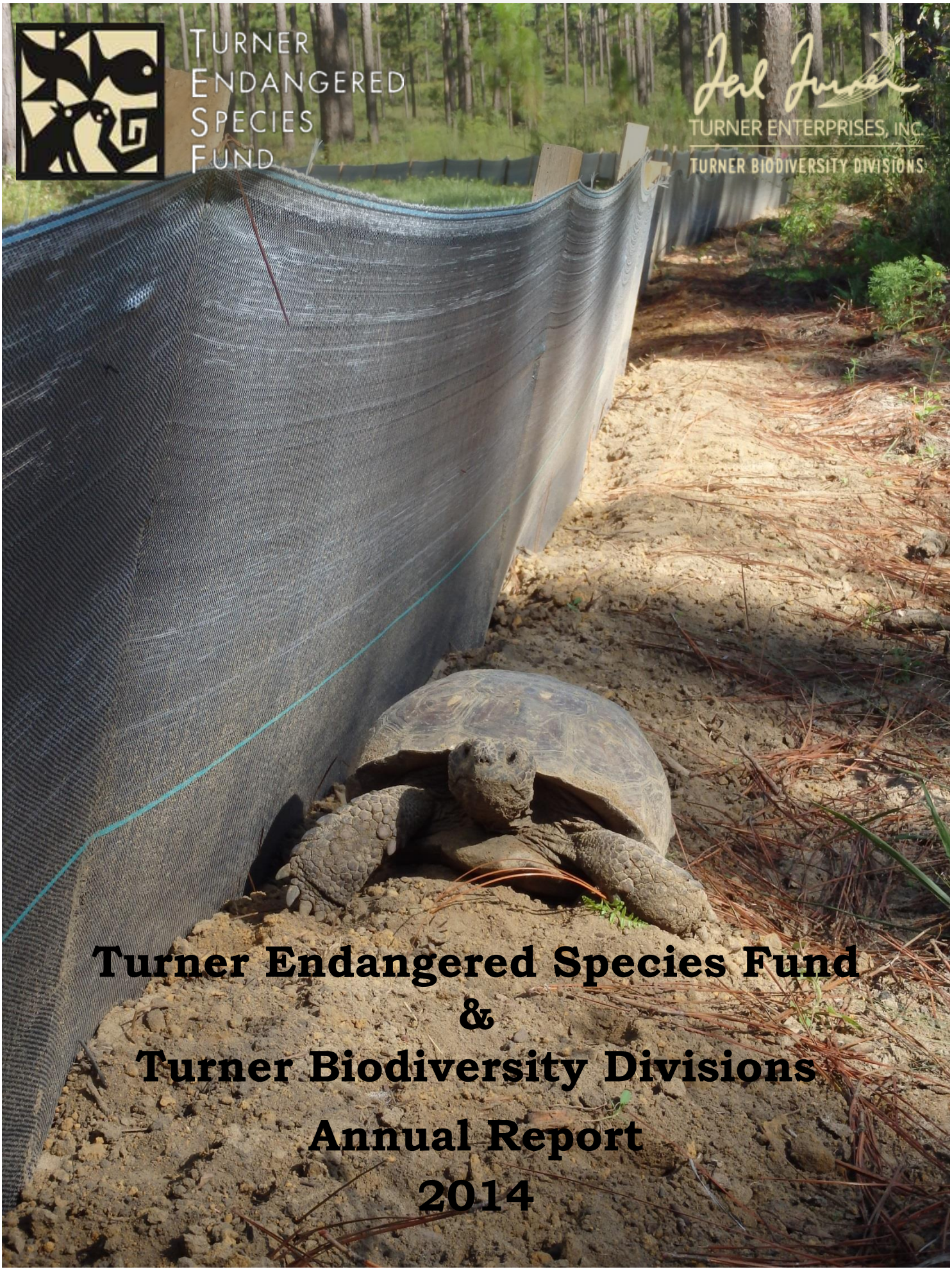

Turner Endangered Species Fund
&
Turner Biodiversity Divisions
Annual Report
2014

Turner Endangered Species Fund & Turner Biodiversity Divisions

Annual Report 2014

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All photos not otherwise marked are TESF/TBD photos.

Cover photo: *A newly translocated gopher tortoise testing the fence integrity of its temporary acclimation pen on the Avalon Annex in Florida (Photo credit: Magnus McCaffery)*

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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, lesser 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.

HANNE SMALL: Field Biologist, TESF. ***hanne.small@retranches.com*** – Hanne joined TESF in 2011, and serves as a field biologist on the Chiricahua leopard frog project. She received a B.S. in Wildlife Science from Virginia Tech.

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

ERIC LEINONEN: : Senior Biological Technician, TBD. ***eric.leinonen@retranches.com*** – Eric joined TBD in 2011 as a seasonal member of the Native Cutthroat Trout Conservation Initiative. From 2015, he will start full time with TBD, and continue work with cutthroat trout and other projects. Eric received two B.A.'s in Environmental Science and 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.

1. BLACK-FOOTED FERRET

Mustela nigripes
ESA listing: ENDANGERED

PROJECT STATUS:
Ongoing

Principal biologist:
Dustin Long

Conservation Problem: Near extinction black-footed ferrets resulted from the range-wide decline of their primary prey item — prairie dogs (*Cynomys spp.*) — due to:

- Sylvatic plague (*Yersinia pestis*)
- Loss of habitat and habitat fragmentation

Conservation Status:
- Listed as endangered in 1967 under the Endangered Species Preservation Act—the predecessor to the Endangered Species Act (ESA). Moved to the ESA upon inception of that law in 1973.
- New Mexico – state listed as endangered species in 1975, but removed in 1988 after surveys indicated that the species was likely extirpated in the state. Now categorized in NM as a protected furbearer, although no legal harvest has been allowed since the 1960's.
- South Dakota – state listed as endangered.
- Kansas – state listed as endangered in 1978.

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

Project Partners:
- U.S. Fish and Wildlife Service (USFWS)
- New Mexico Department of Game and Fish

Project Funding: TESF

Project Goals & Objectives: To work with our partners to meet down listing and delisting criteria for the species. To achieve this goal, a single very specific habitat objective must first be met: develop and protect large prairie dog complexes from sylvatic plague.

Project Background:

Extant black-footed ferret populations can all be traced to seven founders 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 (Figure 1.1).

Figure 1.1. Black-footed ferrets are a highly secretive, nocturnal predator of prairie dogs. Less than 300 survive in the wild today.

TESF's efforts to assist the USFWS in the recovery of black-footed ferrets began in 1998 with the construction of an outdoor preconditioning facility at Vermejo Park Ranch (VPR), NM. 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 as they honed their natural predatory instincts and prepared for life in the wild. Female ferrets were bred and soon thereafter whelped and weaned kits in the pens all the while exposed to real prairie dog burrows and live prey. Ferrets pre-conditioned 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 pre-conditioned 393 ferrets at Vermejo.

From 2005-2007 at Vermejo and 2009-2011 at Bad River Ranches (BRR), TESF took the next step in pre-conditioning ferrets and initiated wild pre-conditioning projects on prairie dog colonies at those ranches. At Vermejo, female ferrets and their kits were released into an enclosure that contained 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 wild conditions. After a 1-3 month wild pre-conditioning period the ferrets were captured and transported to permanent release sites. Survival rates for ferrets used in this wild pre-conditioning strategy were 48% and 45% at Vermejo and BRR respectively.

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 a viable 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 black-tailed prairie dog colonies at Vermejo.

2012 marked the first year TESF began ferret releases on the Gunnison's prairie dogs which occupy the high elevation mountain meadows of Vermejo. Historical records and survival rates over the past 2 years suggest ferrets should survive better on this species of prairie dog than on black-tailed prairie dogs provided sylvatic plague can be managed.

The planned ferret release at BRR in 2013 was interrupted by a plague epizootic in late 2012 which decimated the prairie dog population rendering the site unsuitable for ferrets. In 2014 the BRR prairie dog population made a remarkable recovery and may soon be suitable once again for ferrets.

Project Activities in 2014:

Currently, only one population of prairie dogs on Turner properties supports a ferret population—the Gunnison's prairie dogs at 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 at Castle Rock—the same location where TESF now manages a growing prairie dog and ferret population. Thirteen ferrets were released into the Castle Rock prairie dog complex in September 2014 bringing our total to 59 ferrets released at this location since 2012 (Figure 1.2).

Figure 1.2. One of the 13 black-footed ferrets released onto the Gunnison's prairie dog colonies in the mountain meadows of Vermejo in 2014.

During 2014's spring ferret surveys we were able to capture and identify 8 ferrets—4 captive born animals released in 2012 and 2013 and 4 wild born animals. The ferret population at Vermejo is likely higher than the survey results indicate because we are only able to survey about 60% of the suitable ferret habitat from existing roads. Fragile vegetation and a desire

not to create new roads in this wilderness area limit our ability to perform complete surveys on the Castle Rock complex at this time.

Future Activities & Considerations:

Range-wide ferret recovery efforts have suffered significant setbacks over the last few years largely due to plague. Population estimates within the 8 state region ferrets currently occupy have decreased from an estimated 1,000 animals in 2008 to fewer than 300 today (Figure 1.3). On Turner properties, excepting the Z Bar Ranch, plague remains a constant threat and in 2013 a plague outbreak prevented us from releasing ferrets at BRR.

Figure 1.3. The USFWS is able to produce enough black-footed ferrets to meet recovery needs. However, there is a lack of high quality release sites to accept those ferrets. Photo credit: Kimberly Fraser, USFWS.

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 long dusted ferret release sites indicate fleas have begun to develop immunity to this insecticide—yet another blow to ferret recovery efforts.

Looking forward there is optimism. Ongoing field trials for an oral plague vaccine for prairie dogs have produced encouraging results and the vaccine may be available for ferret recovery sites as soon as 2017.

Associated 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 prairie dog declines are attributable to:

- Non-native sylvatic plague (*Yersinia pestis*)
- Loss of habitat and habitat fragmentation
- Lethal control measures by humans

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

Project Funding: TESF

Conservation Status: Petitions to federally list black-tailed and Gunnison's prairie dogs have been filed in the past, but neither has been listed or afforded any significant state protections.

Project Goals & Objectives: Restoration of prairie dog colonies to provide sufficient habitat for viable black-footed ferret populations.

Project Background: Few species engender as much controversy in the American west as prairie dogs. Many landowners view them as competitors for a limited grass resource, while conservationists consider prairie dogs as a highly interactive species on the landscape which provide habitat for numerous other species. We seek to promote a balanced approach where prairie dogs and their associated ecological role on the landscape can coexist with for-profit endeavors such as bison ranching.

Currently, prairie dogs occupy ~3% of their historical range, with losses largely due to poisoning in the early and mid-20th century. More recently, introduced sylvatic plague has been the primary conservation challenge.

We began prairie dog restoration in 1997 with the expansion of black-tailed prairie dog colonies at Vermejo Park Ranch (VPR) from 500 acres to 10,000 acres; the Ash Creek Restoration Area (ACRA) at BRR from 125

acres to 1,650 acres; the Z Bar from 75 acres to 590 acres; and the Gunnison's at VPR from 23 acres to 3,900 acres. In total, prairie dog acreage on Turner properties has grown from 723 acres to a maximum of 16,140 acres.

For the past 15 years, northeastern New Mexico has experienced a drought. This challenge has thwarted our efforts to manage black-tailed prairie dog colonies for ferret habitation. Ferret reproduction and survival data collected at VPR from 2005-2013 suggests that ferrets are unlikely to survive for any length of time under these prolonged drought conditions. Consequently, TESF no longer manages the black-tails at VPR as potential ferret habitat.

Project Activities in 2014:

Favorable weather and improvement in range and forage conditions resulted in good 2014 prairie dog colony growth. Plague at VPR and BRR are the main challenges at those ranches, while limiting vegetation encroachment into colonies is the primary challenge at Z Bar.

Overall coverage of Gunnison's prairie dogs occupying the high elevation mountain meadows at VPR shrank 2% to cover 3,811 acres, while colonies managed as ferret habitat increased 10% to cover 2,840 acres (Figure 1.4). Prairie dog population surveys on the two ferret release colonies indicated an early spring density of 13 prairie dogs per acre (or ~ 36,920 prairie dogs). We dusted 430 acres on the two largest Gunnison's colonies in an attempt to shield it from sylvatic plague. In early spring 2014 sylvatic plague moved through the Costilla Basin prairie dog complex and reduced that population from 250 acres to around five acres.

