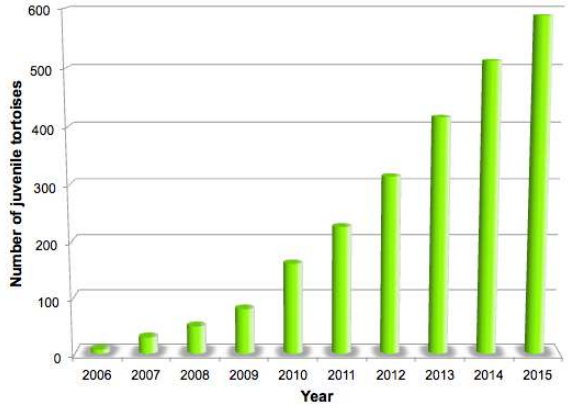


Fig. 3.1. Number of tortoise juveniles born in the captive population from 2006 – 2015.

Successes and milestones attained in 2015

The bolson tortoise project reached four important milestones in 2015:

- We added 76 hatchlings to our population (Fig. 3.2). All 13 adult female tortoises laid eggs in 2015.
- Since 2012, we have moved over 100 juvenile tortoises into larger, predator-accessible enclosures (see Box 3.1).
- We finished expanding the Ladder Headstart pen (LHS-e). This facility can now accommodate all of the juvenile tortoises that are too small to be moved into predator-accessible environments.
- With donations from the San Antonio Zoo, we constructed an "overwinter shed" for housing hatchling tortoises during their first winter.

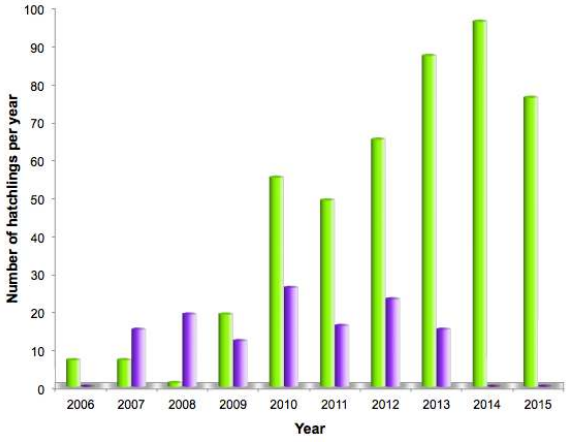


Fig. 3.2. Number of hatchlings produced each year. Green bars = hatchlings produced on the Armendaris (2007-2015) and in Arizona (2006). Purple bars = hatchlings produced at LDZG.

Captive Breeding Program

Captive adults and subadults

The captive bolson tortoise group on the Turner Ranches consists of 25 adult bolson tortoises: 13 females and 12 males (Table 3.1). An additional 4 tortoises (2 males, 2 females) reside at the LDZG in Carlsbad, NM. A large male (EP, found feral in El Paso in 2011) is housed separately at the El Paso Zoo. EP is not yet part of the breeding program, nor are three subadults (2 females, 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 2015, with the exception of Tortoise Y, who suffers from bone degeneration in his hip joints. However, he is able to move around despite a pronounced limp.

Table 3.1. Adult and subadult bolson tortoises in the 2015 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, 09-CT2
El Paso Zoo	Male	09-F1

Husbandry strategies: adult tortoises

Our approach to managing the adult breeding colony is to be as hands off as possible. Towards this end, we survey this captive group twice a year in the spring and in the fall but otherwise leave them alone. We provide water only in severe drought years, which has happened only once (spring 2013) since the inception of the bolson tortoise project. Supplemental irrigation was not necessary in 2015. However, we do continue to intensively manage adult females during nesting season (April – July) to collect eggs each year.

Hatchling production

We used three strategies to produce hatchlings as part of our captive breeding objective:

1. Optimize egg production by monitoring female tortoises and collecting eggs near their due date by induced oviposition, or by collecting eggs from natural nests.
2. Incubate eggs in temperature-controlled environments that are safe from predators.
3. Collect hatchlings, mark them with a unique code, and bank blood for genetic studies and paternity testing.

2015 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 (we would prefer to use ultrasound, but our ultrasound transducer stopped working and we are hoping for a generous donor to replace our portable ultrasound machine). 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.

Table 3.2 summarizes the eggs produced and collected (and hatchlings hatched) for each of the adult female tortoises in the Turner group. Out of a total of 172 eggs produced in 2015, 140 were collected intact and placed in incubators; 76 of these hatched.

Nearly all females contributed to this reproductive record (Table 3.2). One notable exception is Tortoise S, whose eggs failed to develop in 2015. In contrast, we have 14 of Tortoise S's offspring from 2014.

Table 3.2. Egg production and hatching success in 2015 for each female in the Turner group of the captive population.

Tortoise ID	No. of eggs in successive clutches (1st / 2nd / 3rd)	No. of eggs recovered & incubated (2015)	Total offspring production (2015)	2015 hatching success rate
1	6 / 4 / 7	8	7	87.5
2	5 / 5 / 3	13	6	46.1
4	4 / 5 / -	9	7	77.8
A	6 / 9 / 7	22	11	50
F	7 / 4 / -	11	3	27.3
G	7 / 7 / 8	15	3	20
J	4 / 5 / -	5	5	100
K	4 / 4 / 5	13	11	84.6
L	? / 7 / 7	7	7	100
P	4 / 3 / -	7	1	14.3
S	5 / 6 / -	8	0	0
T	3 / 6 / 5	14	11	78.6
X	4 / 6 / -	10	4	40
TOTAL	**59 / 71 / 42**	**140**	**76**	**-**
MEAN	**4.5/5.5/6.0**	**10.8**	**5.8**	**54.3**

Egg incubation

Eggs were distributed into 6 incubators and held at constant temperatures, ranging from 29-32˚C 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 that is attached to the shell with two-part epoxy (the tortoises eventually receive PIT-tags as well, but not until they are much larger). We also generated a photographic

record for each hatchling and drew a drop of blood for banking. 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 (see below).

A total of 76 tortoises hatched on the Armendaris in 2015 (Fig. 3.2), bringing the total number of tortoises produced by our captive adults to 588 since project inception (Fig. 3.1).

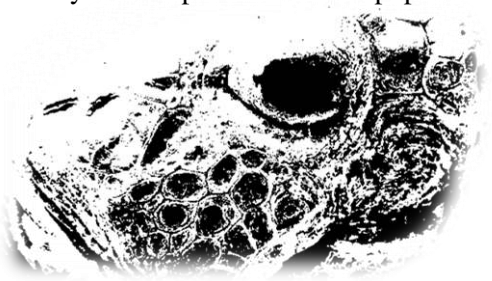
Hatching success rates

Overall hatching success rates varied widely amongst females (Table 3.2), and for a given female from year to year. However, overall hatching success has remained relatively consistent for the last 5 years (Table 3.3), and ranges from 53.4 to 69.4%. The 2015 hatching success rate was slightly below average.

Table 3.3. Hatching success rates of Turner group tortoises since 2010. This rate is the percentage of eggs that hatched from those that were placed into incubators. Eggs not incubated were either lost, broken, or not collected.

Year	No. of eggs hatched	No. of eggs recovered & incubated	No. of eggs not recovered	Hatching success rate
2010	51	78	13	65
2011	50	72	3	69
2012	63	118	10	53
2013	87	126	8	69
2014	96	172	11	56
2015	76	140	32	54.3
Mean	**70.5**	**118**	**12.7**	**61.2**

Over the past few years, we maximized the number of bolson tortoise juveniles produced to enable the implementation of the next phase of our conservation program – to begin establishing 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. 3.3). For 2016, we therefore plan to focus our egg-collection efforts on females that are relatively underrepresented in the population.



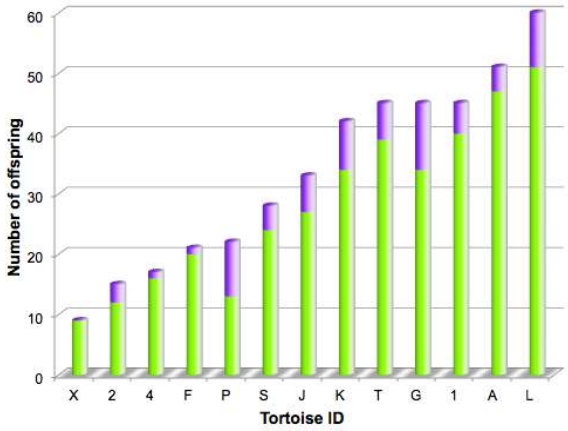


Fig. 3.3. Number of offspring produced by each breeding female. Green bars = no. alive at the end of 2015; purple bars = no. dead at the end of 2015.

Juvenile headstarting

The strategy of headstarting 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.

Since 2006, our captive population has grown by over 1,000%, with about 480 adult and juvenile tortoises in the population at the end of 2015. The Armendaris and Ladder Ranches currently house around 450 of these individuals.

Management of juveniles in headstart enclosures in 2015 was performed in two stages: (1) keeping hatchling "up" during their first winter while providing summer-like conditions inside a newly-erected overwinter Tortoise Shed, and (2) supplemental feeding and watering of juvenile tortoises (those at least one year of age and not yet large enough for release) in outdoor headstart pens. Headstart pen maintenance includes grass-clipping and occasional weeding to remove non-forage plants from the enclosures. Wild globemallow plants

were harvested from the Turner ranches and provided in the enclosures 2-3 times a week for supplemental feeding. While individual growth rates vary between animals (Fig. 3.6) all tortoises are growing at acceptable rates.

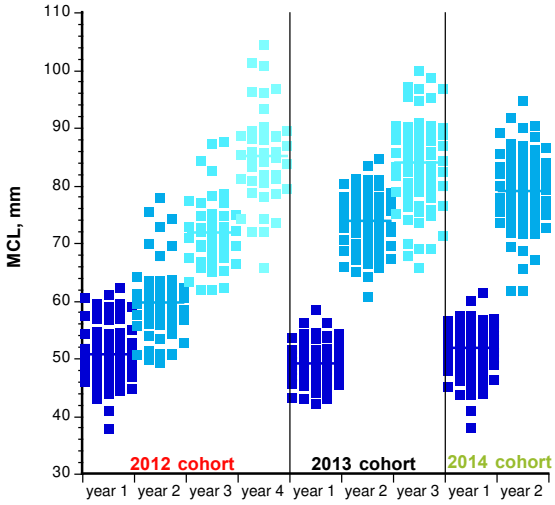


Fig. 3.6. Shell sizes (MCL, in mm) for tortoises born in 2012, 2013, or 2014, as indicated. The 2013 and 2014 cohorts were kept indoors over their first winter. This results in 2 yr-old tortoises (2013 cohort, yr 2 and 2014, yr 2) that are nearly as big as 3 yr-old (2012 cohort, yr 3) tortoises that were overwintered outdoors (2012 cohort).

We improved infrastructure for juvenile tortoise husbandry in two ways in 2015: (1) we finished the expansion of the Ladder headstart pen and began moving animals into the expanded pen (Fig. 3.4), and (2) with generous support from the San Antonio Zoo, we built a movable (but permanent) Tortoise Overwinter Shed on the Ladder Ranch that houses the hatchlings during their first winter (Fig. 3.5).

Tortoise Surveys and Health Checks

We surveyed tortoises in the spring and fall. These health checks revealed that, overall, the juvenile and adult bolson tortoises on the Ladder and Armendaris ranches are in good or excellent health. Health and growth data provides an opportunity to identify juveniles that might need additional management to attain their full growth potential. However, all tortoises examined were assessed to be in good health and no special treatments were required in 2015.

During growth surveys, we measure tortoise weight, as well as shell length, width, and height. These measurements allow the calculation of growth rates, which are our first line of defense against problems such as malnutrition, dehydration, and disease. We found ~390 juvenile tortoises alive and well, but could not locate 71 individuals (27 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"). We documented the death of 11 individuals in 2015, bringing the total number of confirmed juvenile deaths since 2006 to 98.

Fig. 3.4. Young tortoises enjoy Bermuda grass and supplemental water in the expanded Ladder headstart pen.

Fig. 3.5. The new overwinter Tortoise Shed on the Ladder Ranch was built with materials generously provided by the San Antonio Zoo.

Release studies

In the 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 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 the release site. To date, we have transferred a total of 131 juvenile tortoises to two fenced locations on the Armendaris and Ladder ranches (Table 3.4; see also Box 3.2). Of these, we found 113 (86%) to be alive at the end of 2014. This constitutes a surprisingly high survivorship.

Table 3.4. Release cohorts and survivorship of juvenile bolson tortoises transferred to predator accessible pens on the Armendaris (Cedar Tank) and Ladder ranches.

Location	Date	# juveniles released	# deaths to date	# alive
Cedar Tank	Fall 2012	10	2	8
	Spring 2013	8	2	6
	Fall 2013	2	1	1
	Spring 2014	26	8	18
	Fall 2014	14	-	14
	Spring 2015	2	-	2
Ladder Big Pen	Fall 2013	25	5	20
	Fall 2014	2	-	2
	Spring 2015	15	-	15
	Fall 2015	27	-	27
Total		131	18	113

These release studies also revealed that we lost tortoises for a number of reasons, but not due to one specific predator over others (Table 3.5). To evaluate the suitability of their new environment for the health and growth of the released tortoises, we compared growth rates for 5 representative tortoises before and after their release (Fig. 3.5). We found that growth rates are unaffected by the transfer to the "open" pen.