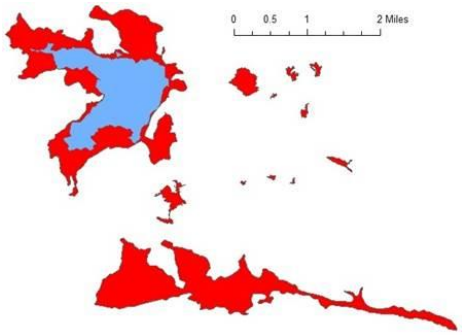


Figure 1.4. Expanding Gunnison's prairie dog colonies at VPR support a growing population of black-footed ferrets (Blue indicates colony size in 2003; Red shows the extent of colonies in 2014).

We prepared a VPR Gunnison's prairie dog management plan that articulates our management strategies for prairie dogs in the around Castle Rock for ferret habitation.

At BRR, black-tailed prairie dogs continue to recover from a 2012 plague epizootic. This disease event reduced densities and coverage throughout the entire ACRA complex. In 2014, the ACRA complex made gains and currently comprises 12 colonies covering 1,192 acres (pre-plague coverage was 1,650 acres). In an effort to reduce the likelihood of another plague event, we strategically dusted 275 acres of the best potential ferret habitat within this area.

To discourage prairie dog colony growth into unwanted areas, three vegetative barriers encompassing 68 acres, 300ft of snow fence, and four raptor poles were maintained in the ACRA.

Acreage occupied by black-tailed prairie dogs at the Z Bar Ranch grew 22% in 2014 to cover 434 acres. Drought in 2012/2013 had reduced the colony from 592 acres to 356 acres with densities of < 5 prairie dogs/acre. Recent weather patterns are encouraging and it appears both coverage and densities are recovering.

Future Activities & Considerations:

We documented prairie dog colony growth in NM, SD and KS in 2014. However, managing prairie dogs at VPR and BRR will require constant plague management. Currently, the only option to accomplish this is to dust prairie dog burrows with an insecticide that kills the fleas which serve as the vector for plague. Given the significant resources required to manage plague on Turner properties, we have focused our efforts on those prairie dog populations most suitable for recovering black-footed ferrets. Currently, only one prairie dog population on Turner properties meets that criterion—the Gunnison's at VPR. For the next several years the TESF is committed to maintaining (through dusting) a small but robust population of Gunnison's prairie dogs at VPR sufficient to support a ferret population and maintain a small population of black-tailed prairie dogs at BRR.

Much of our future work is dependent on the development of an oral plague vaccine for prairie dogs. Lab results and initial field trials have been encouraging and the vaccine is predicted to be available in 2017.

2. BOLSON TORTOISE

Gopherus flavomarginatus
ESA listing: ENDANGERED

PROJECT STATUS:
Ongoing

Principal biologists:
Chris Wiese
Scott Hillard

Conservation problem: Population decline and range contraction due to:
- Habitat fragmentation, degradation, and loss
- Collection for food
- Climate change

Conservation status:
- Listed as endangered under the ESA in 1979
- Listed as Vulnerable on the IUCN Red List

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
- Dr. Jim Jarchow, DVM, Tucson, AZ
- Dr. Peter Koplos, DVM, El Paso, TX
- Taylor Edwards, University of Arizona
- The Appleton Family

Project Funding in 2014:
- TESF
- Funding and in-kind support from: LDZG, El Paso Zoo, Appleton Family, private donations (via the Tucson Herpetological Society).

Project goals & objectives: Our goal is to establish viable and minimally managed bolson tortoise populations in the northern portion of the Chihuahuan Desert. To this end, we aim to:
- Increase bolson tortoise numbers through captive breeding and head-start programs.
- Release juvenile bolson tortoises on the Ladder and Armendaris Ranches to establish wild populations.

Project background: The largest and rarest of the five North American tortoise species, the bolson tortoise once lived throughout the Chihuahuan desert, but its current range is restricted to a small area in north central Mexico. Due to a suite of political, social, economic, and safety issues, the status of bolson tortoises in the wild is unknown. The last population survey estimated fewer than 10,000 animals alive in the early 1980's. However, continued habitat degradation and loss since then make it likely that this number has decreased. In an effort to prevent the extinction of the bolson tortoise, we are working towards establishing free-ranging bolson tortoise populations on the Ladder and Armendaris ranches in New Mexico, which lie at the northern tip of the tortoise's prehistoric range.

The impetus for this project originated with a group of 30 adult tortoises that were in a private collection in Arizona. These animals were donated to TESF in 2006, when 26 adults and 7 hatchlings were relocated to the Armendaris Ranch. Four adult tortoises (2 males, 2 females) were also sent to the LDZG, for exhibit. Breeding at the Armendaris and LDZG have hatched over 500 tortoises since 2006, with hatchlings and most juveniles being kept in outdoor, predator-proof enclosures until they are large enough for release (approximately 100 – 110 mm shell length; age 3 – 7 years).

With their powerful front legs, tortoises dig burrows in which they spend over 85% of their time. The burrows are an important part of a healthy desert ecosystem, as they provide shelter for a myriad other species, including mammals, birds, reptiles, and insects.

Project Activities in 2014:
Current status of the bolson tortoise project
As of October 2014, the bolson tortoise project comprises 29 adult bolson tortoises that serve as the founder population for all juveniles that are part of the project. To date, the project has produced 512 hatchlings (Figure 2.1), of which 383 were found to be alive in the fall of 2014, 86 were known to have died, and 43 juveniles could not be located. 87 large juvenile tortoises (shell length > 100 mm) were outfitted with radio transmitters and moved from predator-proof enclosures to predator-accessible enclosures between fall 2012 and fall 2014. 75 of these animals were known to be alive and one could not be located at the end of 2014.

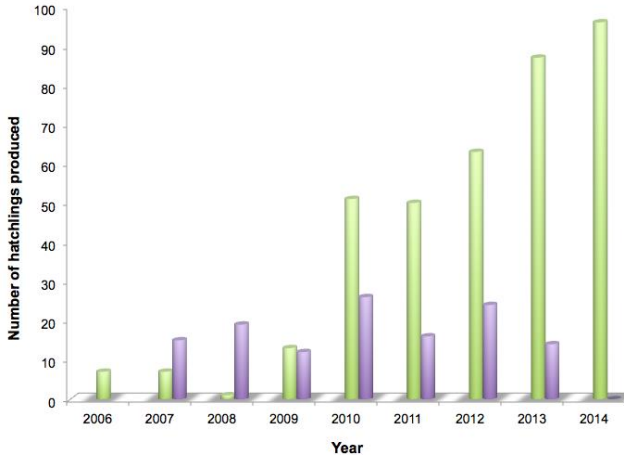


Figure 2.1. Number of hatchlings produced each year. Green bars = hatchlings produced on the Armendaris (2007 - 2014) and in Arizona (2006). Purple bars = hatchlings produced at LDZG.

2014 Successes and milestones

- Our 500th viable egg hatched this year, and the hatchlings turned out to be twins! (see press release on page 14).
- We had a total of 96 hatchlings, a record number for the project in any given year (Figure 2.1).
- Another first: all 13 adult female tortoises laid eggs. This is the first year that Tortoise X produced eggs and hatchlings.
- We initiated the expansion of the Ladder Headstart pen. This facility can now accommodate most of the juvenile tortoises that are too small to be released into predator-accessible environments.

Captive Breeding Program – Egg collection and incubation (= hatchling production)

Our objectives for 2014 hatchling production were threefold:

- To optimize egg production by collecting eggs by induced oviposition or from natural nests.
- To incubate eggs in temperature-controlled environments.
- To collect hatchlings, mark them with a unique code, and bank blood for genetic studies and paternity testing.

Bolson tortoise adults and subadults

The bolson tortoise group on the Turner Ranches comprises 25 adults: 13 females and 12 males (Table 2.1). 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 a part of the breeding program, nor are three subadults (2 females, 1 male) that were transferred to the El Paso Zoo from TESF in 2010.

Table 2.1. Adult and subadult bolson tortoises in the 2014 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

2014 Egg collection

We used a radiography, ultrasound, weight monitoring, and direct observations to determine the number and maturity of eggs carried by each female tortoise. These methods helped us to effectively transfer females to a maternity enclosure to increase our chances of finding nests, and/or to the "Turtle House" on the Armendaris to induce egg-laying. Out of 183 eggs produced, 172 were collected intact and placed in incubators (Table 2.2; Figure 2.1). Tortoise X produced eggs for the first time, and Tortoise 4 ("Pancha"), contributed eggs for a second consecutive year.

Table 2.2. Egg production and hatching success in 2014 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 (2014)	Total offspring production (2014)	2014 hatching success rate
1	5 / 6 / 7	18	11	61.1
2	5 / 4 / 4	13	5	38.5
4	7 / 5 / -	12	6	50
A	6 / 7 / 8	14	12	85.7
F	5 / 3 / -	7	2	28.6
G	10 / 7 / -	17	0	0.0
J	5 / 2 / 4	11	10	90.9
K	5 / 4 / 6	15	13	86.7
L	5 / 4 / 6	15	7	46.7
P	3 / 4 / 4	11	3	27.3
S	6 / 6 / 8	17	13	76.5
T	2 / 6 / 4	12	8	66.7
X	5 / 5 / -	10	5	50
TOTAL	**69 / 63 / 51**	**172**	**96**	**-**
MEAN	**5.3/4.8/5.7**	**13.2**	**7.3**	**54.5**

TURNER ENDANGERED SPECIES FUND

Conserving biological diversity by ensuring the persistence of imperiled species and their habitats with an emphasis on private lands.

PRESS RELEASE: Bolson Tortoise Recovery Project Reaches Major Milestone with 500th Juvenile Born

Turner Endangered Species Fund Reports Important Success for Long-term Restoration Effort

For Immediate Release September I8, 20I4
Contact: Mike Phillips, 406-556-8500
mike.phillips@retranches.com

BOZEMAN, Mont., -- Today the Turner Endangered Species Fund (TESF) announced that the 500th bolson tortoise hatchling recently chipped its way out of the confines of its eggshell on Ted Turner's Armendaris Ranch in southern New Mexico.

But there was a big surprise: hatchling number 500 was actually two hatchlings! This is not the first set of twins the project has witnessed, but it is only the second set that successfully hatched.

The hatchlings are part of a highly successful bolson tortoise breeding and rearing program overseen by the TESF to restore the endangered bolson tortoise to the northern Chihuahuan desert where it once roamed. The twin hatchlings are two of over 80 new bolson tortoises that hatched in 20I4 from eggs that were deposited by their mothers on the Armendaris ranch earlier this spring. The eggs were collected by TESF biologists Chris Wiese and Scott Hillard, who placed them in an incubator for safe keeping. Since hatching, these new tortoises have joined other bolson tortoise juveniles in predator-proof "headstart" facilities on the Ladder Ranch, which is another Turner ranch located west of the Armendaris.

TESF's vision is for these tortoises to be set free in the wild once they reach a size where they are less vulnerable to predation by ravens, coyotes, and other predators. That size is about the size of the native box turtle, which has a shell of ~I00 mm (4 in) in length.

The bolson tortoise is the largest, rarest, and least studied of five species of land tortoise native to North America (the desert tortoises of the Mojave and Sonoran deserts, the Texas tortoise, and the gopher tortoise of the southeastern US are all closely related to the bolson tortoise). Weighing a mere 30 g (~I oz.) when it hatches from the egg, a bolson tortoise can weigh up to I4 kilograms (30 pounds) or more as an adult - but it probably takes upwards of 25 years or more for the tortoise to reach that size. Its lifespan is similar to a human's, living 80 years or more and reaching sexual maturity as a teenager. Paleontologists believe the species ranged from Arizona eastward to west Texas during the late Pleistocene, about I0,000 years ago. Today, the only remnant wild population lives in north-central Mexico in an area known as Bolson de Mapimi (bolsons are enclosed desert basins, or valleys). The demise of the bolson tortoise was largely caused by humans who hunted and ate the tortoises as well as altered - and even destroyed - their ancestral homeland in what is now the southeastern US.

The TESF-led bolson tortoise recovery project aims to repatriate tortoises into portions of their prehistoric range to restore a healthy ecosystem and provide an assurance colony to prevent extinction of the species.