Fall 2015 health assessments once again showed that all juveniles (within headstart pens or in the predator-accessible enclosures) were healthy and in good or excellent body condition.

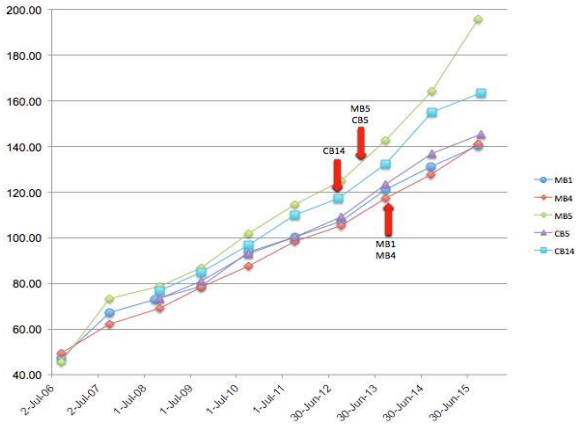


Fig. 3.5. Growth rates for 5 juveniles. Graph depicts fall shell length measurements for each juvenile (in mm). Red arrows = release. CB14 released in Cedar Tank pen in fall 2012; CB5 and MB5 released in Cedar Tank pen in spring 2013; MB1 and MB4 released Ladder Big Pen in fall 2013.

Table 3.5. Juvenile mortalities in the release study. Length = shell length at mortality; time = time tortoise spent at the release location; CT = Cedar Tank; LBP = Ladder Big Pen.

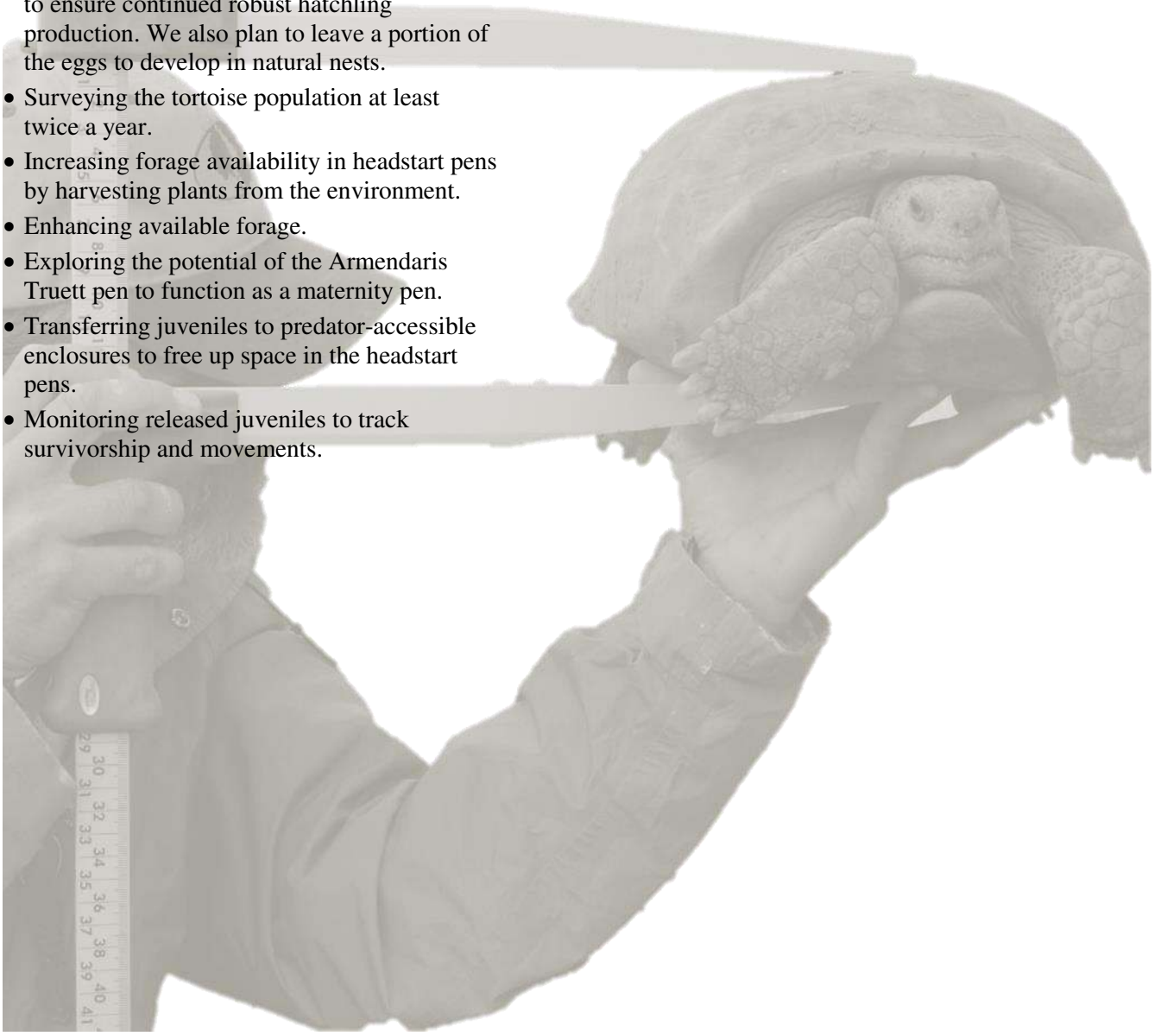
Tortoise ID	Length, mm	Time	Location
09-CB42	112	2-6 mo	CT
Died during winter, no obvious predation.			
10-CB56	114	3 mo	CT
Was predated, badger or coyote.			
10-CB60	123	10 mo	CT
Was predated; found only 1 scute and transmitter.			
10-CB61	98	5 mo	LBP
Probably froze, followed by rodent gnaws.			
10-CB67	106	2 mo	CT
Was upside down in the open, possible raven predation.			
07-CB7	110	3 mo	CT
Found dead outside of enclosure. Crushed (trampled?).			
08-CB29	102	3 mo	CT
Was found upside down in the open, probably natural causes; history of front leg weakness.			
08-CB26	~120	14 mo	CT
Was found predated near its previous burrow.			
07-CB3	~115	1 yr	CT
Did not emerge after winter; no sign of predation.			
08-CB19	~140	~3 yr	CT
Was found upside down in the open.			
07-CB8	115	4 mo	CT
Was found upside down in a large (fox?) burrow.			
08-CB24	120	3 mo	CT
Is presumed dead, found transmitter only.			
09-G6	115	4 mo	CT
Coyote kill, found ~ 0.5 mile west of enclosure.			
08-CB22	~110	11 mo	LBP
Found upside down in the open with no sign of predation.			
11-CB78	~110	12 mo	LBP
11-CB78 found upside down inside a burrow.			
10-CB70	~110	11 mo	LBP
Presumed dead due to no emergence from inside a k-rat burrow.			
10-CB71	~130	~2 years	LBP
10-CB71 escaped LBP and was run over by a vehicle.			
10-CB64	~110	11 mo	CT
Presumed dead inside a rodent burrow.			

Future Activities and Considerations:
Our major objectives for 2016 will be to:

- Continue building a robust captive population of tortoises as a source for wild releases.
- Initiate releases of juvenile tortoises so we can begin to build a strong, repatriated, minimally managed, wild population.
- 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 genetically underrepresented females and incubating them to ensure continued robust hatchling production. We also plan to leave a portion of the eggs to develop in natural nests.
- Surveying the tortoise population at least twice a year.
- Increasing forage availability in headstart pens by harvesting plants from the environment.
- Enhancing available forage.
- Exploring the potential of the Armendaris Truett pen to function as a maternity pen.
- Transferring juveniles to predator-accessible enclosures to free up space in the headstart pens.
- Monitoring released juveniles to track survivorship and movements.



Box 3.1: Another update on the "Wild One"

As we reported last year, we captured trail camera images of an unmarked juvenile tortoise in the Cedar Tank pen in the summers of 2012 and 2013, and identified a juvenile tortoise burrow occupied by an unmarked tortoise in the spring of 2014. Here, we report that on June 4, 2015, we finally got to meet this elusive animal face-to-face in 2015! It weighed over 300 g and had a shell length of 110 mm, suggesting that it was probably ~4 years old. *The existence of a wild Bolson Tortoise juvenile that survived the two major bottlenecks for small tortoises – egg predation and hatchling predation – is highly encouraging, as it establishes that Bolson Tortoises not only thrive in their prehistoric habitat in the northern Chihuahuan Desert, but that they can reproduce without human assistance* (in the form of egg and hatchling protection). This is critical for our goal of establishing wild populations of Bolson Tortoises in the US!

We outfitted the "wild one" with a transmitter and hope to see it mature into a reproductive bolson tortoise adult in the next 10 to 15 years.

The wild one lives! Two images captured on trail cameras in August 2012 (top left) and June 2013 (top row, middle) suggest that at least one un-marked, "wild" juvenile bolson tortoise roams around in the Cedar Tank adult pen. In June 2014, we finally got a chance to take a closer look at the animal, obtain weights and measures, and tag the animal with a transmitter so we can continue to learn about its whereabouts.






Box 3.2: Release of the 100th Bolson Tortoise Juvenile in May 2015

In 2012, we began to move bolson tortoise juveniles of sufficient size (>100 mm shell length) from predator-protected "headstart" pens to large enclosures designed to prevent the tortoises from wandering too far - but not designed to keep out predators. In 2015, we reached a milestone with the "release" of the 100th juvenile tortoise. Our long-time collaborator, Dr. Jim Jarchow (pictured here wearing a blue shirt), was on hand to show tortoise 12-CB96 its new home on the Armendaris. 12-CB96 initially accepted the starter burrow we had provided, but moved to a new burrow the following day.

Along with Jim Jarchow (far left), volunteer Julie Rannou Latella, TESF consulting biologist Scott Hillard, volunteer Enrique Rodriguez and TESF Senior Biologist Chris Wiese (from left to right) were on hand to celebrate the occasion and help with Spring 2015 surveys and health checks (here shown with 12-CB96 before its release).

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:
- Federally 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.

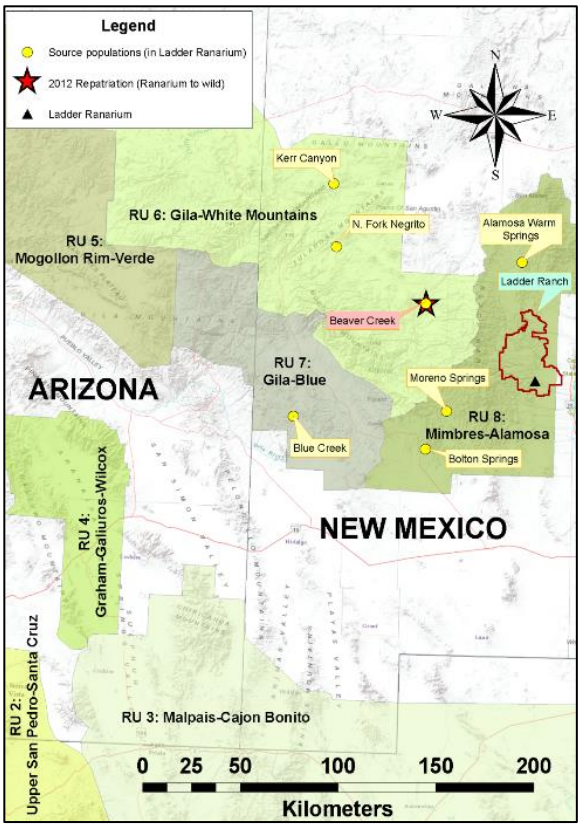


Fig. 4.1. The Ladder Ranch (red outline) is a CLF Management Area within Recovery Unit (RU) 8. In 2015, the Ladder's ranarium facility bred captive CLFs from key off-ranch populations, spanning three RUs

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.; USFWS 2007).

The ranch supports a large CLF population in both natural wetlands and artificial stock water sites (i.e., earthen and steel tanks). 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) threats and causes of decline have been reduced or eliminated, and commitments of long-term management are in place (USFWS 2007).

Specific actions to achieve recovery include: (a) protecting remaining CLF populations; (b) identifying and managing currently unoccupied sites and establishing new CLF populations; (c) augmenting populations; (d) monitoring CLF populations; (e) implementing research to support recovery actions and adaptive management (USFWS 2007).

Project Activities in 2015:

Wild population monitoring

We monitored all known Ladder Ranch sites occupied by wild CLF during 2015. Minimum count data suggests that the Ladder population remains robust (Table 4.1), although it 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 CLF distribution through the creation of a network of natural and artificial wetlands.

Table 4.1. Minimum wild CLF counts in 2015

Site Name	Min. Counts in 2015			
	Egg mass	Tad poles	Meta morph	Adult
[a]Circle 7	3	0	0	5
[a]Avilas	0	>100	0	1
[a]Emrick Spring	7	>100	1	4
[b]Davis (Lower)	5	0	5	35
[b]Davis (Upper)	3	21-50	1	9
[b]N. Seco	119	>100	65	150
[b]Pague	67	>100	95	70
[b]LM Bar	55	>100	180	146
[b]Fish	40	>100	40	15
[b]Johnson	102	21-50	200	192
[b]S. Seco	0	11-20	2	6
[c]Ash Canyon	0	1-10	16	43
[c]Artesia	25	>100	111	50
[b]Seco Box	1	>100	0	8
[d]Animas	0	0	0	0

KEY:
a=Site in Las Palomas Drainage
b=Site in Seco drainage
c=Site in Ash Canyon drainage
d=Site in Las Animas drainage

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 2015, we translocated CLFs into one of the captive refugia tanks designated for use by the USFWS, and two captive refugia tanks designated for Ranch frogs (Table 4.2).