Bolson tortoises were long considered extinct until the small remnant Mexican population was discovered in I959. A group of 26 adult bolson tortoises housed on the Appleton Research Ranch in southeastern Arizona, where they had been collected and bred since the I970s, was moved to the Armendaris Ranch in 2006. Two additional breeding pairs were donated to the Living Desert Zoo and Gardens State Park in Carlsbad, NM, where they contribute to the recovery project by producing some of the juvenile tortoises that now live on the Turner Ranches. Together, the 30 adult tortoises comprise the bolson tortoise breeding colony that serves as the founder population for future repatriation efforts to their former northern Chihuahuan desert home.

The TESF-led bolson tortoise recovery program on the Turner Ranches is unique, both in terms of bolson tortoise recovery and in growing and establishing free-ranging populations of endangered tortoises on private lands. In addition to the Living Desert Zoo in Carlsbad, NM, the Fund has partnered with the El Paso Zoo and renowned tortoise experts to guide the conservation effort.

From a conservation standpoint, having all your tortoise "eggs in one basket" is risky. Hence, establishing a new population, in addition to the original Mexican population, is a significant contribution to science, society, and nature. TESF programs such as the bolson tortoise restoration effort on Turner's ranches play an important role in this regard.

The Turner Endangered Species Fund is a non-profit operational charity dedicated to preserving Nature by ensuring the persistence of imperiled species and their habitats with an emphasis on private land. The Fund was established by Ted Turner and his family in June I997.

The Armendaris and Ladder ranches collectively comprise over 500,000 acres of the most stunning Chihuahuan grassland, desert scrub, riverine mixed forest, and sky island habitat still remaining in the southwestern United States. The properties are located within the prehistoric range of the bolson tortoise in southern New Mexico and are currently the only restoration sites in the United States for the endangered bolson tortoise.

The twins are still connected to each other by the egg's yolk sac.

2014 Egg incubation

Recovered eggs were distributed amongst six incubators, with each incubator was held at a constant temperature (range 29 – 32˚C) to generate male (cooler temperatures) and female (warmer temperatures) offspring. Eggs remained in the incubators until shortly before hatching, and then transferred to second incubator (the "pipping chamber") where they stayed for up to two weeks to finish the hatching process.

2014 Hatchlings

In total, 96 hatchlings emerged from eggs. After yolk absorption, these hatchlings were weighed, measured, and marked with a unique ID tag. We also photographed each individual and drew a drop of blood for banking. Processed hatchlings were placed in outdoor holding tanks where they remained until the end of October.

Six hatchlings died within days of hatching. Thus, the final hatchling number to enter the captive population in 2014 was 90 individuals, bringing the total number of juveniles hatched since project inception to 512 (Figure 2.4).

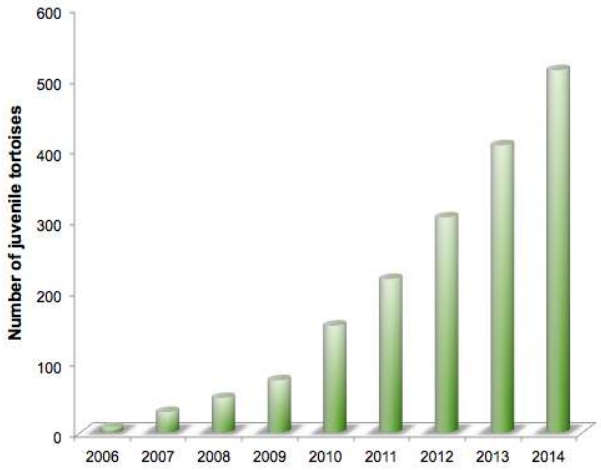


Figure 2.4. Number of juveniles hatched through captive breeding from 2006 – 2014.

2014 Hatching success rates

Hatching success rates varied amongst females (Table 2.2), and for a given female amongst years. However, overall hatching success has remained relatively consistent for the last 4 years (Table 2.3), even though the hatching success rate was slightly below average in 2014.

Table 2.3. Hatching success rates of Turner group tortoises since 2010. Hatching success rate is the percentage of eggs that hatched from those that were placed into incubators. Eggs not incubated were either lost or broken

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
Mean	69	113	9	63

A contributing factor to the relatively low 2014 hatching success was that none of Tortoise G's eggs developed. Tortoise G tends to be one of the most prolific hatchling producers (second only to Tortoise L). Also one of Tortoise L's clutches also failed to develop in 2014, leading us to suspect that the cause of this reproductive failure may involve one (or more) of the males.

2014 Juvenile headstarting

To maximize juvenile survival rates until a predator-resistant size is attained, we:

- Hold juveniles in a covered enclosure.
- Provide supplemental food/water as needed.
- Monitor growth rates/health in spring and fall.

Our tortoise population has grown by over 950% since 2006, with over 400 animals in captivity at the end of 2014. The Armendaris and Ladder ranches house around 390 of these individuals, while LDZG holds 20 juveniles and 4 adults.

Management of juveniles in headstart enclosures entailed supplemental feeding and watering, as well as grass-clipping and occasional weeding to remove non-forage plants. Supplemental feeding was facilitated by an abundance of globemallow plants on both ranches, which were harvested and broadcast in the enclosures 2-3 times a week.

2014 Tortoise Surveys and Health Checks

We surveyed tortoises in spring and fall. Health checks revealed that juveniles and adults on the Ladder and Armendaris ranches are in good or excellent health. Using health and growth data from these surveys, we identified juveniles in need of additional attention to attain their full growth potential. These animals were placed into stock tanks on the Armendaris, and

provided with an augmented diet.

We found one of the adult male (tortoise "Y") tortoises to be limping and unwilling to extend his hind leg during routine monitoring in the summer. Subsequent diagnosis suggested joint degeneration, most likely due to old age.

During growth surveys, we measure tortoise weight, as well as shell length, width, and height. These measurements allowed the calculation of growth rates, and help us to identify problems such as malnutrition, dehydration, and disease. During fall surveys and health checks we found ~380 juvenile tortoises alive and well, but could not locate 43 individuals. We consider tortoises "missing" until we find the individual, find evidence of its demise, or have not seen it for three consecutive years (whereby we consider it deceased). We documented the death of 25 individuals in 2014, bringing the total number of moralities in our captive population to 86 since 2006.

Our forage management provided juveniles with sufficient nutrition to attain an average growth of 16.9% (range: 1.2 – 24.6%) at the Ladder headstart pen, and 13% growth (range: 4.8 – 21%) in the Armendaris pen (Figure 2.5). These growth rates are ~50% higher than 2013 growth rates, suggesting that our 2014 management strategies were successful.

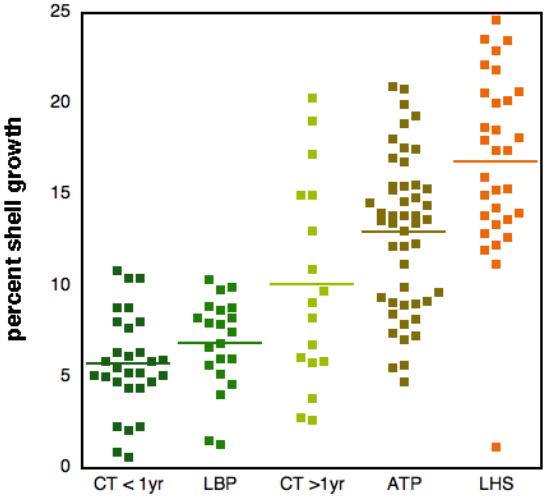


Figure 2.5. Juvenile growth rates (fall 2013 to fall 2014) at different locations: LHS = Ladder Headstart pen, ATP = Armendaris Truett pen, LBP = Ladder Big Pen, and CT = Cedar Tank pen on the Armendaris. Juvenile growth rates at CT for less than 1 year (CT<1yr) are listed separately from growth rates for juveniles at CT for more than 1 year (CT>1yr). Each dot corresponds to the % growth rate of an individual; the horizontal bar represents the mean.

Determining the sex of the juvenile tortoises

Since 2010, we have incubated all bolson tortoise eggs in constant-temperature incubators set at temperatures appropriate for tortoises (29˚C – 33˚C). The sex of a bolson tortoise is determined by the temperature experienced by the incubating egg, although the critical temperatures that produce males or females are unknown. We therefore tested a range of temperatures. In 2013 and 2014, we used endoscopy to examine the results of our incubation experiment. This involved directly visualizing the gonads of juvenile tortoises to determine their gender. For juvenile tortoises, this is a delicate technique that requires anesthesia and minor surgery. Between February 2013 and March 2014 we scoped a total of 275 juvenile tortoises. As expected, we found that the tortoises incubated at warmer temperatures were mostly female, while tortoises incubated at cooler temperatures were male.

Although highly successful and safe for the tortoises, we sought to develop protocols that would be less invasive than endoscopy and therefore more suitable for fieldwork. We hoped that plasma testosterone levels could reveal the sex of juvenile bolson tortoises, as it had been previously reported in the scientific literature that adult bolson tortoise males have ~200-fold higher levels of testosterone compared with females. We collected blood samples from 60 juvenile tortoises of various sizes and of known sex in the hopes of generating a standard curve for future hormone analysis. Unfortunately, the hormone analysis results were inconclusive and did not allow us to distinguish male and female juvenile tortoises.

Release studies

In the fall of 2012, we began outfitting large juveniles (> 100 mm shell length) with transmitters and moving them from the predator-proof headstart enclosures to the predator-accessible adult pens. Although the ultimate goal is to establish wild populations, our releases of juveniles into larger, more natural, fenced areas will provide information on juvenile behavior and predation risks. Thus far, our release studies suggest that juveniles do not travel long distances from their release location. To date, we have transferred a total of 87 juvenile tortoises

to two fenced locations on the Armendaris and Ladder ranches (Table 2.4). Of these, we found 75 (86%) to be alive at the end of 2014. This constitutes a surprisingly high survivorship, with most of the losses occurring within a few weeks of moving the tortoises to the new location. Nine of the ten tortoises released in 2012 were still alive at the end of 2014, but the one mortality from that release did not survive the first winter. These release studies also revealed that we lost tortoises for a number of reasons, but not due to one particular predator (Table 2.5).

Table 2.4. Release cohorts and survivorship of juvenile bolson tortoises transferred to predator accessible pens on the Armendaris (Cedar Tank) and Ladder ranches.

Location	Date	No. of juveniles released	No. of deaths to date	No. alive
Cedar Tank	Fall 2012	10	1	9
	Spring 2013	8	2	6
	Fall 2013	2	-	2
	Spring 2014	26	5	21
	Fall 2014	14	-	14
Ladder Big Pen	Fall 2013	25	3	22
	Fall 2014	2		2
Overall total		87	11	76

To evaluate the suitability of the adult pens to support young tortoises, we compared health metrics and growth rates for the released juveniles to those obtained from other juvenile holding locations. We found that the first cohort of juveniles, released to the adult Cedar Tank pen in fall 2012 (marked "CT>1yr" in Figure 2.5), had an average growth rate of ~10% (range: 2.7 to 20.3%; Figure 2.5). Growth rates for juveniles at Cedar Tank for less one year, or tortoises released in the adult Ladder Big Pen, were more modest at 5.6 and 6.9%, respectively.

Unlike 2013, when juveniles released in the spring exhibited stronger growth, juveniles released in the spring of 2014 ("CT<1yr") showed average increase in shell length of only 5.6% (range: 0.6 to 10.9%). In comparison, changes in management of forage availability in the headstart pens ("ATP" and "LHS" for "Armendaris Truett pen" and "Ladder headstart" pen, respectively), increased 2014 growth rates to ~13% and ~17% inside the headstart pens, respectively. On the other hand, fall 2014 health assessments showed that all juveniles (within headstart pens or in the predator-accessible enclosures) examined were healthy and in good or excellent body condition.