Table 4.2. Captive refugia tanks stocked in 2015.

Refugia	Source	Egg mass	Tadpole	Meta/ Adult
Antelope	Seco Cr.	1	-	-
No. 2	Seco Cr.	1	-	-
Avant	Beaver Cr.	-	-	13

Overall, refugia tanks designated for both Ladder Ranch and USFWS use produced 87 viable egg masses in 2015 (Table 4.3).

Table 4.3. Egg masses laid in captive refugia in 2015.

Refugia	# Egg Masses	# Viable
Antelope	2	2
Seco	17	17
Wildhorse	15	15
South	1	1
Fox	22	19
No. 2	33	33
Avant	0	0
No. 16	0	0

Captive breeding: ranarium program

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. CLFs in ranarium cages during 2015.

Cage No.	Source population	No. ♂/♀	Date of entry
1	Seco Cr.	2/2	5/27/13
2	Alamosa W.S.	3/3	10/31/12
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.	5/1	10/17/12
	Moreno Spr.	0/2	10/29/13
8	Bolton Spr.	1/1	9/27/10
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 2015, 46 viable egg masses were transferred from adult cages to tadpole tanks (Table 4.5). Tadpoles from these masses were released into the wild, or into captive refugia holding tanks in consultation with the USFWS (Tables 4.5 & 4.6).

Table 4.5. Ranarium tadpole production and management in 2015.

Cage	Source	# EM	# TP prod.	Tadpoles to:
1	Seco Cr.	2		(C) Ladder Ranch
2	Alamosa	5	2,846	(C) Middle Well (JER)
3	Beaver Cr.	15	7,643	(W) Beaver Creek
4	San Fran	7	3,184	(W) Cienega Tank, Saliz Creek, Hell's Hole
5	Diamond Cr.	-	-	-
6	Blue Cr.	2	1,184	(C) Garcia Tank (JER)
7	Moreno	3	1,158	(W) Douglas Property, Dissert Property, Mimbres River
8	Bolton	-	-	-
9	Animas	12	3,203	(W) Cave Creek

KEY:
EM = Egg masses
TP = Tadpole
Prod. = Adult
Cr. = Creek
C = Captive
W = Wild

In 2015, the Ladder ranarium produced over 19,000 tadpoles. These tadpoles were released to wild or captive sites across New Mexico on both public and private lands.

Photo of 2015 field employees, Cassidi Cobos (left) and Vivian Porter (right).

Table 4.6. Production and disposition of offspring produced at the ranarium in 2015.

Date	Source	# EM	# TP	# Ad/Met	Release site type
4/12	Seco Cr.	1			C
5/1	Blue Cr.			40	C
5/6	Beaver Cr.	2	1,181		W
5/14	San Fran	1	674		W
5/20	Alamosa	1	1,167		C
6/8	Beaver Cr.	2	616		W
6/12	Alamosa	1	221		C
6/16	San Fran	2	334		W
6/16	Moreno	1	716		W
7/5	Seco Cr.	1			C
7/15	Animas	2	348		W
7/15	Animas	2	470		W
7/28	Alamosa	1	366		C
7/28	Alamosa	1	580		C
8/5	Beaver Cr.	1	372		W
8/5	Beaver Cr.	1	460		W
8/12	Animas	3	647	80	W
8/13	Alamosa	1	481		C
8/13	Blue Creek	1	689		C
8/31	Moreno	2	442	12	W
9/30	Beaver Cr.			13	C
10/1	San Fran	1	1012		W
10/1	San Fran	2	568		W
10/1	San Fran	1	27	9	W
10/1	San Fran			2	W
10/1	San Fran	1	569		W
10/2	Animas	2	1669		W
10/2	Animas	3	716		W
10/7	Beaver Cr.	2	1033		W
10/7	Beaver Cr.	2	1043		W
10/7	Beaver Cr.	2	1331		W
10/7	Beaver Cr.	2	1607		W
11/2	Blue Cr.	1	495		C
11/2	Alamosa		31		C

KEY:
EM = Egg masses
TP = Tadpole
Ad = Adult
Met = Metamorph
Cr. = Creek
C = Captive
W = Wild

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 2015 we continued a study to determine whether spot-pattern identification (SPI) methods provided comparable results to the commonly used PIT tagging method. 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.

We have also partnered with the USGS to help create software unique to Chiricahua leopard frog spot identification. For this, we submitted our database of photographs from our PIT/SPI fieldwork. In addition, we raised 10 tadpoles through metamorphosis to small juveniles in captivity, photographing them each month. By photographing regularly, we are examining how spots on the dorsal side of a frog change as the individual grows.

Photo of Ladder Ranch frog during PIT tag/SPI study.

References:

USFWS. 2007. Chiricahua leopard frog (*Rana chiricahuensis*) recovery plan. U. S. Fish and Wildlife Service Southwest Region, Albuquerque.

5. TESF FIELD PROJECT – CHUPADERA SPRINGSNAIL (CSS)

Pyrgulopsis chupaderae
ESA listing: ENDANGERED

PROJECT STATUS
Ongoing

Principal biologists
Dustin Long
Magnus McCaffery
Cassidi Cobos

Conservation Problem: Highly endemic species; the potential for habitat degradation and loss due to groundwater pumping in the surrounding area and springhead modification; and increased likelihood of severe drought. At this time it is unclear what impacts livestock grazing may have on the habitat of this species.

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: The goal of this project is to mitigate threats of extinction and assist USFWS in developing a Recovery Plan.

Objective: To accomplish this goal we will convene a conservation working group; this group will 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, the development of a more complete understanding of the springsnails' life history, and the establishment of captive populations.

Supporting Rationale for Objective:
The CSS is rare and highly endemic and the potential for extinction is greater than with many other imperiled species. Furthermore, very little is known about the species and currently there is no federal recovery plan to guide conservation efforts or provide downlisting/delisting criteria. The recovery plan (USFWS 1993) for 2 similar species found in New Mexico, the Alamosa (*Tryonia alamosae*) and Socorro (*Pyrgulopsis newmexicana*) springsnail, provide downlisting/delisting criteria that 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.

Project Background: The Chupadera springsnail is a small (2 – 3 mm) freshwater snail that is endemic to Willow Spring. The snail was also found in a nearby unnamed spring but habitat degradation resulted in the extirpation of that population. The springsnail is considered highly susceptible to extinction given the limited extent of (0.5 to 2 m wide x 38 m long) and potential threats to occupied habitat.
Habitat, water quality, and abundance data were last collected at Willow Spring in 1997-1998 by NMGF biologists. These data suggest that the species survives only on rhyolitic gravels within a relatively stable range of water quality parameters.

In 2014 TESF executed an agreement with Highland Springs Ranch which allows access to the Willow Spring site. During the short period that TESF has had access to the site we have collected water quality data at Willow Spring on three occasions, deployed temperature and dissolved oxygen data loggers and hosted USFWS, NMDGF personnel and a springsnail expert to evaluate the site and consider the next steps in conserving the species.

Project Activities in 2015:

A site visit in early 2015 by the last biologist to visit Willow Spring in 1998 proved instructive and encouraging. CSS densities appeared to be similar to those observed in 1998, however, CSS had colonized previously unoccupied habitat further up the spring and water flow appeared to have increased. Water quality and chemistry were similar to those last collected in 1998.

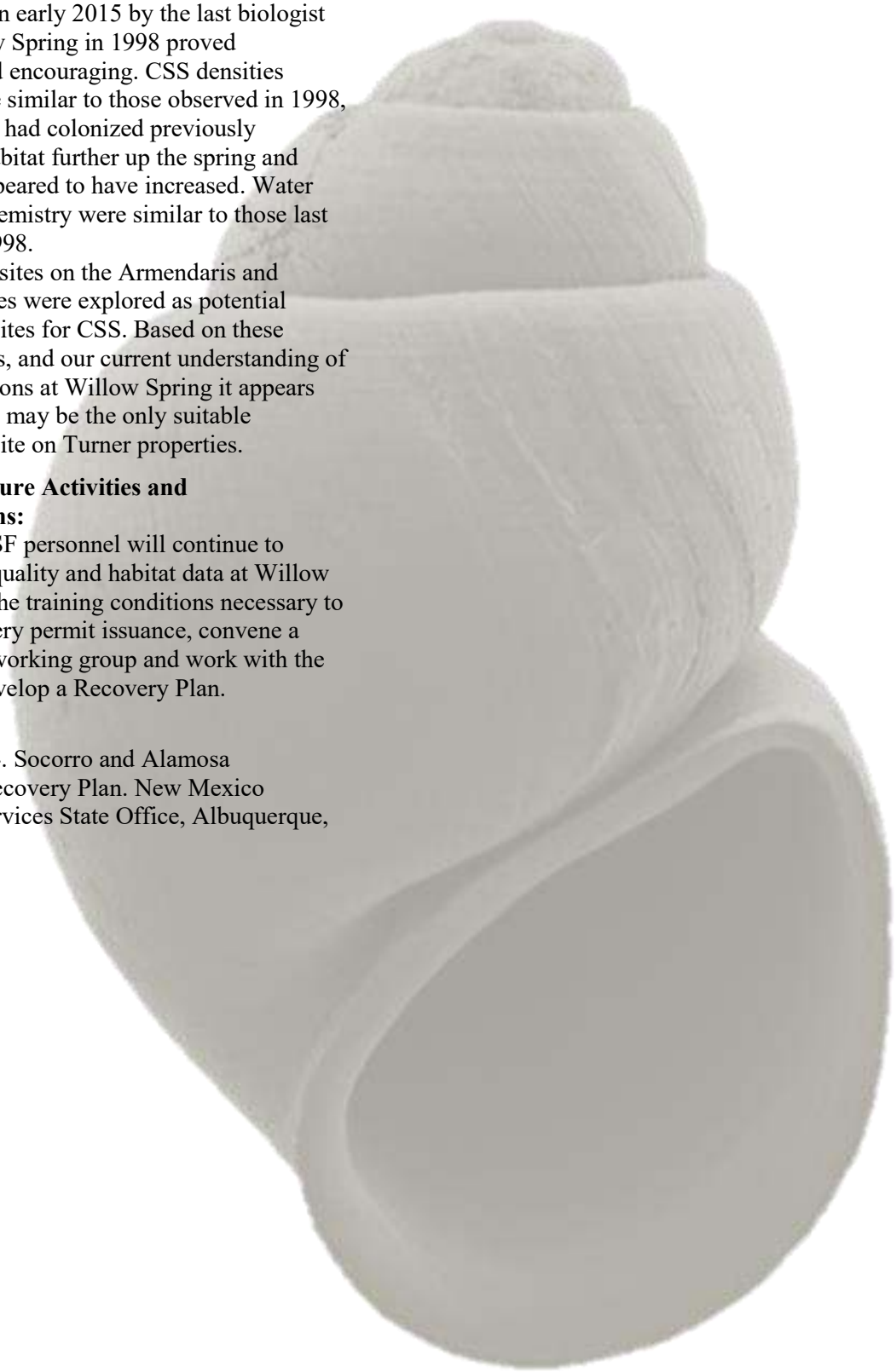
Nine spring sites on the Armendaris and Ladder Ranches were explored as potential translocation sites for CSS. Based on these habitat surveys, and our current understanding of habitat conditions at Willow Spring it appears McRae Spring may be the only suitable translocation site on Turner properties.

Proposed Future Activities and Considerations:

In 2016 TESF personnel will continue to collect water quality and habitat data at Willow Spring, meet the training conditions necessary to finalize recovery permit issuance, convene a conservation working group and work with the USFWS to develop a Recovery Plan.

References:

USFWS. 1994. Socorro and Alamosa Springsnail Recovery Plan. New Mexico Ecological Services State Office, Albuquerque, NM. 24pp.



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 is 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:
Nonami Plantation, GA; Avalon Plantation, FL

Project Partners:
- GADNR
- FWC
- Saving Florida's Gopher tortoises (SFGT)

Project Funding: TESF

Goal: Restore viable gopher tortoise population levels to the Avalon and Nonami plantations.

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), and (2) at least one viable population on the Nonami Plantation 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) and Nonami Plantation (3,578 ha; in Dougherty County, GA) are principally managed for northern bobwhite quail recreational hunting as well as for ecological conservation. The properties have extensive areas (~ 1,600 ha and ~ 360 ha, respectively) of suitable gopher tortoise habitat (FWC 2007), 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 populations on these properties are low but it is likely that the species was historically distributed far more widely and in greater densities. Reductions in both range and numbers 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 land management.

The overall estimated density of tortoises at both Avalon and Nonami is 0.07 tortoises/ha. This is based on the number of potentially occupied burrows (i.e., active and inactive burrows: Avalon = 248, Nonami = 52) located by TESF surveys within Avalon's 1,600 ha and Nonami's 360 ha areas of suitable habitat, and assumes a burrow occupancy rate of 50 % (FWC 2007). 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 and Nonami 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 2015:

Nonami Plantation

Burrow mapping and occupancy surveys

We re-visited mapped burrows on the Nonami Plantation and used a burrow scope to assess their occupancy status. Of the 52 currently known burrows at Nonami, we found 24 to be occupied by a tortoise.

Planning activities

We worked with the Nonami Plantation manager, Ray Pearce, to identify a 350 acre area (Fig. 6.1) that could serve as a site for receiving tortoises rescued from either Georgia or Florida in order to bolster the extant Nonami population. Tortoises translocated to this area would undergo an acclimation period in temporary pens from March to October. To minimize impact to other activities at Nonami, the pens would be installed after burning season and removed prior to the start of quail hunting season. Designation of this area as a recipient site would involve no changes to quail management, although effort would be made to avoid burrows with heavy machinery to reduce the risk of collapse.

Gopher tortoise on the Avalon Annex (Photo: M. McCaffery)

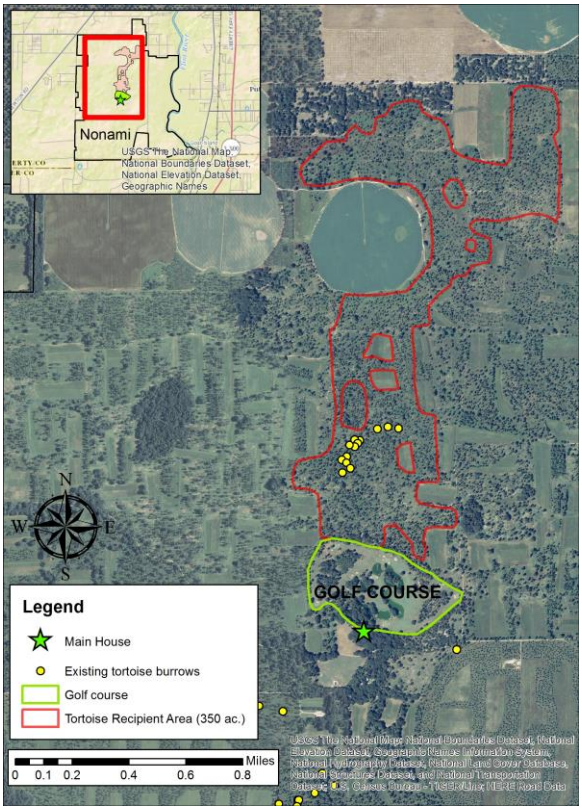


Fig. 6.1. Location of proposed gopher tortoise recipient area (red polygon) on the Nonami Plantation.

Avalon Plantation

Burrow occupancy surveys

We conducted burrow surveys in two temporary pens used for ITP tortoise translocations in 2014 (i.e., North Pen and South Pen) to determine the number of potentially occupied burrow in each of these areas. The visual status of each burrow was evaluated, and where possible the occupancy status was determined using a burrow camera (Data summarized in Table 6.1).

Table 6.1. Summary data for 2015 burrow surveys conducted within the North and South Pens on the Avalon Annex.

BURROW STATUS	No. of burrows (North Pen)	No. of burrows (South Pen)
Active	38	51
Inactive	37	56
Occupied	13	28
Empty	60	76
Undetermined	2	2
Total surveyed	**75**	**107**

Avalon Annex ITP tortoise program

Removal of old acclimation pens

We removed two acclimation pens (i.e., the North Pen and the South Pen) used to soft release ITP tortoises translocated to the Annex in 2014.

2015 Annex ITP tortoise translocations

In preparation for receiving ITP tortoises in 2015, we installed a 52 acre acclimation pen ("2015 Pen"; Fig. 6.2) in the 505 acre Annex ITP recipient site. We then worked collaboratively with Carissa Kent (SFGT) to translocate 139 gopher tortoises to the 2015 Pen (Table 6.2). Prior to release at pre-dug starter burrows in the 2015 Pen, we examined and measured (maximum carapace length (MCL), maximum plastron length, mass, plastron concavity, annuli count, examination for parasites and injury) each tortoise. In addition, tortoises that were assessed to have hardened carapaces and sufficient space on their marginal scutes were also marked with an individual identification number by drilling a unique combination of small holes in the marginal scutes. MCL data from translocated animals are summarized in Table 6.2.

The fence line of the acclimation pen were monitored twice daily (morning and evening) for two weeks following tortoise releases.

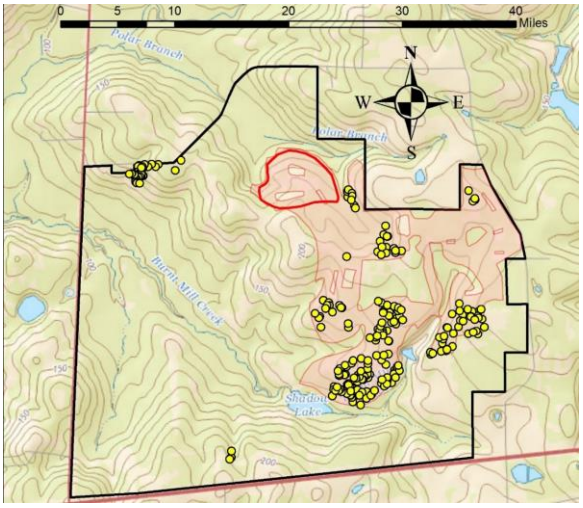


Fig. 6.2. Location of the 52 acre acclimation pen ("2015 Pen"; unfilled red polygon) for receiving translocated ITP tortoises to the Avalon Annex Recipient Site (505 acres; filled-transparent red polygon). Potentially occupied burrows indicated by yellow points.

Avalon Proper ITP tortoise program

We investigated potential areas of Avalon Proper that could be used to build a viable population of gopher tortoises that would satisfy habitat requirements for indigo snake reintroductions. We identified a ~ 500 acre area with an extant, but non-viable, tortoise population (Fig. 6.3) that could be rapidly populated with tortoises through translocations. We will continue to develop a strategy for restoring a viable tortoise population to Avalon Proper and aim to begin implementing translocations to this part of the property in 2016.

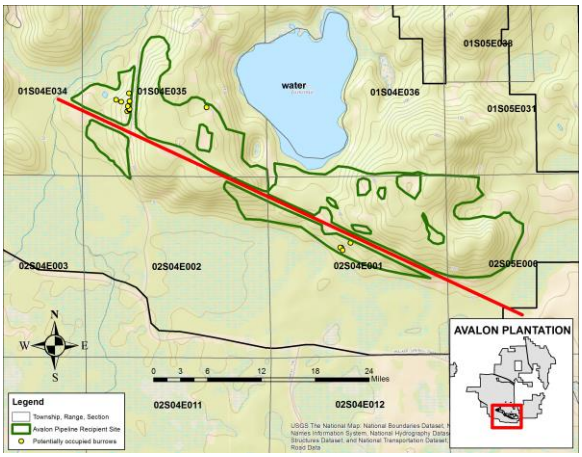


Fig. 6.3. Potential ITP tortoise recipient site (~ 500 acres) on Avalon Proper.

Table 6.2. Summary data for gopher tortoises translocated to the Avalon Annex unprotected recipient site (2015 Pen) in 2015.

Permit #	FLA-017	STJ-067	SAR-050
♀	n=7 $\bar{x}$ CL=252	n=25 $\bar{x}$ CL=240	n=2 $\bar{x}$ CL=306
♂	n=6 $\bar{x}$ CL= 244	n=25 $\bar{x}$ CL=254	n=1 $\bar{x}$ CL=291
Lge. J	n=2 $\bar{x}$ CL=146	n=10 $\bar{x}$ CL=152	–
Sm. J	n=2 $\bar{x}$ CL=90	n=59 $\bar{x}$ CL= 88	–

KEY:
n = number of tortoises translocated to recipient site
$\bar{x}$ CL = ave. Max. Carapace Length (MCL; mm
♀ = female; ♂ = male
Lge. J = large juvenile (> 130 mm MCL). Sex ?
Sm. J = small juvenile (< 130 mm MCL). Sex ?

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 (see Section 6) 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. 6.1).

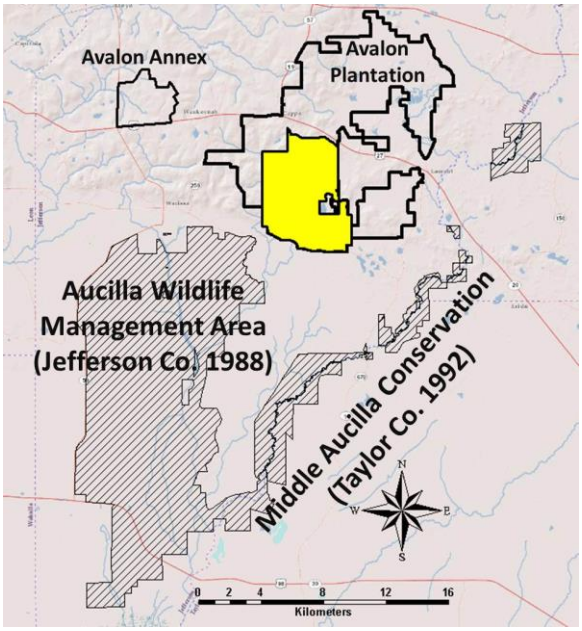


Fig. 7.1. The Avalon property in relation to surrounding protected lands where the most recent eastern indigo snake sightings occurred in 1988 and 1992. Yellow polygon indicates area of Avalon with a TNC conservation easement.

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.

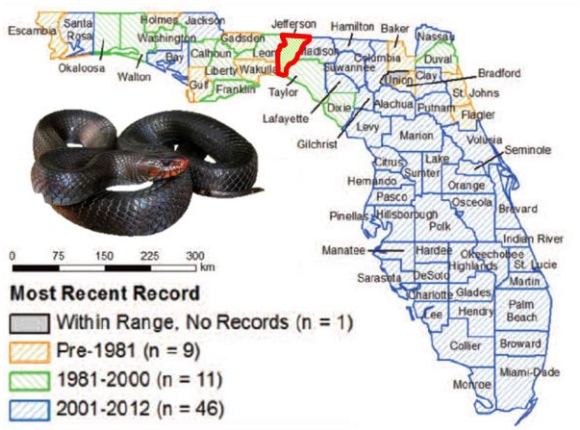


Fig. 7.2. The most recent sighting records for eastern indigo snakes in Florida for each county by time period: pre-1981, 1981–2000, and post-2000. Avalon is located in Jefferson County (red polygon). Source: Enge et al. 2013.

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; see Section 6).

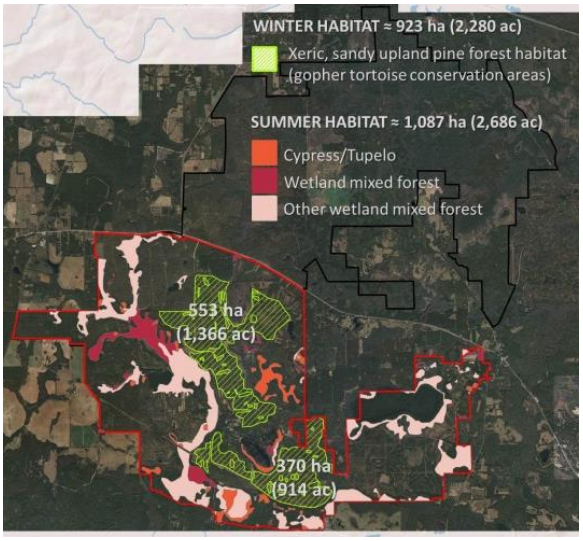


Fig. 7.3. The potential eastern indigo snake recipient site (red outline) comprising around 6,000ha of the Avalon Plantation. Areas that could be populated with gopher tortoises, thereby restoring indigo snake winter habitat are shown as green hatched polygons. Indigo snake summer foraging habitat is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

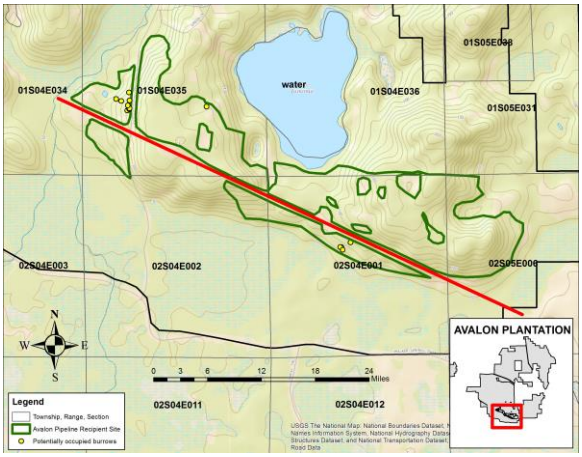


Fig. 7.4. Potential area (green polygon) for future gopher tortoise translocations to augment the small extant tortoise population (burrows = yellow circles) and therefore restore indigo snake overwinter habitat on Avalon Proper.

Project Activities in 2015:

We investigated potential areas of Avalon Proper that could be used to initially build a viable population of gopher tortoises that would satisfy habitat requirements for indigo snake reintroductions. We identified a ~ 500 acre area (Fig. 7.4) with an extant, but non-viable, tortoise population that could be rapidly populated with tortoises through translocations. We will continue to develop a strategy and aim to implement tortoise translocations to Avalon Proper in 2016.

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: Petitioned for listing in 1995, but judged "warranted but precluded." Subsequent habitat and population losses led to listing as threatened in 2014. A federal court stripped the species of ESA protections in 2015. USFWS will appeal the decision in 2016.