Table 2.5. Cause of death of juvenile tortoises in the release study. Length = approximate shell length at time of death; time = length of time the 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
09-CB42 died during winter, no obvious predation			
10-CB56	114	3 mo	CT
10-CB56 was predated, badger or coyote			
10-CB60	123	10 mo	CT
10-CB60 was predated; found only 1 scute and transmitter, digging at overwinter burrow (claw marks)			
10-CB61	98	5 mo	LBP
10-CB61 probably froze, followed by rodent gnaws; recent			
10-CB67	106	2 mo	CT
10-CB67 was upside down in the open, possible raven predation; history of pyramiding and being outside of burrow			
07-CB7	110	3 mo	CT
07-CB7 was found outside of enclosure (near southwest corner); no bite marks, but crushed (trampled?)			
08-CB29	102	3 mo	CT
08-CB29 was found upside down in the open, probably natural causes; history of front leg weakness			
08-CB24	120	3 mo	CT
08-CB24 is possibly still alive, found transmitter only			
09-G6	115	4 mo	CT
09-G6: coyote kill, found ~ 0.5 mile west of enclosure			
08-CB22	~110	11 mo	LBP
08-CB22 was found upside down in the open with no sign of predation; one anal scute missing, but otherwise intact shell; seemed light (dehydrated) a month earlier			
11-CB78	~110	12 mo	LBP
11-CB78 was found upside down inside a burrow with no sign of predation; intact shell; some rodent chew marks on limbs, probably post-death			

An update on the "Wild One"

In 2012, we captured an image of an unmarked juvenile tortoise on one of the trail cameras deployed in the Cedar Tank pen. In summer 2013, we again captured an image of an unmarked juvenile tortoise with a trail camera. Because the 2012 and 2013 photographs were taken of different sides of the tortoise, we were unable to determine whether they are of the same individual.

In spring 2014 we came across a rodent burrow not far from where the two trail camera pictures had been snapped. The rodent burrow appeared half-moon shaped - a telltale sign for small tortoises. Since we knew the whereabouts of all juvenile tortoises that we had released, we were confident that the tortoise that might inhabit the rodent burrow would not be a known tortoise. We deployed trail cameras at the burrow entrance and recorded images of a small, unlabeled tortoise. Numerous attempts were made throughout the spring, summer, and fall of 2014 to capture the occupant of the burrow, but we were unsuccessful. However, it is exciting to have confirmation that juveniles have hatched out naturally in the Cedar Tank pen, and that they can survive undetected (or minimally detected) for years (Figure 2.6).

Figure 2.6. The wild one lives?! Images captured on trail cameras in August 2012 (top left) and June 2013 (top right) suggest that at least one unmarked, "wild" juvenile bolson tortoise roams the Cedar Tank adult pen. Trail cameras deployed in 2014 captured new images of this elusive individual (all labeled June 2014).

Husbandry strategies: adult tortoises

Our approach to managing the adult breeding population is to be as hands off as possible. 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. Supplemental water was not necessary in 2014. We continue to intensively manage adult females during nesting season (April – July) to maximize the number of eggs collected each year.

Husbandry strategies: juvenile tortoises

Juvenile management is relatively intensive and involves housing young tortoises in predator-resistant headstart pens until they are large enough to resist most predation attempts. This requires ensuring the availability of adequate forage in the headstart pens on the Armendaris and the Ladder, and involves frequent irrigation and the transplantation of forage plants (globe mallow, portulacas, and grass sod) into the pens. In 2014, we harvested forage plants outside of the headstart pens and brought cut plants into enclosures two to three times a week. While labor-intensive and dependent on the availability of suitable forage plants on the ranches, this strategy provided enough forage to increase average growth rates from ~10% in 2013 to ~17% in 2014. Moreover, this strategy is much less dependent on frequent irrigation.

In an attempt to achieve more rapid rates of juvenile growth, we implemented a management strategy in 2013 where new hatchlings were prevented from going into torpor by overwintering the animals indoors and continuing feeding throughout the winter months. This proved successful: between fall 2013 and fall 2014, the one-year-old tortoises doubled in size and resembled 3 year old tortoises by summer 2014 (Figure 2.7). Therefore, we predict that these tortoises will reach a releasable size around 2-3 years faster than hatchlings that are allowed to enter torpor during their first winter. In turn, this intensive management strategy will allow us to raise a cohort of tortoises that spends overall less time in the predator-resistant enclosures and consequently requires less management over their lifetime.

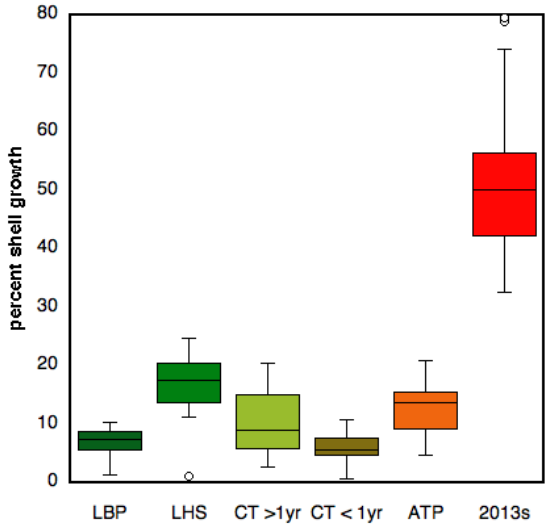


Figure 2.7. Juvenile tortoise kept up over winter doubled in size within 1 year (2013s), compared with tortoises allowed to enter torpor each winter (all remaining categories).

Future Activities & Considerations:

Our major objectives for 2015 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 most of the eggs 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 tortoise enclosures 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 pens to free up space in the headstart pens
- Monitoring released juveniles to track survivorship and movements.

3. CHIRICAHUA LEOPARD FROG

Lithobates chiricahuensis
ESA listing: THREATENED

PROJECT STATUS:
Ongoing

Principal Biologists:
Magnus McCaffery
Hanne Small
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
- AZ state listed as threatened

Project Location: Ladder Ranch, NM

Project Partners:
- United States Fish & Wildlife Service
- New Mexico Department of Game & Fish
- Dr. Colleen Caldwell (NMSU)
- Dr. Andrea Litt/Ross Hinderer (MSU)

Grant Funding in 2014:
- TBD/TESF
- Partners for Fish and Wildlife ($24,900)

Project Goals & Objectives: We aim to work in partnership with the CLF Recovery Team to achieve range-wide recovery that results in the species being delisted. To this end, our CLF conservation strategy on the Ladder Ranch incorporates three core objectives:

1. To maintain and expand wild CLF populations on the Ladder Ranch.
2. To maintain captive refugia and captive breeding facilities for on- and off- ranch frog populations.
3. To further CLF conservation by securing grants, research, developing effective conservation methods, and collaborating with partners.

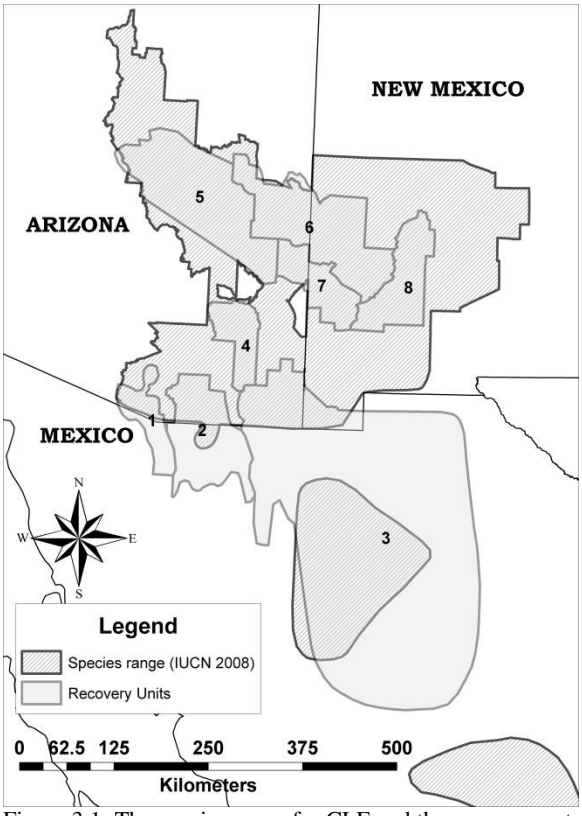


Figure 3.1: The species range for CLF and the arrangement of Recovery Units (RUs) as delineated by the CLF species Recovery Plan (2007).

Project Background:

TESF has worked in partnership with the USFWS, and the NMDGF to conserve the CLFs on the Ladder Ranch since 2001. The conservation value of the Ladder Ranch's 62,950 ha of diverse habitat in New Mexico cannot be overstated. As home to the last, large CLF population in New Mexico, the Ladder Ranch plays a crucial role in the survival of this species. The ranch is one of four CLF Management Areas within Recovery Unit (RU) 8 (Mimbres-Alamosa RU; Figure 3.1). From a broader conservation perspective, the Chihuahuan Desert Ecoregion is a WWF Global 200 Priority Ecoregion, conservation of which will help maintain a broad diversity of Earth's ecosystems, and the Ladder Ranch itself is recognized as a Key Conservation Area by The Nature Conservancy.

Numerous factors are involved in the range-wide decline of this species, including: disease, nonnative species invasions, habitat degradation, and an increase in the severity and duration of drought events. Perhaps in response to reduced

natural habitat availability and drying climatic conditions, CLFs have been found to naturally colonize man-made livestock water tanks.

This behavior motivated us to manage these tanks for the conservation of wild CLF populations on the ranch, as well as to modify several tanks for use as CLF refugia to act as temporary captive holding facilities for rescued off-ranch population that are small, unique, and at high risk of extirpation in the wild.

Project Activities in 2014:

Wild population – Monitoring & management

We monitored all known sites occupied by wild CLF on the Ladder Ranch in 2014. Minimum count data from this survey work suggests that the Ladder Ranch population remains robust (Table 3.1). However, CLF on the Ladder Ranch continue to be largely confined to a single drainage (Seco Creek). Our long-term strategy is to improve the likelihood of CLF persistence on the Ladder by augmenting existing populations and expanding the species' distribution through the creation of a network of natural and artificial wetlands. In 2014, we improved wetland habitat in Las Palomas drainage, and began translocating CLFs into two of these improved sites. We aim to continue these translocations to unoccupied sites in 2015.

Table 3.1: Minimum CLF counts at wild sites in 2014.

	MIN. COUNTS IN 2014			
Site Name	**Egg mass**	**Tadpole**	**Metamorph**	**Adult**
[a]Circle 7	0	0	0	11
[a]Avilas	0	>100	0	1
[a]Emrick Spring	3	>100	2	4
[b]Davis (Lower)	0	>100	5	52
[b]Davis (Upper)	5	11-20	50	53
[b]N. Seco	83	>100	210	153
[b]Pague	47	>100	55	127
[b]LM Bar	42	>100	167	162
[b]Fish	2	>100	216	9
[b]Johnson	58	21-50	49	210
[b]S. Seco	1	21-50	0	14
[c]Ash Canyon	0	11-20	1	26
[c]Artesia	14	>100	135	91
[d]Cave Creek	0	>100	3	0
[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 Well to maintain habitat quality for CLF.
- Improved fence and diversion ditch at Fish Well to maintain CLF habitat.
- Planted native grasses and shrubs on the banks at Avilas, Rouse, Emrick Spring, Bear Canyon and S. Seco.
- Installed vegetated islands at Avilas, Emrick Spring, and S. Seco well.
- Created dam at Bear Canyon.
- Installed ramp at S. Seco Well.
- Improved CLF habitat at Avilas, Rouse, Emrick Spring, Bear Canyon and S. Seco.
- Translocated 40 CLF to Emrick Spring to create new population.
- Installed ungulate exclosure fencing at Davis Well and Sissel Well.
- Improved water level at Circle 7 with additional pipe from creek.
- Installed solar panels at Rouse and S. Seco Well to improve water levels.

Captive refugia program

In 2014, we translocated CLFs into two captive refugia tanks designated for use by the USFWS, and two captive refugia tanks designated for Ladder Ranch frogs (Table 3.2).

Table 3.2: Numbers of CLF stocked into captive refugia tanks in 2014.

Refugia	**Source Population**	**Egg mass**	**Tadpole**	**Meta/ Adult**
Fox	Seco Cr.	1	-	-
No. 2	Seco Cr.	1	2	44
South Well	Cuchillo Cr.	-	-	2
Avant	Beaver Cr.	-	213	-

Overall, refugia tanks designated for both Ladder Ranch and USFWS use produced 64 viable egg masses in 2014 (Table 3.3).

Table 3.3: Egg masses laid in captive refugia in 2014.

Refugia Name	**No. Egg Masses**	**No. Viable**
Antelope	5	5
Seco	34	34
Wildhorse	6	6
South	0	0
Fox	7	7
No. 2	12	12

Captive ranarium program

In 2014, the Ladder Ranch ranarium housed adult CLF from seven off-ranch source populations, spanning three CLF Recovery Units, as well as adults from three on-ranch populations (Table 3.4). Egg masses produced in adult cages were transferred to the integrated tadpole rearing facility.

Table 3.4: CLFs in ranarium cages during 2014.