Project Locations: Z Bar Ranch, KS

Project Partners:
- WAFWA
- Natural Resources Conservation Services
- Kansas Dep. of Wildlife, Parks and Tourism

Project Funding:
- TESF/TEI
- Western Assoc. of Fish and Wildlife Agencies

Goal: To return ~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.
- Implementing a grazing strategy 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:
In the 1990's and early 2000's the Z Bar supported a modest lesser prairie-chicken population with at least 2 lek sites on the ranch. However, the population has since decreased to the point that only occasional individual sightings are reported. The cause of this rapid population reduction is unclear, but it appears to have been a range-wide phenomenon which led to the species listing in 2014. To ensure a sustainable lesser prairie-chicken population WAFWA recommends habitat blocks (aka. lek complexes) of 21,000 – 25,000 acres be managed for prairie-chicken habitat. The 42,500 acre Z Bar has sufficient existing and potential habitat to meet that lek complex requirement.

Project Background:
In 2014, TESF and TEI finalized a10 year lesser prairie-chicken Conservation Plan with WAFWA to manage 21,256 acres for lesser prairie-chicken habitat. An additional 10,269 acres were added to the Conservation Plan in early 2015 bringing the total to 31,525 acres.

Project Activities in 2015:
We developed a prescribed fire plan for the ranch and burned a total of 2,848 acres at two locations, clearing 627 acres of woody vegetation from the uplands at three locations and establishing 2 spring lek survey routes with a total of 28 listening points. No lesser prairie-chickens were detected during 2015 spring lek surveys.

Proposed Future Activities and Considerations:
In 2016 we will continue prairie-chicken habitat improvement efforts at the Z Bar through the use of prescribed fire, beneficial bison grazing regimes, and through the removal of red cedar and other woody vegetation from the uplands. Our hope is that the lesser prairie-chicken population at the Z Bar increases as we improve habitat quality. The return of a stable population of prairie chickens to the Z Bar could occur naturally through reproduction of resident birds and through dispersal from nearby (>20 miles) populations. If natural repopulation of the Z Bar fails to occur in the near future we will begin to evaluate the practicality of prairie-chicken translocations.

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: To manage for and increase suitable habitat for monarch butterflies and other native pollinators on Turner properties through milkweed (*Asclepias spp.*) and native wildflower plantings. Within 5 years we will double the milkweed plant density at the Z Bar and establish stable milkweed populations of not less than 500 plants at both the Avalon and Nonami Plantations. Over the next 3 years will recruit 2 additional Turner properties into the project.

Supporting Rationale for Objective:

Most Turner properties lie within the migration route 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.

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 2015:

In 2015 we surveyed Z Bar, Avalon and Nonami for milkweed. Z Bar surveys indicated 1 milkweed stem per 2,153 square feet. Milkweed species identified on these transects included: *A. latifolia* (broadleaf), *A. stenophylla* (narrow-leaf) and *A. verticillata* (whorled). We also located several patches of *A. speciosa* (showy). Surveys performed in 2000-2002 identified *A. viridis*, however, we were unable to locate any during 2015 surveys. Surveys at the Avalon Plantation indicated low densities of *A. variegate* (white) and no milkweed was detected at the Nonami Plantation.

No monarch eggs or larva were detected during habitat surveys at any of the properties, although adults were regularly observed at all locations throughout the summer.

In collaboration with our KS partners we planted 6 milkweed species (*A. speciosa, A. incarnata, A. verticillata, A. viridis, A. tuberosa, and A. syriaca)* and 18 native wildflower species at 8 sites covering 6 acres at the Z Bar.

Proposed Future Activities and Considerations:

At the Z Bar we will survey for milkweed species and density, survey for monarch butterfly eggs and larvae, and assess the success of the 2015 milkweed/wildflower plantings. We will begin planting milkweed plugs at the Avalon and Nonami plantations and at Bad River Ranches, SD.

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. Under the ESA, 1,973 species are listed as threatened or endangered and several hundred others are being considered for 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 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 immeasurably 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 and thrive 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. To this end we have worked with landowners and conservation scientists to help found the Western Landowners Alliance (WLA; Fig. 10a.1).

At the national level, the WLA advances policies and practices that sustain working lands, connected landscapes, and native species. It draws attention to the Turner approach of land ownership. 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 that effort.

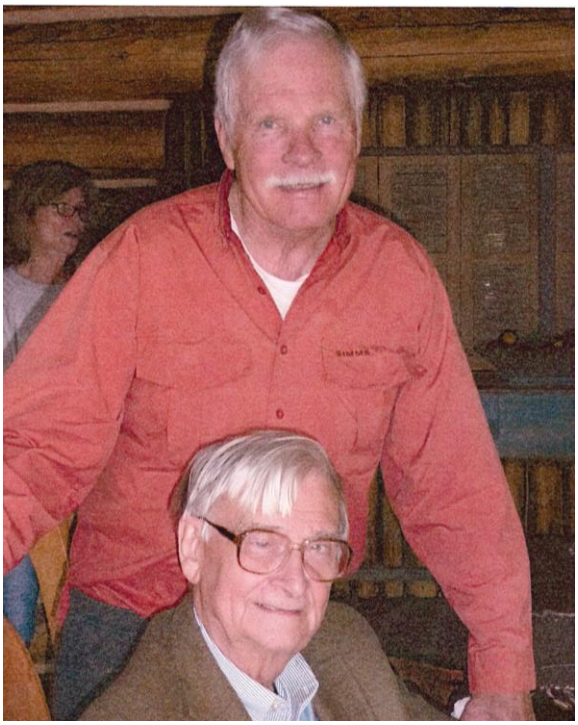


Fig. 10a.1. Ted Turner and E.O. Wilson at the Flying D Ranch in 2015. Wilson's book *Half-Earth: Our Planet's Fight for Life* highlights the importance of private lands, like those owned by Ted, for arresting the extinction crisis.

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

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 (EOWBF) into the GLI.

Project Activities in 2015:

For the WLA, Phillips continued to serve on the Board of Directors with a focus on efforts to advance imperiled species conservation and ideas for improving implementation of the ESA. For the GLI, Phillips cemented the involvement of the Recanati-Kaplan Foundation, Panthera, Orianne Society, and the E.O. Wilson Biodiversity Foundation. He also recruited the Wildlife Cooperative Research Unit from Oxford University to the effort.

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 20 – 25 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 2015:

Artificial Cavity Construction

During cluster surveys, we determined that 3 clusters had lost an active tree during 2015 due to natural causes (wind, lightning or natural

mortality). Supplemental cavities (Fig. 11.1) were installed in the 3 clusters to ensure each cluster contained a minimum of 4 cavities.

A total of 2 recruitment clusters were established, with a total of 4 artificial cavities installed at each recruitment site.

Fig. 11.1. Artificial cavity.

Recruitment Clusters

2 recruitment clusters were established in 2015). Effort was concentrated on the northeast section of the property; as retention rates have historically been higher in this area. Each recruitment cluster was placed within 0.4 – 1.0 km of an existing active cluster and within 0.4 km of each other. This has proven most effective for previous recruitment cluster establishment.

Cavity Tree Management

All clusters (active, inactive and abandoned) were mowed in February before burning season. All cavity trees were marked prior to mowing and the burn season. 44 acres were mowed in 2015 (i.e., 2 acres/cluster). No cavity tree mortality or scorch occurred during the burning season. Moreover, prior to any activity within or near cluster sites, operators were reminded of the locations of cavity trees.

Prescribed Fire

Approximately 60 - 65% of the entire property was burned during March and early April 2015.

Cluster Monitoring

Each cluster was monitored in October 2015. Monitoring is used to ensure each cluster has minimum of 4 suitable cavities and to determine activity status (i.e., active or inactive). Results indicated the population currently consists of 15 active, 6 inactive and 1 abandoned (Fig 11.2).

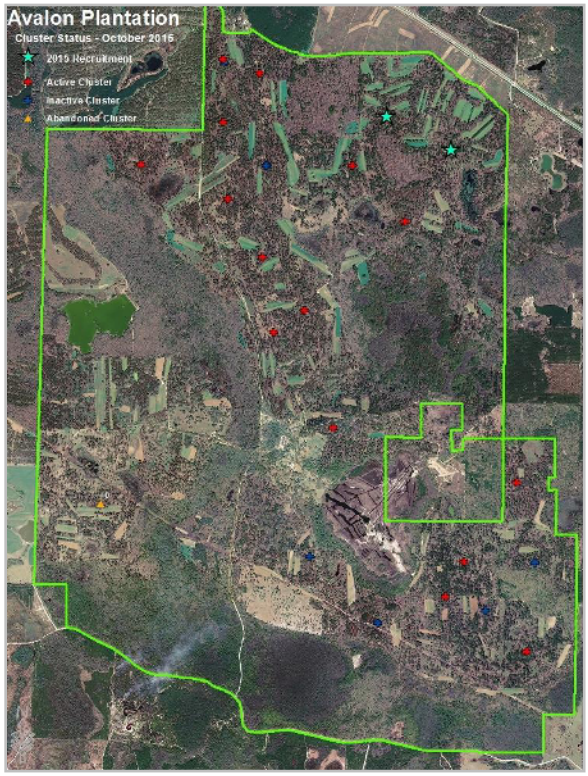
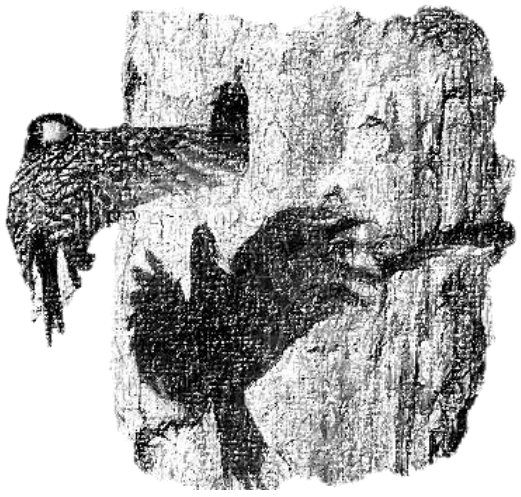


Fig. 11.2. Results of 2015 RCW cluster surveys at Avalon Plantation.



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 non-native competition and introgression, habitat degradation, and exploitation. Westslope cutthroat trout (WCT) were historically the most widespread cutthroat subspecies – occupying ~90,800 km of streams and rivers throughout the headwaters of the Columbia and Missouri river basins of Montana, Wyoming and Idaho. The range of genetically pure populations has contracted by 76%. On the east side of the Continental Divide range reduction has been the most dramatic, exceeding 95%. Rio Grande cutthroat trout (RGCT) were historically found in ~10,700 km of habitat in the upper Rio Grande basin of Colorado and New Mexico; however the distribution of genetically pure populations has been reduced by 92%.

Conservation Status:

- RGCT are considered a Species of Greatest Conservation Concern/Need (SGCN) by the NMDGF and Colorado Parks and Wildlife.
- WCT are considered a SGCN by Montana Fish Wildlife and Parks and Idaho Department of Fish and Game.
- Both subspecies have been petitioned for listing under ESA, but found not warranted for listing in part because of conservation activities underway.

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

Table 12.1. Cutthroat trout conservation projects on Turner Ranches under the TBD Cutthroat Trout Initiative

Stream	Ranch	Species	Project length (km)	Status
Cherry	FD	WCT	100	Trt. complete: 2010 Restocking complete: 2012 Res. & Mon.: ongoing
Spanish	FD	WCT	30	Plan. & develop.: ongoing Implementation in 2018
Green Hollow	FD	WCT	4	1-2 yrs. from complete eradication (95%)
Greenhorn	SR	WCT	32	Trt. complete 2014 Restocking in 2016.
Costilla	VPR	RGCT	175	Trt. 100% complete Restocking underway.
Las Animas	LR	RGCT	48	2013 Silver Fire killed non-native trout; monitoring habitat recovery.
Vermejo	VPR	RGCT	32	4 year non-native removal complete (2013). Chronic maint. Required.

KEY:
FD = Flying D Ranch
SR = Snowcrest Ranch
VPR = Vermejo Park Ranch
LR = Ladder Ranch

Trt. = Treatment
Res. & Mon. = Research & Monitoring
Plan. & develop. = Planning & development
Maint. = maintenance

Project Partners:

- 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 NFWF ($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)

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

Project Goal: Restore or enhance self-sustaining populations of native cutthroat trout on Turner ranches and surrounding landscapes to improve their conservation status.

Project Objectives: Over a two decade period we will lead recovery of native cutthroat trout stocks in 400 km of stream (Table 12.1) in the Rocky Mountain west to advance conservation and recovery, serve as a model for large scale conservation efforts on private landscapes, and contribute to science through innovation, implementation and research. Our cutthroat projects will include at least two subspecies, be implemented in at least 6 sites, and include at least one metapopulation restoration effort per subspecies. Restored populations will be allopatric and exhibit minimum mean densities of 100 adults (i.e., $\geq$ 120 mm total length) per km 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 NGO's guide conservation and restoration activities for WCT and RGCT across jurisdictional boundaries. Objectives outlined in these documents include securing and monitoring populations; seeking opportunities to restore or found new populations, especially over large areas and including private lands; identifying or locating additional wild populations; coordinating conservation activities among resource agencies and NGO's; and providing public outreach and technical assistance. These range-wide objectives are consistent with the mission of TEI and fit within the land management framework on the 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 has developed a *Cutthroat Trout Initiative* to catalyze cutthroat restoration or conservation activities on 400 km of stream. This the most comprehensive and ambitious private effort on behalf of native cutthroat trout. Efforts to restore or conserve cutthroat trout are in planning or 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 Mountain and coastal areas of the western US and is classified into as many as 14 subspecies. The seven major inland subspecies of cutthroat trout historically occupied most accessible cold water environments from Canada to southern New Mexico. However, all subspecies have incurred significant range reductions primarily due to competition and introgression with introduced salmonids, but also from habitat degradation and exploitation. Lahontan (*O. c. henshawi*) and greenback (*O. c. stomias*) cutthroat trout are listed as threatened under the ESA and the other inland subspecies have either been petitioned for listing under the ESA or are considered species of concern by state and

federal agencies. Recovery and conservation efforts are underway for all major subspecies, with many notable successes; however such efforts are hindered by ongoing non-native invasions, limited opportunities for large-scale projects, social resistance, changing habitat conditions (e.g., climate change), and past, widespread introductions of cutthroat trout subspecies outside their native ranges.