Cage #	Source population	No. ♂/♀	No. metas	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	6/0	-	4/26/12
	N. F. Negrito	0/1	-	9/18/12
	Divide/LM	1/1	-	5/6/13
5	Cave Cr.	2/3	-	6/13/13
6	Blue Cr.	2/2	-	6/16/14
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	11	6/13/13

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

Associated with the ranarium are nine tadpole rearing tanks, which can hold around 1,000 tadpoles each. During 2014, 30 viable egg masses were transferred from adult cages to tadpole tanks (Table 3.5). Tadpoles from these masses were released into the wild, or into captive refugia holding tanks in consultation with the USFWS (Tables 3.5 & 3.6).

Table 3.5: Ranarium egg mass (EM) management in 2014.

Cage #	Source Pop.	# EM	Ovi. Date	TP Exit	Disposition
1	Seco Cr.	1	4/27/14	4/30/14	Ladder Ranch
		1	7/5/14	7/7/14	Ladder Ranch
2	Alamosa W.S.	1	4/10/14	5/29/14	Middle Well (JER)
		1	4/12/14	5/29/14	
		1	5/27/14	5/29/14	
3	Beaver Cr.	2	3/26/14	5/16/14	Stovall Place
		2	4/28/14	6/19/14	Stovall Place
		2	5/26/14	6/19/14	Stovall Place
		2	6/9/14	7/10/14	Stovall Place
		2	6/23/14	6/25/14	Avant
		2	7/6/14	7/10/14	Stovall Place
		1	7/27/14	10/9/14	Kent Mesa
		1	7/29/14	10/9/14	Stovall Place
		2	9/13/14	10/9/14	Stovall Place
4	ASDM/ Kerr/ N.F. Negrito/ Divide Well	1	4/8/14	7/12/14	Chimney Rock Canyon,
		1	5/30/14	7/12/14	Saliz Place
		1	7/6/14	8/6/14	Hell's Hole
		1	7/29/14	10/13/14	
5	Cave Cr.	-	-	-	-
6	Blue Cr.	1	7/17/14	7/28/14	Garcia Tank (JER)
7	Moreno Spr.	1	4/18/14	8/6//14	Mimbres River Douglas Property
		1	5/21/14	7/12/14	
		1	6/12/14	7/12/14	Douglas Property
		1	7/8/14	8/6/14	Mimbres River
8	Bolton Spr.	-	-	-	-
9	Las Animas	1	4/21/14	8/21/14	Cave Creek
		1	5/19/14	11/3/14	Cave Creek
		1	5/20/14		Cave Creek

KEY:
Ovi. = Oviposition
TP = Tadpole
Pop. = Population
Cr. = Creek
W.S. = Warm Springs
Spr. = Spring
Metas = metamorph

Photo: Charles R. Peterson

In 2014, the Ladder ranarium produced over 8,000 tadpoles. These tadpoles were released to public and private lands across New Mexico and Arizona – 2014 marked the first time that we collaborated with Arizona Department of Game and Fish and USFWS to release frogs into wild sites in Arizona.

Table 3.6: Production and disposition of CLF produced in the ranarium in 2014.

Source Pop.	Date	# EM	# TP	# Meta/ Adult	Release type
Seco Cr.	4/30/14	1			Captive
Beaver Cr.	5/16/14		836		Wild
Alamosa W.S.	5/28/14	1	309		Captive
JER & Ran.	6/17/14		88	59	Wild
Beaver Cr.	6/19/14		1423		Wild
Beaver Cr.	6/25/14	2			Wild
Seco Cr.	7/5/14	1			Captive
Beaver Cr.	7/10/14	2	756		Wild
Moreno Spr.	7/12/14		717		Wild
Beaver Cr.	7/21/14		213		Captive
Blue Cr.	7/28/14		618		Captive
Animas Cr.	8/1/14		63		Wild
San Fran Hap.	8/6/14		1391		Wild
Moreno Spr.	8/6/14		126		Wild
Animas Cr.	8/21/14		43		Wild
Beaver Cr.	10/9/14		1642		Wild
San Fran Hap.	10/13/14		468	7	Wild
Animas Cr.	11/7/14		420	52	Wild

KEY:
EM = Egg mass
TP = Tadpole
Pop. = Population
Cr. = Creek
W.S. = Warm Springs
Spr. = Spring
Hap = Haplotype
Meta = metamorph

CLF movement study

Beginning in 2013, TBD funded a graduate student position to investigate aspects of CLF movement ecology on the Ladder Ranch. We partnered with Montana State University professor, Dr. Andrea Litt, who hired Ross Hinderer (as a graduate student) to develop a M.S. project. During the 2013 and 2014 field seasons, Ross captured CLF in pitfall traps at two occupied sites in the Seco Creek drainage. He attached radio transmitters to frogs to track their movements throughout the summer monsoon season (see Ross' field notes on pages 22 – 29). Ross concluded his fieldwork in 2014 and is expected to defend his M.S. thesis in 2015.

Individual identification studies: Spot recognition and PIT 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 2014 we continued a study to determine whether spot-pattern identification (SPI) methods provided comparable results to the commonly used PIT tagging method (which involves the subcutaneous injection of a small Passive Integrated Transponder chip). We selected two captive refugia tanks (Fox and No. 2) on the Ladder Ranch in which to perform PIT tagging and SPI techniques in 2013 and 2014.

In addition to our own analyses, we are collaborating with Dr. David Pilliod (USGS) to help develop software for the automated individual identification of CLF from spot pattern images. In 2014, we hosted David Pilliod and Dr. Charles Peterson at the Ladder Ranch to help us improve field photography procedures for spot pattern recognition. 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 spot pattern of CLFs change as the individual grows. This work will continue into 2015.

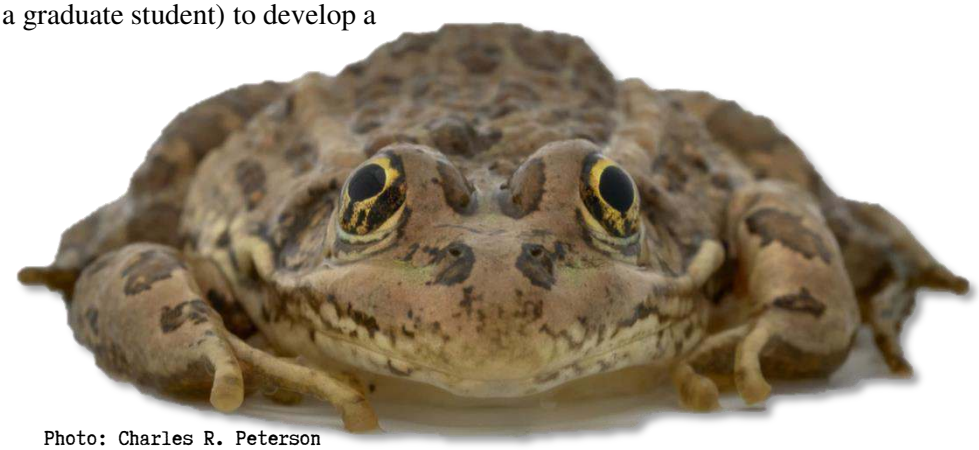


Photo: Charles R. Peterson

4. CHUPADERA SPRINGSNAIL

Pyrgulopsis chupaderae
ESA listing: ENDANGERED

PROJECT STATUS:
Ongoing

Principal biologists:
Dustin Long
Magnus McCaffery
Hanne Small

Conservation Problem: Potential habitat degradation and loss due to groundwater pumping in the surrounding area, springhead modification and increased drought severity and duration.

Conservation Status:
- The Chupadera springsnail was identified as a candidate for listing in 1984. The species was listed as endangered under the ESA in 2012
- NM Species of Greatest Conservation Concern

Project Location: Willow Spring on Highland Springs Ranch (approximately 1 mile north of the Armendaris Ranch in Socorro County, NM).

Project Partners:
- Highland Springs Ranch, LLC
- United States Fish & Wildlife Service (USFWS)
- New Mexico Department of Game & Fish (NMDGF)

Grant Funding:
- NMDGF Share with Wildlife grant ($10,000)

Project Goals & Objectives: The goal of this project is to recover the Chupadera springsnail (CSS) so that it can be removed from the federal list of threatened and endangered species (Figure 4.1). To accomplish this we must first collect and understand basic ecological information regarding the species which will then be used to inform the development of a recovery plan. This process will include the following activities:

- *Water Quality monitoring:* Basic water quality measurements will be collected at Willow Spring including water depth, velocity, temperature, pH, conductivity, salinity and dissolved oxygen.
- *Geology assessment:* Indurate substrate in Willow Spring will be collected and tested for mineral composition. Similar appearing terrestrial substrate will also be tested for suitability for use in habitat expansion at Willow Spring or translocation sites.
- *Population survey:* The level and type of population monitoring will be determined in collaboration with USFWS and NMDGF, and outlined in permitting documents. TESF has proposed to monitor CSS abundance using clay tiles which will be placed throughout Willow Spring, allowed to be colonized by CSS, and the number of snails per tile counted in situ. We will also document periods of peak reproduction to correlate with water quality attributes, seasonality, or other triggers of reproduction and identify the presence and abundance of larval or immature CSS during each site visit.
- *Recovery Planning:* TESF will help coordinate CSS recovery plan meetings. Invitations will be extended to relevant and interested biologists and stakeholders to attend a two day meeting hosted by the Ladder Ranch with the objective of outlining a recovery planning document.
- *Captive Breeding:* If the recovery plan indicates a need, TESF will coordinate establishment of one or two captive rearing facilities for CSS. Early discussions have focused on the Ladder Ranch ranarium as a suitable location. CSS would be transferred from Willow Spring to populate any captive facility.
- *Translocations:* Spring sites on the Armendaris and Ladder Ranches will be explored and prioritized as potential translocation sites for CSS.

Figure 4.1. Chupadera springsnails are found only at Willow Spring, a 125 foot long spring just north of the Armendaris Ranch.

Project Background:

The Chupadera springsnail (CSS, *Pyrgulopsis chupaderae*) is a small (0.08-0.11 inches tall) freshwater snail that is endemic to Willow Spring and a nearby unnamed spring (Figure 4.2). CSS no longer survive at the unnamed spring. The CSS is considered imperiled given the limited extent of (1.6 to 6.5 feet wide x 125 feet long) and potential threats to occupied habitat.

Figure 4.2. Chupadera springsnail habitat at Willow Spring.

Habitat, water quality, and CSS abundance data were last collected at Willow Spring in 1997-1998 by NMDGF biologists. These data suggest that the species survives only on rhyolitic gravels within a relatively stable range of water quality parameters. .

A recent site visit by the last biologist to visit Willow Spring in 1998 proved instructive and encouraging. CSS densities appeared to be similar to those last observed in 1998, however the quality and extent of occupied habitat appeared to have improved since then.

Project Activities in 2014:

In 2014 TESF executed an agreement with Highland Springs Ranch, which allowed TESF access to the Willow Spring site to conduct conservation activities. During the short period TESF had access to the site in 2014 we made water quality assessments at Willow Spring on two occasions, deployed temperature, conductivity and dissolved oxygen data loggers, and arranged for USFWS, NMDGF personnel, and a springsnail expert to evaluate the site and consider the next steps in conserving the species.

All water quality measurements made in late 2014 corresponded with those last made in 1997-1998. The federal and state permits required to perform population surveys, and other springsnail handling activities which may result in a take (translocations and establishing a captive population), were submitted in early 2015. We identified nine potential spring/stream locations on Turner properties for field investigation as potential translocation sites. Based on habitat surveys and our current understanding of habitat conditions at Willow Spring, we deployed water quality data loggers at three of these sites. Two of the 3 sites exhibited significant seasonal, and sometimes daily, temperature fluctuations and are likely unsuitable as CSS translocation sites. The one potential translocation site, McRae Spring, registered a low temperature of 61F in December and a high of 72F in October with most temperatures falling in the 63-66F range throughout the 4 month period data was collected (Oct-Jan). These temperature ranges are within those necessary to support CSS. Conductivity values at McRae Spring were much higher (mean 1,060) than those collected at Willow Spring in 1997-1998 (mean 188) so it remains unclear whether the McRae Spring site can support a CSS population.

Future Activities & Considerations:

TESF's future conservation efforts are conditional on receiving federal and state recovery permits. Assuming those permits are issued TESF will begin population surveys in 2015 and host the first of what are likely to be many recovery plan meetings.