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

Through the *RGCT* and *WCT Range-Wide Conservation Working Groups*, TBD has partnered with public agencies and other private organizations to implement two of the largest cutthroat trout restoration projects ever undertaken in the United States. 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 increases the extent of stream occupied by WCT in the Madison River basin from 7 km to over 100 km or from 0.3% of historical occupancy to almost 5%. Perhaps more importantly the success of the Cherry Creek project, and lessons learned from, has catalyzed several 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. If this project is fully implemented as scheduled by 2020 it will represent a 20% increase in the amount of stream genetically pure RGCT currently occupy 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.

Project Activities in 2015:

Cherry Creek – Electrofishing indicated cutthroat trout numbers and average size exceed that of the pretreatment nonnative trout population. In some cases the population may have surpassed carrying capacity (Fig. 12.1). These numbers should moderate in coming years and more closely align with pretreatment averages. No nonnative trout have been captured in the project area since piscicide treatments were completed in 2010. Environmental DNA samples collected from several sites in the upper Cherry Creek watershed in 2015 confirmed the absence of non-native trout. Nearly 4,000 WCT in the project area have been individually marked with PIT tags. Through regular sampling and remote antennas many of these fish have been "recaptured" several times, providing data on survival, movement, growth, and genetic fitness of the population. Analyses of these data

are ongoing; however, funding for genetic comparisons remains limited. A National Science Foundation grant application was unsuccessful, but TBD recently partnered with University of Idaho and University of Montana to assist with genetic analyses. Initial designs for a fish ladder to provide upstream fish passage from Phase IV ("Butler Reach") of the project area into the upper watershed were modified into a more natural rock jump pool configuration. The appropriate permits were obtained in 2015 and installation of the fish passage structure was completed in early 2016 (Fig. 12.2). Fish have been seen moving over the structure. MTFWP Future Fisheries Program provided 50% cost share for the structure. Anglers consistently report large numbers of cutthroat trout in the Madison River in the vicinity of Cherry Creek. These are likely individuals that have moved downstream from the project area.

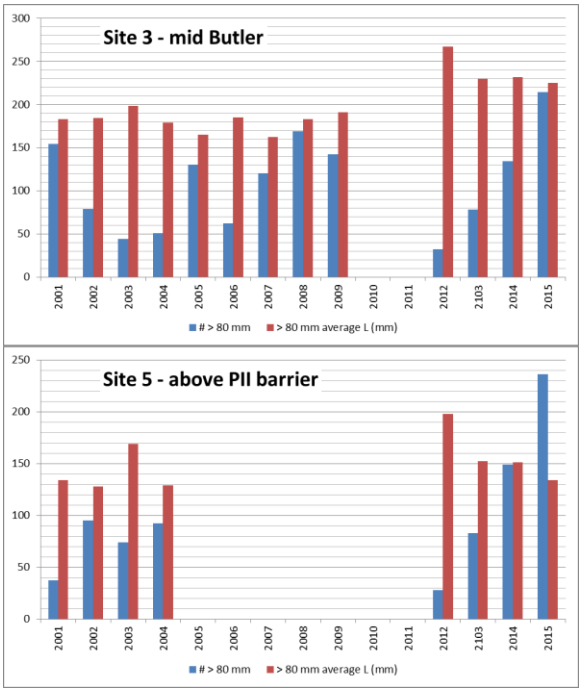


Fig. 12.1. Number and size of fish captured in two 100-m monitoring sites before (2002-09) and after (2012-15) piscicide treatment and native WCT introduction in Cherry Creek. Site 3 is in the Butler Section of Cherry Creek, and Site 5 is upstream from Cow Camp. Horizontal red and blue lines are average size and number of all fish > 80 mm (3") in size at each site, each year, respectively. Densities (e.g., #) of fish in all monitoring sections are now higher than before removal of non-native trout, although that is expected to moderate in coming years.

Fig. 12.2. The Cowboy Canyon irrigation diversion (top panel) prevented fish movement from the Butler Section (Phase IV) of Cherry Creek into upper portions of the project area. Installation of rock jump pools now allows fish movement over the irrigation diversion, providing important genetic exchange with the upper watershed.

Costilla Creek – All remaining waters containing nonnative trout in the Costilla watershed on VPR were treated in 2015 (Fig. 12.3). This included piscicide applications to over 50 km of stream in July and August, as well as a treatment of Costilla Reservoir in October.

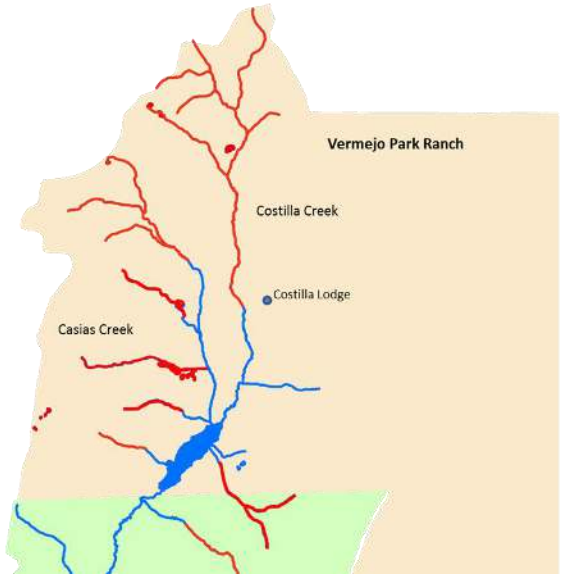


Fig. 12.3. Costilla Creek project area showing previously treated waters (red) and waters treated in 2015 (blue). All Costilla Creek waters on Vermejo Park Ranch have now been treated at least once with piscicide.

Follow-up monitoring has not captured any fish, suggesting a successful treatment. As a precaution these same waters will be retreated in 2016, hopefully completing the removal phase of the project. To facilitate stream and reservoir treatment at different times, seasonal fish movement barriers were installed on reservoir tributaries to prevent fish movement out of the reservoir back into treated streams (Fig. 12.4). These barriers were removed following reservoir treatment. Population monitoring and restocking continued in those areas where RGCT have already been reestablished. Planning for a RGCT hatchery at the Ladder Ranch is underway. Following RGCT recovery in the Costilla watershed, this proposed hatchery will collect RGCT gametes at a streamside spawning station on Vermejo Park Ranch, hatch and grow RGCT, and then stock at Vermejo to support recreational fishing programs.

Fig. 12.4. A seasonal fish migration barrier on Costilla Creek. This barrier was installed in July to prevent fish moving out of Costilla Reservoir and into treated stream reaches prior to reservoir treatment in October. The barrier was removed from the stream following reservoir treatment.

Vermejo River – This is the only project in the *Cutthroat Trout Initiative* where genetically pure (or nearly so) native cutthroat trout (in this case RGCT) are known to remain within their historical range on Turner ranches. This conservation population is threatened by encroachment of rainbow trout hybrids, competition with nonnative brook trout (BKT), and declining habitat quality (e.g., increased stream temperatures and turbidity). From 2010-2013 TBD removed approximately 17,850 BKT from the upper 30 km of the Vermejo River. More importantly, 20 confirmed rainbow x cutthroat trout hybrids were removed from the watershed over the four year period. Removal of these hybrids has helped keep the genetic status of Vermejo River RGCT at least 99% pure. Effort in 2014 and 2015 has focused on searching for additional hybrid fish. No suspected hybrids were found in 2015. Recent drought and long term 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 has destabilized banks and impacted water quality to the detriment of native fishes and riparian obligate species (Fig. 12.5).

Fig. 12.5. An example of limited riparian development along the upper Vermejo River due to chronic over browsing and drought.

In 2014 TBD applied for and received $75,000 in grants (50% cost share) from New Mexico Partners for Fish and Wildlife (US Fish and Wildlife Service) to construct six ½ mi long x 8 ft. high exclosure fences along sections of the upper Vermejo River. The fences will exclude large ungulate grazing. Two exclosures were completed in 2014 and four more in 2015 (Fig. 12.6). Another $66,000 in grant funding was received in 2015 to construct four additional (ten total) exclosures in 2016-17. 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.

Fig. 12.6. One of ten high fence exclosures to be installed along the upper Vermejo River to improve riparian health.

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. Around 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 USFS draft environmental assessment (DEA) for the project in 2014. The DEA concluded a rotenone treatment to remove nonnative longfin dace (*Agosia chrysogaster*) and hybridized rainbow x cutthroat trout from the project area was the best path for native fish community restoration. However, while the DEA was under development the 138,000 acre Silver Fire burned the entire 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 (Fig. 12.7). Population surveys indicated that the fire and its aftermath killed or displaced most of the fish in the project area. Only nonnative longfin dace survived (likely in off-channel refugia such as small springs and tributaries not impacted by the debris flows) and are repopulating the project area. The hybrid trout appear to have been removed by the fire and it is unlikely that a rotenone treatment will be conducted to remove longfin dace. Although the project partners are assessing habitat recovery and reviewing options, it is likely that restoration of the native fish community will be attempted by restocking (perhaps as early as 2017) despite the presence of longfin dace.

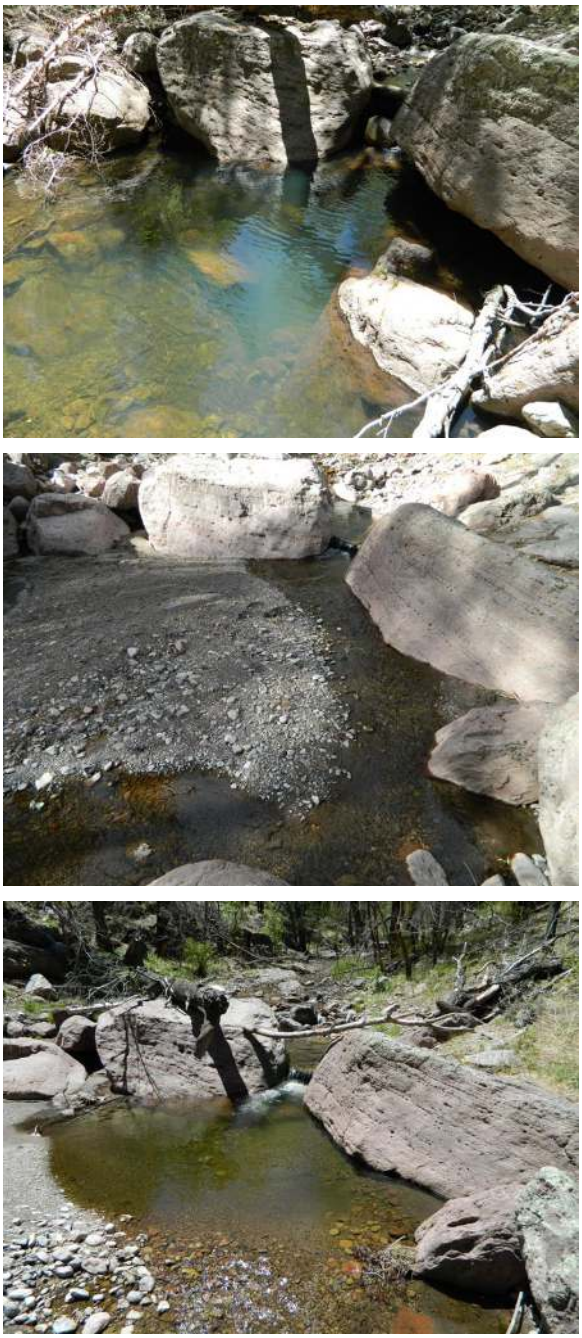


Fig. 12.7. Pool habitat in upper Las Animas Creek before (2012, top), after (2014, middle) and 2 ½ yr post (2016, bottom) Silver Fire (2013). Photos taken at the same site – note two large rocks in both pictures. Sequence shows the devastating effects of ash and sediment flows, and the gradual recovery of pool habitat.

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 establishes 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 drafted in 2015 and published in early 2016. Fundraising for fish barrier construction was initiated with a grant application to the Jackson Hole One Fly organization. Fundraising and barrier design will continue in 2016. Barrier construction is planned for 2017, with piscicide application in 2018. TBD continued to gather pre-treatment information in 2015 by conducting population monitoring at standard sampling sites and mapping fish distributions throughout the watershed.

Greenhorn Creek – The 32 km project area, including the NF and SF of Greenhorn Creek, was successfully treated with rotenone for the second time during July 2014. In July 2015 TBD, MTFWP, BLM, and USFS personnel conducted extensive electrofishing surveys to determine if non-native trout persisted after two consecutive years of rotenone treatment. A single brook trout was captured and destroyed. Environmental DNA samples were collected simultaneously with the electrofishing effort and putatively detected brook trout at one additional location where electrofishing had not captured any fish. Additional electrofishing captured no fish and follow-up eDNA samples were negative. An annual inspection was conducted on the Greenhorn fish migration barrier. WCT will be introduced into the watershed in late summer 2016. When completed, this project will represent a significant conservation gain for WCT in the Ruby River drainage.