5. CUTTHROAT TROUT

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

ESA listing (both species): NOT LISTED

PROJECT STATUS:
Ongoing
Principal biologist(s):
Carter Kruse
Eric Leinonen

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

Conservation Status:

- RGCT are considered a Species of Greatest Conservation Concern/Need by the New Mexico Department of Game and Fish and Colorado Parks and Wildlife.
- WCT are considered a Species of Greatest Conservation Need by Montana Fish Wildlife and Parks and Idaho Department of Fish and Game.

Project Locations (Table 3.1):
Costilla Creek, Vermejo Park Ranch – RGCT
Vermejo River, Vermejo Park Ranch – RGCT
Las Animas Creek, Ladder Ranch – RGCT
Cherry Creek, Flying D Ranch – WCT
NF Spanish Creek, Flying D Ranch – WCT
Green Hollow Creek, Flying D Ranch – WCT
Greenhorn Creek, Snowcrest Ranch – WCT

Table 5.1. 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
Green Hollow	FD	WCT	4	1-2 yrs. from complete eradication (95%)
Bear Trap	FD	WCT	8	Under consideration
Greenhorn	SC	WCT	32	Trt. complete 2014 Assessment underway
Costilla	VPR	RGCT	175	Trt. 70% complete Restocking underway
Las Animas	LAD	RGCT	48	Silver Fire impacted project area; assessment underway
Vermejo	VPR	RGCT	32	Mon. ongoing; habitat restoration underway

KEY:
FD = Flying D Ranch
SC = Snowcrest Ranch
VPR = Vermejo Park Ranch
LAD = Ladder Ranch
Trt. = Treatment
Res. & Mon. = Research & Monitoring
Plan. & develop. = Planning & development
Maint. = maintenance

Project Partners (integral to success):

- New Mexico Department of Game and Fish (NMDGF)
- Colorado Parks and Wildlife
- Montana Fish Wildlife and Parks (MTFWP)
- US Forest Service
- US Fish and Wildlife Service (USWFS)
- 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 MTFWP ($5,000)
- 2010 US Forest Service ($2,500)
- 2011 USFS Res. Advisory Council ($20,000)
- 2011 MTFWP Future Fisheries ($81,983)
- 2013 Partners for Fish and Wildlife ($24,900)
- 2014 Partners for Fish and Wildlife ($50,000)

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

Project Goals & Objectives: Range-wide conservation agreements among management agencies and non-governmental organizations are in place to guide conservation and restoration activities for WCT and RGCT across jurisdictional boundaries. Objectives outlined in these documents include: securing and monitoring known cutthroat trout populations; seeking opportunities to restore or found new populations, especially over large areas and including private lands; identifying or locating any additional wild populations; coordinating conservation activities among resource agencies and non-governmental organizations; and providing public outreach and technical assistance. These range-wide objectives for cutthroat trout conservation are consistent with the mission of Turner Enterprises and fit within the land management framework on the 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* with a goal of catalyzing cutthroat restoration or conservation activities on 400 km of stream. This is by far the most comprehensive and ambitious private effort on behalf of native cutthroat trout. Efforts to restore or conserve cutthroat trout are in planning or underway in eight streams on four ranches; not all may ultimately be implemented or successful but they provide the framework to reach our goal. The overall goal is to improve the range-wide status of RGCT and WCT and prevent listing under ESA, and this encompasses the following objectives:

- 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.

Project Background:

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 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 allowing expression of multiple life histories and connecting local sub-populations – conferring a better chance of withstanding population stressors.

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 restoration projects ever undertaken in the U.S. The Cherry Creek Native WCT Project on the Flying D Ranch in Montana encompasses approximately 100 km of stream habitat and 3 ha of lake suitable for cutthroat, 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%. Importantly, the success of the Cherry Creek project, and the lessons learned from it, has catalyzed other cutthroat re-introduction projects in southwestern MT. The Costilla Creek Native RGCT Project on Vermejo Park ranch in NM and CO is the most ambitious watershed renovation project ever initiated to date on behalf of any cutthroat trout, encompassing approximately 175 km of stream habitat (50% 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 occupied by genetically pure RGCT within their historical range. This project would not have been initiated without Turner support and is the flagship restoration effort on behalf of RGCT for the NMDGF. Planning and implementation of the Costilla Project is largely responsible for the development of consistent NM state guidelines regarding the use of piscicides, and for re-development of the NMDGF'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 USFWS 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 2014:

Cherry Creek – TBD continued to monitor the recovery of WCT in the Cherry Creek project area on the Flying D Ranch. Electrofishing monitoring in 2014 continued to confirm that the native trout population is rapidly filling the entire extent of stream that contained non-native trout prior to treatment, and natural reproduction is occurring throughout the watershed. The overall population of cutthroat trout now likely exceeds 50,000 individuals. No non-native trout have been captured in the project area since piscicide treatments were completed in 2010. At several monitoring sites cutthroat trout numbers and average size now exceed that of the pretreatment population (Figure 5.1). Nearly 4,000 WCT in the project area have been individually marked with passive integrated transponder (PIT) tags and through regular sampling and remote antennas, many of these fish have been "recaptured" several times, providing data on the of survival, movement, growth, and genetic fitness of the population. Analyses of this data began in 2014 and will continue in earnest in 2015; however, funding for genetic comparisons remains limited. An important remaining task is to provide upstream fish passage from Phase IV ("Butler Reach") into the upper watershed to facilitate genetic exchange. Initial designs for a fish ladder over the Cowboy Canyon irrigation diversion (Figure 5.2) were developed in 2014 and installation is scheduled for 2015. MTFWP has received several reports of anglers catching native cutthroat trout in the Madison River in the vicinity of the mouth of Cherry Creek (Figure 5.3). These are likely individuals that have moved downstream from the project area.

Figure 5.1. Average number and size of fish captured in the 100-m Butler Section monitoring site before (2002-09) and after (2012-14) piscicide treatment and native WCT introduction. Horizontal red and blue lines represent the pretreatment average size and number, respectively.

Figure 5.2. Cowboy Canyon irrigation diversion that prevents fish movement from the Butler Section (Phase IV) into the upper portions of the project area.

Figure 5.3. Native WCT caught in Madison River near Blacks Ford by angling public in January 2015. Fish originated from Cherry Creek project area.

Costilla Creek – TBD installed the seventh and final temporary fish migration barrier that will be needed to complete the Costilla Creek project on Long Canyon (Figure 5.4) in 2014, and on two separate occasions treated 4 km of Long Canyon and the Seven Lakes complex (actually eight lake basins) with rotenone (Figure 5.5). Another 3.7 km of stream were treated for a second time in the Beaver Creek watershed. The treatments were successful and in late October these waters were stocked with approximately 1,700 multi-aged RGCT. Another 1,000 young of year RGCT were put into Allen Creek where treatment was completed in 2013. Planning continued for treatment of the remaining stream reaches and Costilla Reservoir in 2015.

Figure 5.4. The temporary fish barrier on Long Canyon at Vermejo Park Ranch.

Figure 5.5. One the Seven Lakes complex following water draw down and rotenone treatment during July 2014.

Preparations were made to salvage large numbers of non-native trout from lower Costilla Creek and Costilla Reservoir during summer 2014 in advance of treatment in 2015; however, the presence of bacterial kidney disease precluded salvage and movement of any trout. Anticipating a potentially warmer and drier future, a decision was made to reconfigure water management at the Seven Lakes complex. Earthwork was initiated in fall 2014, and will continue in early 2015 to maximize water volume and minimize water temperatures in three primary fishing lakes while abandoning water delivery to most of the remaining lake basins. Unfortunately, with advances in genetic analyses, the presence of Colorado River cutthroat trout genes was confirmed in some of the RGCT that originated from CO and had been stocked in the early phases of the project. To alleviate this issue, the upper 25 km portion (Phase I) of Costilla Creek was retreated in early September to remove these "hybrid" cutthroat trout. This area was restocked with around 9,000 genetically pure RGCT from NM sources. Monitoring of restored RGCT populations in Casias and Costilla creeks with electrofishing continued in 2014 and suggests restored populations are recovering well. In October 2014 the US Fish and Wildlife Service determined that listing of RGCT under ESA was not warranted and removed RGCT from the candidate species list. The conservation efforts in the Costilla Creek watershed by TBD and project partners were cited as an important basis for this decision (Figure 5.6).

"In our PECE analysis, we found that the conservation efforts in the Vermejo CCAA have a high level of certainty of implementation and effectiveness because of the demonstrated ability of the Vermejo Park Ranch for carrying out effective conservation actions for the subspecies. Therefore, we considered these conservation efforts as part of the basis for our listing determination for the Rio Grande cutthroat trout."

Figure 5.6. A quote by the US Fish and Wildlife Service on their decision not to list RGCT as a threatened species and to remove it from the candidate species list. Federal Register, Oct. 2014, Vol. 79, No. 190, Page 59144.

Vermejo River – This is the only project in the *Cutthroat Trout Initiative* where cutthroat trout (in this case RGCT) actually remain within their historical range on Turner ranches. This conservation population is threatened by encroachment of rainbow trout hybrids and competition with nonnative brook trout (BKT). TBD is using electrofishing to reduce or eliminate rainbow trout hybrids in the upper Vermejo River watershed to maintain or reduce the current level of introgression; and to reduce BKT numbers in the upper Vermejo River watershed to maintain and perhaps enhance RGCT populations. To accomplish the first two objectives over 30 km of the upper Vermejo River drainage was electrofished multiple times

from 2010-13 to remove non-native fish. Approximately 17,842 BKT were removed during that period. More importantly, 20 confirmed rainbow x cutthroat trout hybrids were removed from the watershed over the four year period helping to keep the genetic status of Vermejo River RGCT at least 99% pure. Much less effort was spent by TBD removing BKT in 2014. One electrofishing pass over 7.2 km removed 214 BKT and 2 suspected (not confirmed with laboratory analyses) rainbow x cutthroat trout hybrids (Table 5.2).

Table 5.2. Number of brook trout (BKT) removed by electrofishing over past five years in the upper Vermejo River watershed.

Year	Location	Sampling reach (km)	BKT removed
2010	Vermejo River	23.8	2583
2011	Vermejo River	31.2	8631
2012	Vermejo River	32.2	3894
2013	Vermejo River	32.2	2734
2014	Vermejo River	7.2	214

Recent drought and years of over browsing by wildlife and livestock have negatively impacted the riparian habitat along the upper Vermejo River. Reduced riparian vegetation and limited woody plant recruitment have destabilized banks and impacted water quality to the detriment of native fishes and riparian obligate species (Figure 5.7).

Figure 5.7. Limited riparian vegetation development along the upper Vermejo River due to chronic over browsing and drought.

TBD applied for and received $75,000 in grants from Partners for Fish and Wildlife (US Fish and Wildlife Service) to construct exclosure fencing along sections of the upper Vermejo. That money is being matched by Vermejo Park Ranch to construct six, ½ mi long, 8 ft. high ungulate exclosures. The first two exclosures were completed in 2014 (Figure 5.8). 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 groundwater storage in the upper Vermejo River system.

Figure 5.8. The first of six high fence exclosures to be installed along the upper Vermejo River to improve riparian health.

Las Animas Creek – This project seeks to restore the native fish community (i.e. RGCT, Rio Grande chub (*Gila pandora*), and Rio Grande sucker (*Catastomus plebeius;* a state species of concern) to the upper 48 km of Las Animas Creek. Approximately half of the project area is located on the Ladder Ranch, with the remainder on the Gila National Forest. In early 2014 a draft environmental assessment (EA) for the project was completed in anticipation of a rotenone application to remove non-native longfin dace (*Agosia chrysogaster*) and hybridized rainbow x cutthroat trout from the project area. However, a new complication for this project is the aftermath of the 138,000 acre Silver Fire that burned the entire national forest portion of the watershed in summer 2013. Monsoon rains in 2013 and 2014 resulted in significant flood and ash flows, drastically changing the instream habitat (Figure 5.9).

Electrofishing surveys in 2014 suggest these flows, coupled with water quality and habitat changes, killed or displaced most of the native (e.g., Rio Grande chub and sucker) and non-native fish (e.g., long fin dace and trout hybrids) in the project area. Only a few longfin dace

appeared to survive in off- channel refugia areas, such as small springs and tributaries that were not impacted by the fire. This fish kill and habitat change will lead to a reassessment of the proposed piscicide treatment and may have simplified or even nullified the need for a piscicide treatment. However, no decisions will be made until the watershed has been given a few years to recover and additional sampling confirms impacts or changes to the fish community.