Green Hollow Creek – Since 2003, 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 trout from upper Green Hollow Creek to reduce BKT numbers. 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 2015, with modest effort, 228 BKT were removed from upper Green Hollow Creek, bringing the 13 year total number of fish removed to 14,785. Unfortunately this was more fish than in 2014, suggesting that a few BKT spawned in the project area in 2014. Nevertheless 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, which are nearly extinct.

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 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 15 years ago. Our partners appreciate the resources, commitment, 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.

13. TESF FIELD PROJECT – WOLVES

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

PROJECT STATUS
Ongoing

Principal biologists
Chris Wiese
Mike Phillips

Conservation problem: Human persecution resulted in Mexican gray wolf extirpation from historical range in AZ, NM, TX, and Mexico. Challenges to recovery include political pressures against wolf releases, illegal shootings, and lack of space for population expansion. Recovery efforts are also hampered by a small founder population, with diminished genetic diversity affecting fecundity and survival. Limited pen space in the captive breeding program also restricts the size and reproductive output of the captive 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 2015:

The LRWMF held two wolves (M1344 and F1056) for the first three weeks of 2015, but was empty during the rest of 2015. M1344 and F1056 were moved to the SWMF in late January 2015 and were introduced to each other for the breeding season. F1056 became pregnant, but unfortunately she died a few weeks later – possibly a result of complications from whelping her puppies. M1344 remains at the SWMF.

In 2014, the NM Game Commission enacted a procedural change for review of state permitting applications to hold carnivores on private lands. These rules increased scrutiny of requests to move wolves in and out of the LRWMF. It was unclear how the new rules would impact management flexibility, so we moved all wolves back to the SWMF for the 2015 breeding season.

The LRWMF was therefore unoccupied for much of 2015, and TESF activities on this project largely focused on off-site activities like breeding observations and wolf captures at the SWMF and serving on the MGW Recovery Team. In addition, we attempted to amend our current State permit (valid until the end of 2016) to move wolves back into the LRWMF, and to renew our state permit to hold wolves on the LRWMF in the future. Both requests were denied by the NMDGF in mid-2015. Appeals of the denial decisions were heard by the NM Game Commission on November 19, 2015, and the denial was upheld (see Box 13a.1).

Proposed Future Activities and Considerations:

As one of three pre-release facilities in the country, and the only facility in the vicinity to the wild BRWMA population, the SWMF, and Mexico, the LRWMF plays an important role as a transitional facility for wolves that are being transferred between captivity and the wild. We will therefore redouble our efforts to bring the LRWMF back online by re-applying for NM State permits to hold wolves at the facility. As a way to appease the State Game Commissioner's concerns about the release of captive-reared wolves in NM, we propose that until a new federal recovery plan for the Mexican wolf has been adopted, our holding permit stipulates that no wolf older than two months of age will be released in New Mexico or Arizona directly from the Ladder Ranch. We plan to re-apply for a new holding permit in early 2016.

The rationale for the 2-month age restriction for "releasable" wolves is that wolves are born unable to hear or see until they are several weeks old. Thus, concerns of captive-born wolves habituating to humans are mooted if wolves are released prior to their being able to perceive sights and sounds. This process, in which very young pups from genetically desirable captive wolf pairings are swapped or introduced to denning wild wolf parents, is known as "cross-fostering". Cross-fostering has been used successfully to increase the genetic diversity of red wolves in North Carolina (Waddell et al., 2002), and has also been tested in European gray wolves (Scharis and Amundin, 2015). Moreover, it has been used successfully in 2014 to place two MGW pups into the den of a wild wolf pack that was known to rear young that avoid conflict with humans (USFWS, 2015).

In this way, we propose to continue our strong support of the USFWS-led efforts to recover the MGW 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.

References:

Scharis, I., and M. Amundin. 2015. Cross-Fostering in Gray Wolves (*Canis lupus lupus*). Zoo Biology 9999 : 1–6.

USFWS, 2015. http://www.fws.gov/southwest/es/mexicanwolf/CEBRWRA.cfm

Waddell W, Behrns S, Lucash G, McLellan S. 2002. Intraspecific fostering in the red wolf (*Canis rufus*). Poster presentation at Defenders of Wildlife Carnivores, Monterey, California

Box 13a.1. Timeline of TESF's Communications with the NMDGF and the NM Game Commission (GC) re: Permits to Hold Captive Wolves at the Ladder Ranch Wolf Management Facility (LRWMF)

November 13, 2014: The NM Game Commission (GC) adopts a new rule (7:0) to review permit requests for holding carnivores on private lands. Current wolf holdings at the LRWMF: seven individual wolves, including two potential breeding pairs that may be used for cross-fostering (i.e., pup releases) and a lone male waiting for his mate to arrive from Mexico (this requires an importation permit).

December 14, 2014: As it is unclear how wolf holdings on the Ladder will be affected, TESF and the USFWS decide to move wolves to the Sevilleta Wolf Management Facility (SWMF).

December 15, 2014: The new rule takes effect.

After December 15, 2014: TESF needs to apply for a renewal of our application (although our current permit is valid until December 30, 2016) if we want to bring "new" wolves to the Ladder (this would have applied to the female arriving from Mexico).

March 21, 2015: TESF submits application for renewal of permit to bring wolves back to the Ladder**;** TESF requests meeting with the Game Commission on May 7, 2015 to present permit request.

May 7, 2015: Game Commission votes to deny TESF's permit renewal request; reason given: absence of a federal recovery plan.

May 22, 2015: NMDGF notifies TESF of the permit denial.

May 29, 2015: TESF files a request with NMDGF for clarification re: continued validity of current permit (valid until Dec 31, 2016).

June 2, 2015: TESF files an appeal of the GC decision with Chair of GC; TESF requests meeting with GC for their June 13, 2015 meeting.

June 18: TESF sends an informal request to NMDGF to move wolves from SWMF to LRWMF.

June 22: NMDGF responds re: bringing wolves to the LRWMF and requests that TESF file a permit amendment.

June 22: TESF files an amendment request with NMDGF to move six wolves from SWMF to LRWMF.

July 2: NMDGF denies the amendment request to bring wolves to Ladder under current permit. Justification: concerns about pre-release husbandry protocols.

July 16: TESF files appeals of both NMDGF denial decisions with NM Game Commission; TESF requests meeting with GC on September 29, 2015 to present the appeal.

September 29, 2015: TESF is not on the GC agenda; GC votes 7:0 to uphold a NMDGF denial decision regarding three permit requests from the USFWS to cross-foster and release wolves in NM.

November 19, 2015: TESF presents the denial appeals to the GC during their regular meeting on November 19, 2015; final decision will be announced during the Jan 2016 meeting.

A wolf pen at the LRWMF. The LRWMF held wolves for only a few weeks at the beginning of 2015 due to a change in state permitting rules for holding carnivores in captivity on private lands

13(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 promote wolf persistence and to understand their relationship with ungulate prey.

Objective: We will locate and identify predator-killed prey to assess cause of death, prey vulnerabilities and body condition. Wolf scats will be collected as an additional source in understanding food habits. Monitoring the wolf population will be obtained via visual observations and track surveys. Den and rendezvous sites will be monitored to document pup production and sites where wolves localize. We will obtain bison and elk numbers annually by working closely with the Flying D ranch manager and Montana Hunting Company. Information regarding our findings will be shared in the form of monthly and annual reports, in addition to, special interest groups and guests visiting the ranch. Finally, we will continue to assist state, federal and academic groups in wolf research and wolf recovery.

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 2015:
Wolf population
In 2015 we saw a slight decline in the wolf population (Fig. 13b.1), and we attributed this to the smaller Tanner Pass pack being comprised of older animals (the original breeding pair) with 1-2 additional members. We have not documented pup production in this group over the last two years. They are also localized on the western side of the ranch and forest. The larger Beartrap pack produced 6 pups this year. They use the entire ranch and occasionally travel through neighboring properties to the north. Two known mortalities occurred in 2015. One yearling male died from peritonitis and one gray female (yearling or two-year old) was shot while in a neighboring cattle herd. No depredations were reported but she exhibited 50% hair loss over her body due to sarcoptic mange (*Sarcoptes scabiei).*

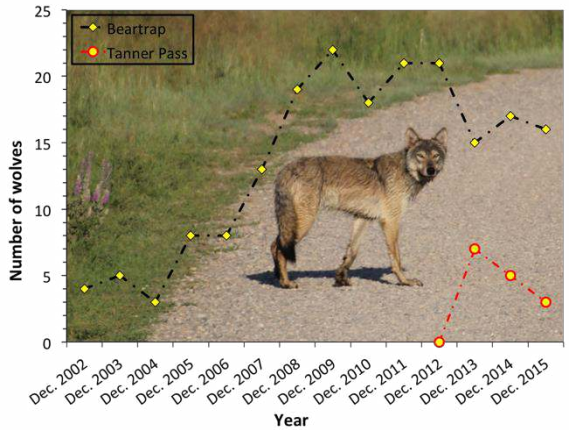


Fig. 13b.1. Beartrap and Tanner Pass pack numbers.

Food habits

Of the 1,004 carcasses investigated since monitoring began in 2010, 307 were documented as predator kills. 223 were attributed to wolves, with the remainder categorized as coyote (51), mountain lion (8), bobcat (2), bear (5), 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. 13b.2).

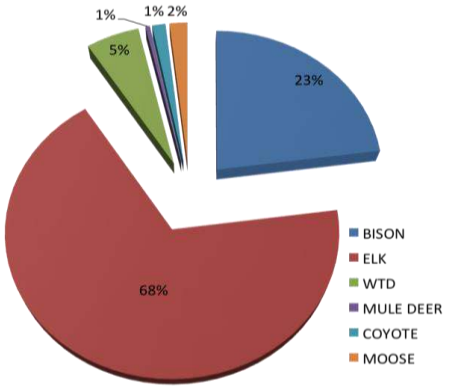


Fig. 13b.2. Percentage of wolf kills by prey species.

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. 13b.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.

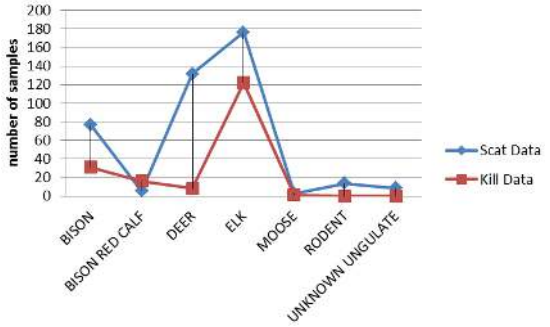


Fig. 13b.3. Comparison of wolf scat data to observed verified wolf kills.

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. 13b.4).

Marrow was collected from 144 elk, deer and moose kills showing 69% in marginal to poor health condition.

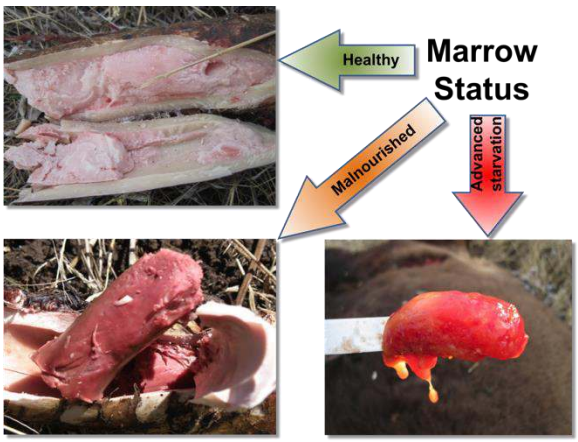


Fig. 13b.4. Femur marrow helps determine the condition of prey species.

A second dramatic vulnerability has been disfigured/injured hooves and legs. Of the 242 elk carcasses investigated of varying cause of death, 28 had visible deformities. Interestingly, all 28 were killed by wolves (Fig. 13b.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. 13b.6)

Fig. 13b.5. Examples of elk legs with visible and varying deformities.

Fig. 13b.6. Significant bone re-calcification would certainly produce a limp or uneven gate for prey animals.

More data will need to be acquired to understand if this is related to injury or other causes. In addition, we will begin 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 2015, we conducted over 17 tours and talks on the Flying D totaling ~60 since 2010. We also share our population estimates with MTFWP and data with both the Anthrax and Brucella projects. In 2015, we assisted Acoustic Atlas in obtaining recordings of wild sounds for MSU's audio library. We also hosted National Geographic to support photographers for a 2016 issue focusing on Yellowstone and the Greater Yellowstone area. Finally, we continue to produce monthly and annual reports on wolf activities and food habits.

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. We have yet to collect enough samples to determine how quickly cortisol levels decrease over time after a wolf interaction (e.g. a bison cow's level after her calf has been killed). We will continue to pursue obtaining these data in the future.

Wolf Recovery in Mexico – 2015 was the second year we visited Chihuahua, Mexico to capture and collar free ranging Mexican wolves. Three wolves were captured and released with GPS collars (Fig. 13b.7). A second pack of 6 individuals were released and we hope to assist as needed with any future collaring efforts.

Fig. 13b.7. This breeding male was captured and re-collared in 2015).

13(c) Southern Rockies gray wolf *(C. lupus)*
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:
- None at this time but building

Project Funding:
- TESF

Project Goals & Objectives: To advance gray wolf restoration to the SRE.

Project Background: Despite the gray wolf's improved conservation status in the Great Lakes states (MN, MI, WI) and the northern Rocky Mountains (MT, WY, ID), 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. 13c.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.

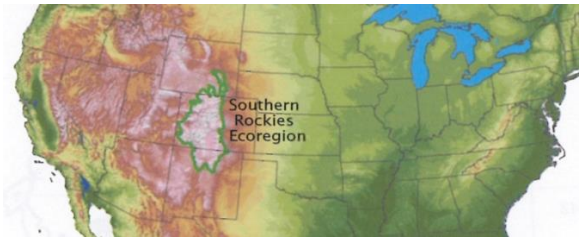


Fig. 13c.1. The Southern Rockies Ecoregion represents a vast refugia of high quality habitat for gray wolves.

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. 13c.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. 13c.3).

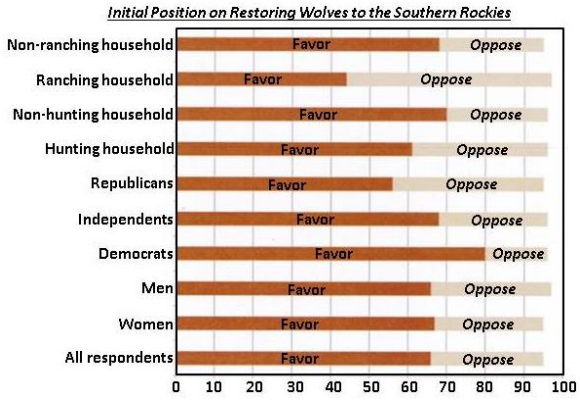


Fig. 13c.2. Results of a 2001 public opinion survey revealed widespread support for restoring wolves to the Southern Rockies. Source: Decision Research, 2001.

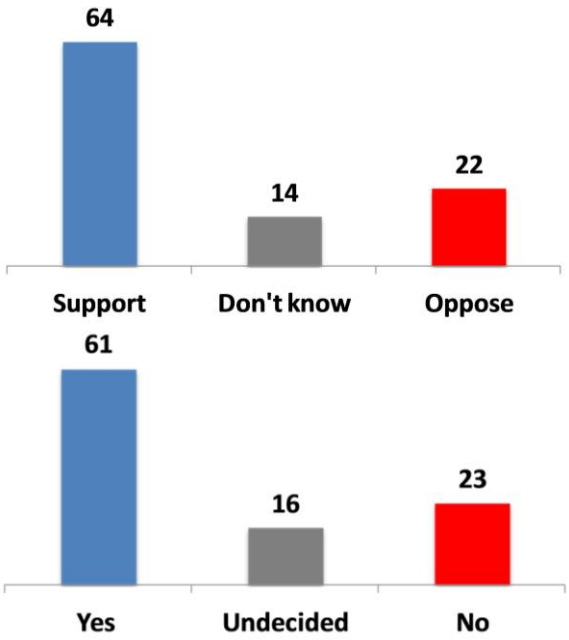


Fig. 13c.3. Results of a 2014 poll measuring level of support/opposition for re-establishing wolves in western Colorado (top panel), and support (i.e., yes) or opposition (i.e., no) for a combined wolf restoration ballot measure (bottom panel)

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 2015:

The year was dedicated to raising the requisite $1 M needed to launch the Colorado Wolf Restoration Project.

The Project is an outreach and education effort that will develop and distribute science-based educational material via traditional means (e.g., lecture series, short films, educational brochures, books, etc.) and contemporary social media (e.g., Facebook, Linked-In, Twitter, YouTube, Flickr). The singular aim of the Project is to improve understanding of wolf behavior and ecology and restoration options of relevance to Colorado. It is based on the simple premise that education advances restoration.

We intend for the Project to be supported by a conservation coalition catalyzed by TESF. It is reasonable to expect that at least the following organizations will join the coalition: Captain Planet Foundation, International Wolf Center, Defenders of Wildlife, WildEarth Guardians, Wildlands Network, Center for Biological Diversity, Rocky Mountain Wild, Rocky Mountain Chapter of Sierra Club, and the Natural Resources Defense Council.

We intend for the Project to be supported by a roster of notable conservation scientists to work with Mike Phillips to ensure that the best available science is used to instruct conversations about restoring wolves to Colorado. The roster should include the likes of E. O. Wilson (Harvard University), Michael Soule (retired, Wildlands Network), Joel Berger (Colorado State University), Barry Noon

(Colorado State University), Kevin Crooks (Colorado State University), Doug Smith (Yellowstone National Park), Rolf Peterson (retired, Michigan Technological University), John Vucetich (Michigan Technological University), Dave Mech (U.S. Geological Survey), Bob Wayne (University of California, Los Angeles), Phil Hedrick (Arizona State University), Rich Reading, (retired, Denver Zoo), Ed Bangs, (retired, U.S. Fish and Wildlife Service), and Carter Niemeyer (retired, U.S. Fish and Wildlife Service).

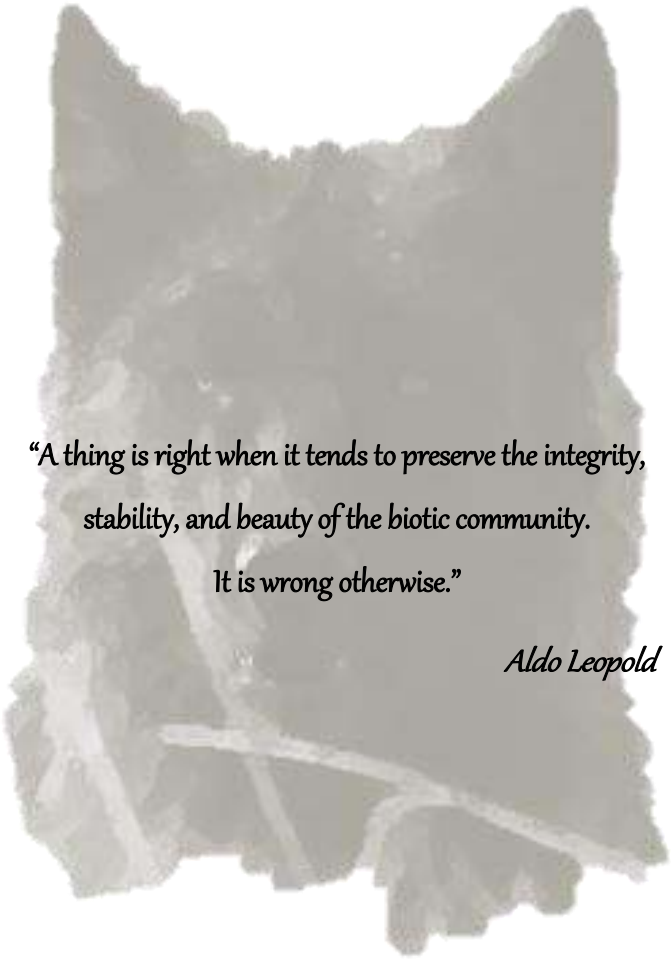
We intend for the Project to work closely with the Wolf and Wildlife Conservation Center, Denver Zoo, Cheyenne Mountain Zoo, Pueblo Zoo, and Rocky Mountain National Park. These Colorado-based conservation organizations hosts millions of visitors annually and represent outstanding "education and outreach theaters" of relevance to the Project.

We intend for the project to work closely with Colorado Parks and Wildlife. Indeed, it would be a major accomplishment for the Project to catalyze efforts by the state of Colorado to actively promote restoration through education.

As an outreach and educational effort the Colorado Wolf Project represents an important initiative to conserve biological diversity and one that aligns well with some of the founding principles of the Turner Endangered Species Fund and Turner Conservation Trust (TCT). Specifically, the Project aligns with:

- TESF's aim of disseminating credible scientific and policy information about conserving biological diversity.
- TCT's approved charitable activities related to education, outreach, and restoration projects to benefit listed species like the gray wolf.

Photo: Ronan Donavan



"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong otherwise."

Aldo Leopold

PUBLICATIONS IN PRESS OR PUBLISHED IN 2015

Fredrickson, R. J, P. W. Hedrick, R. K. Wayne, B. M. vonHoldt, and **M. K. Phillips**. 2015. Mexican wolves are a valid subspecies and an appropriate conservation target. Journal of Heredity, Advance access published 5-11-15

Hagan, G. T., and **M. K. Phillips**. 2015. First attempt to restore a red-cockaded woodpecker population via re-introductions to unoccupied habitat at the Avalon Plantation, Florida, U.S.A. Pages 132 – 136 in P.S. Soorae, ed. Global Re-introduction perspectives: 2016. Case studies from around the globe. Gland, Switzerland: IUCN/SSC Re-introduction Specialist Group and Abu Dhabi, UAE: Environment Agency Abu Dhabi. xv + 276 pp.

McCaffery, M. and L. Eby. In Press. Beaver activity increases aquatic subsidies to terrestrial consumers. Freshwater Biology.

Sasmal, I. K., **M. McCaffery**, K. Kunkel, J. A. Jenks, and **M. Phillips**. 2015. Release method evaluation for swift fox reintroduction at Bad River Ranches in South Dakota. Restoration Ecology 23:491-498.

Sasmal, I. and **M. K. Phillips**. 2015. Swift fox re-introduction at Bad River Ranches, South Dakota, U.S.A. Pages 157 – 161 in P.S. Soorae, ed. Global Re-introduction perspectives: 2016. Case studies from around the globe. Gland, Switzerland: IUCN/SSC Re-introduction Specialist Group and Abu Dhabi, UAE: Environment Agency Abu Dhabi. xv + 276 pp.

Sweikert, L. A. and **M. K. Phillips**. 2015. Re-introducing captive bred juvenile northern aplomado falcons to south-central New Mexico, U.S.A. Pages 123 – 126 in P.S. Soorae, ed. Global Re-introduction perspectives: 2016. Case studies from around the globe. Gland, Switzerland: IUCN/SSC Re-introduction Specialist Group and Abu Dhabi, UAE: Environment Agency Abu Dhabi. xv + 276 pp.

Sweikert, L. and **M. K. Phillips**. 2015. The effect of supplemental feeding on the known survival of reintroduced aplomado falcons: implications for recovery. Journal of Raptor Research 49:389-399.

Wiese, C. and S. Hillard. 2015. Restoration of the bolson tortoise in the northern portion of its prehistoric range in the southwestern U.S.A. Pages 56 – 61 in P.S. Soorae, ed. Global Re-introduction perspectives: 2016. Case studies from around the globe. Gland, Switzerland: IUCN/SSC Re-introduction Specialist Group and Abu Dhabi, UAE: Environment Agency Abu Dhabi. xv + 276 pp.

PUBLICATIONS IN PREP OR REVIEW IN 2015

Hinderer R. K., A. Litt, and **M. McCaffery**. In prep. Dispersal of Chiricahua Leopard Frogs from perennial ponds. For submission to Journal of Herpetology.

Hinderer R. K., A. Litt, and **M. McCaffery**. In prep. Quantifying Fine-Scale Habitat Selection by a Desert Amphibian. For submission to Conservation Biology.

Long, D. and J. Stuart. In Prep. Black-footed Ferret (*Mustela nigripes*). In J. L. E. Cartron and J. K. Frey (eds.). The Wild Carnivores of New Mexico. University of New Mexico Press, Albuquerque.

Long, D. In Prep. Growth of translocated Black-tailed prairie dog colonies in northeastern New Mexico.

McCaffery, M. and **M. K. Phillips**. In Prep. Linking captive and wild population models to guide the reintroduction of the bolson tortoise, a Pleistocene relict, to the United States.

Eastern diamondback in an armadillo burrow on the Avalon Plantation (Photo: M. McCaffery).

PRESENTATIONS IN 2015

Phillips, M.K. 2015. Wolves, Tortoises, and Trout: The World's Most Significant Private Effort to Restore Imperiled Species. Oral Presentation, 6th World Conference on Ecological Restoration: Towards Resilient Ecosystems: Restoring the Urban, the Rural and the Wild. Manchester, England. August 23-27, 2015.

Phillips, M.K. 2015. Wolves, Tortoises, and Trout: The World's Most Significant Private Effort to Restore Imperiled Species. Invited lecture, Wildlife Cooperative Research Unit, Oxford University, Oxford, England. August 26, 2015.

Phillips, M. K. 2015. The obstacles of net metering in Montana. Panel Discussion: Smart Grid and Utilities: Solutions at Scale. Speaker and Moderator, American Renewable Energy Day 2015, Snowmass, Colorado. August 11, 2015.

Phillips, M. K. 2015. The extinction crisis, Endangered Species Act, and gray wolves in Colorado. Invited guest lecture. American Renewable Energy Day 2015, Snowmass, Colorado. August 11, 2015.

Phillips, M. K. 2015. Wolves, tortoises, and trout: the world's most significant private effort to save creation. First National Conference on At-Risk Species in Mexico, Queretaro, Mexico. November 3-5, 2015.

Phillips, M. K. 2015. Politics, science, and wildlife conservation. University of Florida Graduate Seminar, University of Florida, Gainesville, Florida. September 21, 2015.

Phillips, M. K. 2015. Wolves, tortoises, and trout: the world's most significant private effort to save creation. University of Florida Faculty Seminar, University of Florida, Gainesville, Florida. September 21, 2015.

EXTERNAL SERVICE IN 2015

McCaffery, M. Graduate committee member (MSU)
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)
Phillips, M. K. Member, IUCN Reintroduction Specialist Group

APPOINTMENTS IN 2015

Asher, V. J. Liaison to the Mexican wolf/Livestock Coexistence Council.

Chihuahuan Desert on the Armendaris Ranch
(Photo: M. McCaffery)

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

Ladder Ranch sign (Photo: M. McCaffery).