Figure 5.9. Stream habitat in upper Las Animas Creek before (top) and after (bottom) the 2013 Silver Fire. Photos taken at the same site – note two large rocks for reference.

NF Spanish Creek – Preparation for this proposed project, partially on the Flying D Ranch, continues to move slowly. Since the majority of this project is on public land, MTFWP is the lead agency and TBD is supporting the pre-implementation public scoping and data gathering process. The public scoping process, started in 2013, languished in 2014. TBD continued to gather pre-treatment information by monitoring fish populations at standard sampling sites during the summer, while fish distributions throughout the watershed continued to be mapped. A visual inspection of the wild cutthroat trout that were introduced into Placer Creek from Bostwick Creek (in the Bridger Mountains) last fall indicted that the fish had successfully spawned in 2014. Upper Placer Creek was fishless due to a natural barrier falls in the drainage. These fish could serve as a founding source for a restored NF Spanish Creek WCT population.

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 the last week of July 2014 by TBD, MTFWP, BLM, and USFS personnel. No non-native fish were captured during initial post-treatment electrofishing assessments. Additional electrofishing will be conducted in 2015 before native WCT are re-introduced into the drainage in 2016. When completed in 2016, 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 their 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 2014, with modest effort, 104 BKT were removed from upper Green Hollow Creek, bringing the 12 year total number of fish removed to 14,557 (Figure 5.10). Even fewer adult or spawning fish were captured in 2014 than 2013, suggesting that BKT extirpation above the fish barrier could occur within the next year or two. MTFWP is exploring upper Green Hollow as a potential refugia site for Gallatin Drainage WCT stocks, which are nearly extinct.

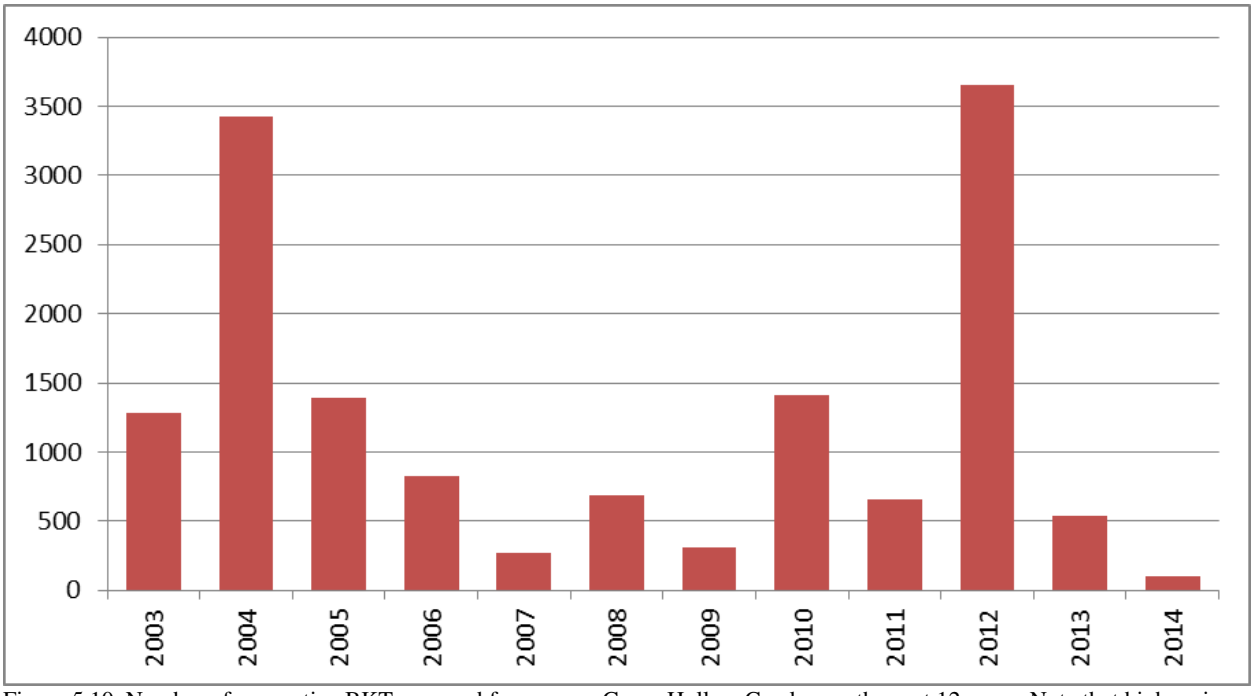
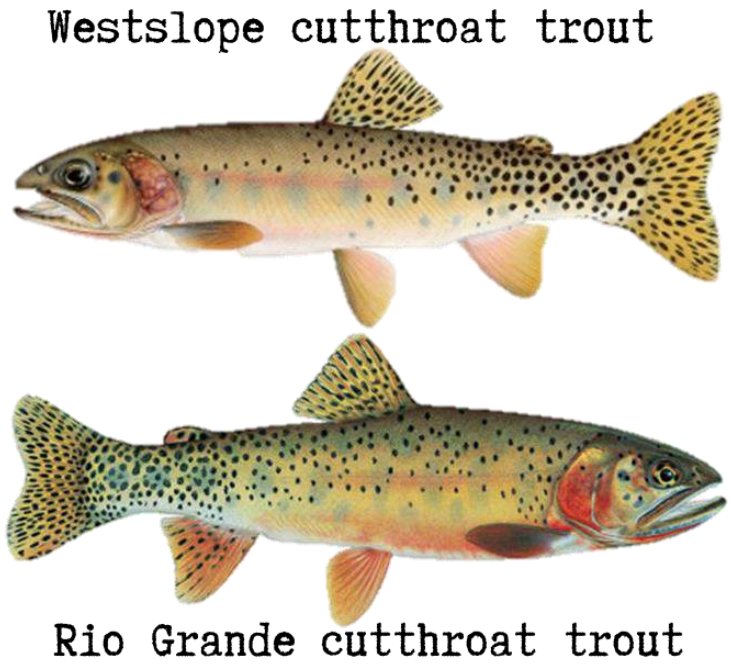


Figure 5.10. Number of non-native BKT removed from upper Green Hollow Creek over the past 12 years. Note that high spring flows in 2011 allowed a few adult BKT to pass the fish barrier and spawn resulting in large numbers of young BKT to be captured in 2012. Barrier was modified in 2013 to prevent a reoccurrence. Variability in catch is partially due to differential effort on an annual basis.

Future Activities & 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. With the exception of the Bear Trap Creek project, all other cutthroat trout restoration and conservation efforts have substantial momentum behind them and the majority should be completed by 2020.



6. EASTERN 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:

- U.S. Fish and Wildlife Service
- Central Florida Zoo's Orianne Center for Indigo Conservation (OCIC)
- The Orianne Society
- Florida Fish and Wildlife Conservation Commission (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 7) 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., although it can now only be found in southern Georgia and peninsular Florida. In the northerly portions of their historical range (north of Gainesville, FL), indigo snakes require sandhills 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.

In 2014, the OCIC hatched a record number of eastern indigo snakes (67 hatchlings). This allowed reintroduction expansion to a second reintroduction site in the Florida panhandle. With the Conecuh program in its fourth year of releases, the new site will initiate recovery in a region where indigo snakes have largely disappeared. Reintroductions are guided by the *Eastern Indigo Snake Reintroduction Committee*.

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 (Figure 6.1).

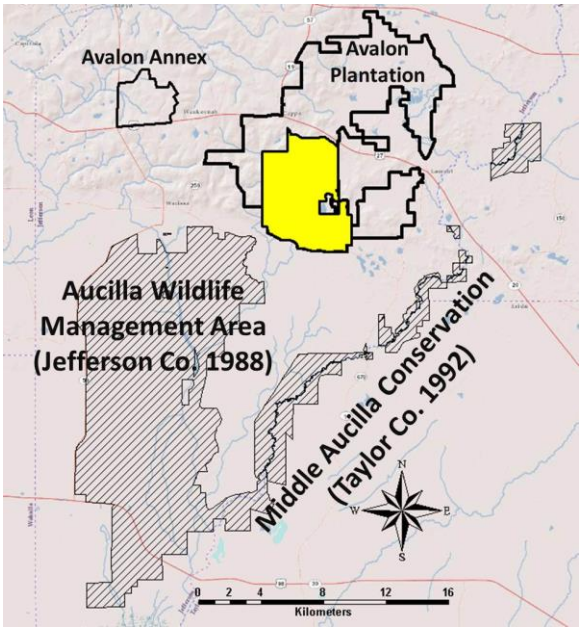


Figure 6.1. The Avalon property in relation to surrounding protected lands where the most recent eastern indigo snake sightings occurred in 1988 and 1992. Yellow polygon indicates area of Avalon with a TNC conservation easement.

A lack of recent sightings from the panhandle area (Figure 6.2) 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 7), 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 (see page 38).

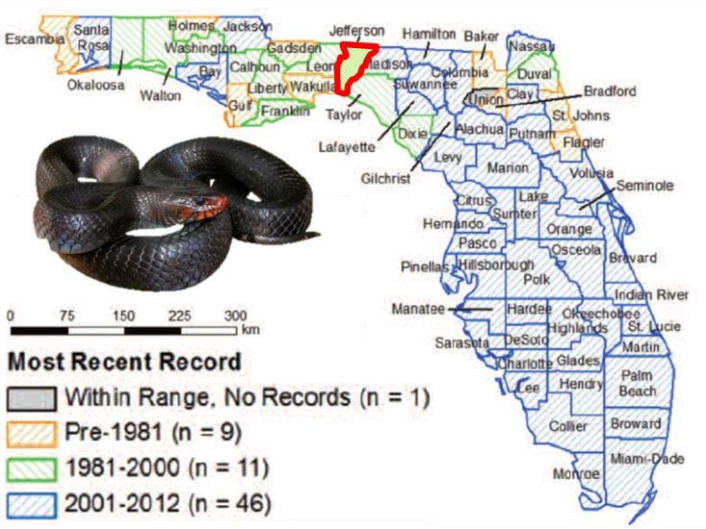


Figure 6.2. The most recent sighting records for eastern indigo snakes in Florida for each county by time period: pre-1981, 1981–2000, and post-2000. Avalon is located in Jefferson County (red polygon). Source: Enge et al. 2013.

Project Activities 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 (Figure 6.3). We

identified a recipient site of around 6,000 ha, with lowland wetlands comprising around 20% of the total area, thus meeting recipient site criteria in these regards (see page 38). However, with only 14 gopher tortoise burrows found on Avalon Proper to date, 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 (Figure 6.3; see Section 7).

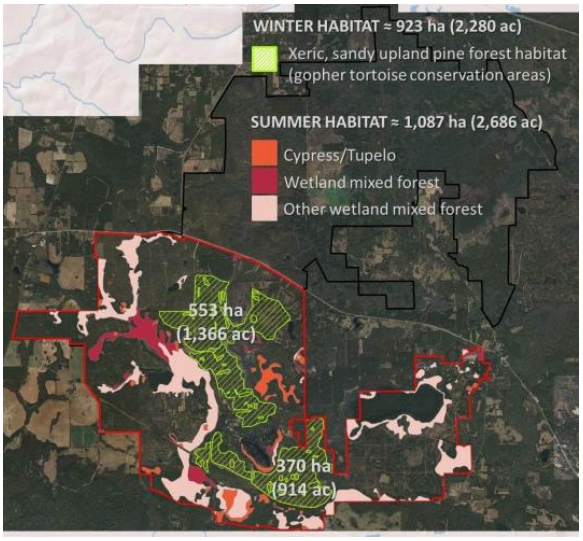


Figure 6.3. The potential eastern indigo snake recipient site (red outline) comprising around 6,000ha of the Avalon Plantation. Areas that could be populated with gopher tortoises, thereby restoring indigo snake winter habitat are shown as green hatched polygons. Indigo snake summer foraging habitat is indicated by solid polygons.

We attended the annual meeting of the *Eastern Indigo Snake Reintroduction Committee,* where we presented a talk to the group on the potential for Avalon Proper to serve as a future eastern indigo snake reintroduction site. The merits and characteristics of all potential recipient sites were discussed during the meeting (Table 6.1), and a final decision was made by the group to select The Nature Conservancy's Apalachicola Bluffs and Ravines Preserve as the second recipient site for receiving indigo snakes produced by the OCIC.

Future Activities & Considerations:

With the inception of our gopher tortoise recovery program at the Avalon Annex in 2014 (see Section 7) and the availability of gopher tortoises for translocation in Florida, we anticipate that we could establish a gopher tortoise MVP at Avalon Proper within five years. Upon restoration of such a tortoise population, the Avalon Plantation would satisfy all the required attributes of an eastern indigo snake reintroduction site, and would be a strong contender for receiving indigo snakes produced by the OCIC.

Table 6.1. Potential eastern indigo snake reintroduction sites considered by *Eastern Indigo Snake Reintroduction Committee* at the 2014 reintroduction planning meeting at Ichauway Plantation. The committee selected TNC's Apalachicola Bluffs and Ravines Preserve (***bold, italicized font***) to begin receiving indigo snakes from the OCIC beginning in 2015. The Avalon Plantation (**bold font**) meets most of the reintroduction site criteria, except for the availability of indigo snake winter habitat that would be conferred by a robust gopher tortoise population.

Site	Area (ac.)	Habitat Condition	Gopher tortoise population	Roads (1-4, 4 best)
Nokuse Plantation	30k	Good	2,600	4
Apalachicola Bluffs (TNC)	***18k***	***Excellent***	***824***	***4***
Apalachicola NF (Munson)	17k	Good	N = 872, 1.48/ha	1
Apalachicola NF (Camel Lake)	17k	Good	Low	3
Blackwater River State Forest	7k	Excellent	pretty good size (a pile)	2
Avalon Plantation	**15k**	**Excellent**	**9**	**3**
Conecuh NF	15k	Excellent	viable	3
Silver Lake WMA	17k	Excellent	600	3

Eastern Indigo Snake: DRAFT Criteria for Reintroduction Sites

LOCATION:

An indigo snake reintroduction site should be wholly located within the historical range of the species (see Enge at al. 20I3). A reintroduction site should be connected by natural and intact corridors to vast acreages of other landscapes that either support indigo snake populations or have the potential to support snake populations.

AREA (Size of Reintroduction Site):

Reintroduction sites should be **5,000 ha or greater** in size.

Potential reintroduction sites in the northern part of the species range (north of Gainesville, Florida) are within the region where indigo snakes seasonally require gopher tortoise burrows, and where tortoise burrow use may occur throughout the year. Some individual snakes may make long-distance dispersal movements of up to 4.0 miles (6.4 km) between tortoise colonies where they overwinter and summer foraging areas. We recommend that future reintroduction sites are a minimum of 5000 ha in size. The USFWS I982 Recovery Plan stated that 4000 ha are needed to support an indigo snake population; Paul Moler (I992) estimated that at least I000 ha of habitat is needed to provide conservation benefits to the species because of its large home range, habitat needs and behavioral traits. The collective extent of the radiolocations for the 32 snakes tracked by Hyslop (2007) spanned an area of 8,000 ha (MCPs of all locations) to I4,000 ha (rectangular area).

HABITAT:

Reintroduction sites should include sufficient acreage of xeric, sandy upland habitats for snake overwintering and for a gopher tortoise population that will be viable over the long-term (see below). Habitats at reintroduction sites should include a matrix of upland and lowland/wetland habitats (important for foraging) with lowland/wetland habitats comprising at least 20-30% of the total acreage.

GOPHER TORTOISE POPULATION:

An indigo snake reintroduction site should support, within its boundaries, a minimum viable population of gopher tortoises.

The gopher tortoise population criteria follow the recent *Gopher Tortoise Council Minimum Viable Population* (MVP) document.

The MVP for the gopher tortoise is 250 adults, with a density of no less than 0.4 tortoises per hectare (approximately 0.I6 tortoises per acre) with:

- A male-female ratio of I:I
- Evidence of recruitment into the population
- Variability in size and age class; the smallest size and age classes should be monitored over the long-term (i.e., every 5-I0 years) because recruitment and detectability within any given year can vary considerably.
- The landscape should not have major constraints to gopher tortoise movement (i.e., major rivers or highways).

Minimum reserve size: An MVP of gopher tortoises (>250 adults) can persist on a reserve that is at least I00 ha in size, provided the site receives intensive management.

PROTECTION:

An eastern indigo snake reintroduction site should be a conservation land with assured long-term conservation status (i.e., will be a dedicated conservation land, managed appropriately for indigo snakes and gopher tortoises in perpetuity).

7. GOPHER TORTOISE

Gopherus polyphemus
ESA listing: CANDIDATE

PROJECT STATUS: Ongoing

Principal biologist: *Magnus McCaffery*

Conservation Problem: The primary threat to gopher tortoises is habitat destruction, fragmentation, and degradation.

Conservation Status: The species is 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 (Figure 7.1).

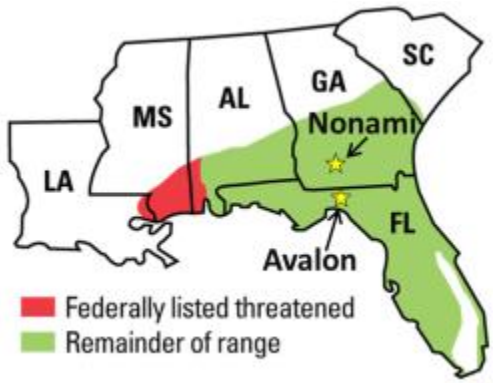


Figure 7.1. Gopher tortoise range, federal listing status, and the locations of Nonami and Avalon Plantations.

Project Locations: Nonami Plantation, GA; Avalon Plantation, FL (Figure 6.1)

Project Partners:
- Georgia Department of Natural Resources
- Florida Fish and Wildlife Conservation Commission (FWC)
- Saving Florida's Gopher tortoises (SFGT)

Project Funding:
- TESF

Project Goals & Objectives: To restore viable gopher tortoise populations to the Nonami and Avalon Plantations. Specific objective:
- Establish tortoise densities of 1 to 2/ha within tortoise reserves at least 100 ha in size.

Project Background: The Nonami Plantation (3,578 ha) in Dougherty County, GA, and the Avalon Plantation (composed of two discrete property units: Avalon Proper = 11,445 ha, Avalon Annex = 1,018 ha) in Jefferson County, FL are principally managed for northern bobwhite quail recreational hunting as well as for ecological conservation. Both properties include extensive areas of quality gopher tortoise habitat, characterized by large tracts of suitable soil types combined with a pine/grassland vegetation structure that is maintained by frequent prescribed burns and hardwood mid-story control. Despite habitat conditions conducive to occupancy by large gopher tortoise populations, the species is only patchily distributed on these properties and at relatively low densities. It is likely that gopher tortoises were historically distributed far more widely and in greater densities on these properties, with reductions in both range and numbers 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.

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. We hope to contribute to producing a level of benefit to the species that could preclude any need to list the gopher tortoise under the ESA in Georgia and Florida.

Our gopher tortoise restoration goals and objectives are based on minimum viable population (MVP) criteria codified in 2014 by the Gopher Tortoise Council (see page 38) document. The major recommendations of this document are that a gopher tortoise MVP:
- Comprises at least 250 adults, with a density of no less than 0.4 tortoises per hectare
- Exhibits a male-female ratio of 1:1.
- Shows evidence of recruitment.

- Shows variability in size and age classes.
- Is located in a landscape that has no major constraints to tortoise movement.
- Meets minimum reserve size guidelines: An MVP of gopher tortoises (>250 adults) can persist on a reserve of at least 100 ha in size.

Project Activities in 2014:

Nonami Plantation

Burrow mapping and occupancy surveys

We mapped burrows on the Nonami Plantation and assessed their occupancy status. The coordinates of each burrow was recorded, and all burrows were visually evaluated as either active or inactive. Burrows were scoped with a camera to determine tortoise occupancy, and categorized as 'occupied' or 'empty'. The burrow was classified as 'undetermined' if we were unable to visualize the end of the burrow due to burrow architecture or obstructions.

We identified a total of 52 burrows at Nonami. We found 20 of these burrows to be occupied by a tortoise, and classified 23 as undetermined (Table 7.1; Figures 7.2 and 7.3) mostly due to our camera encountering water – forcing us to abort investigation of the burrow. Gopher tortoises can take refuge within a flooded burrow (making use of air pockets, or holding their breath), and we were unable to confirm these burrows were empty (Table 7.1).

Unfortunately, we did record some evidence of burrow disturbance, possibly caused by being driven over by heavy mowing machinery, causing some burrows to collapse. In an effort to reduce burrow destruction, we provided Ray Pearce (plantation manager), with burrow location data, and Ray subsequently organized the installation of metal T-post markers at each burrow entrance.

Table 7.1: Summary of results from Nonami Plantation 2014 burrow surveys.

BURROW STATUS	No. of burrows
Active	31
Inactive	21
Occupied	20
Empty	9
Undetermined	23
Total Nonami burrows	**52**

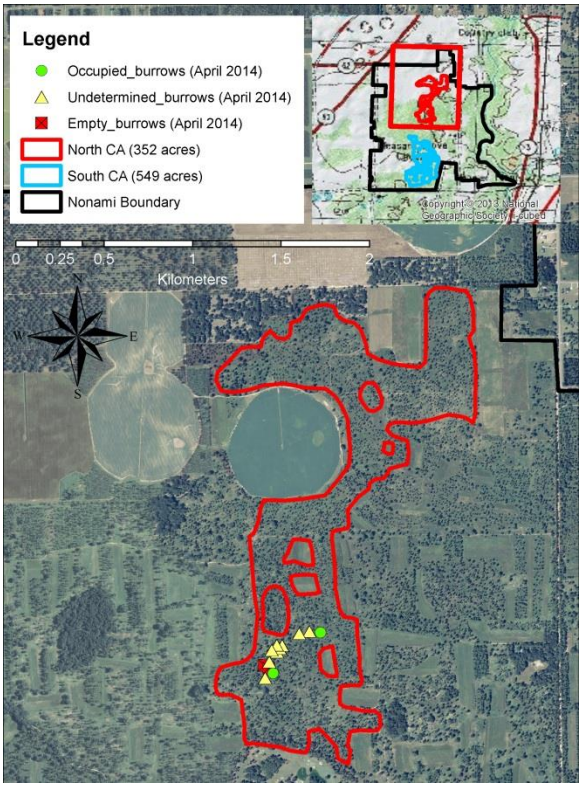


Figure 7.2. Proposed Conservation Area (CA) at Nonami, with the occupancy status of known burrows.

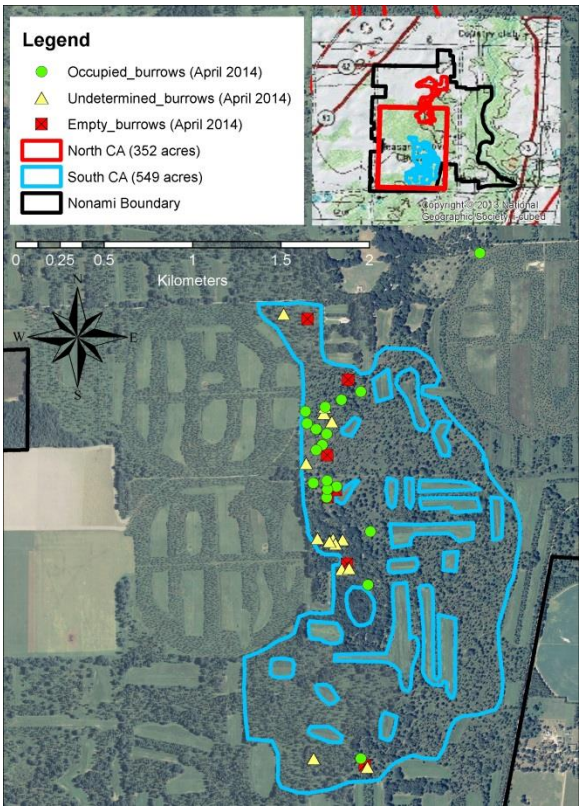


Figure 7.3. Proposed Conservation Area (CA) at Nonami, with the occupancy status of known burrows.

Tortoise trapping and handling

In an effort to collect demographic and health information on the existing Nonami gopher tortoise population, we attempted to trap tortoises (Figure 7.4) from burrows identified by our surveys to be occupied by tortoises. Unfortunately, our trapping schedule coincided with cool, wet weather – when tortoises tend to be inactive and not leave their burrows – and we were only successful in capturing one gopher tortoise. We physically examined and measured (maximum carapace length (MCL), maximum plastron length (MPL), mass, and plastron concavity (PC)) from this individual, implanted a PIT tag to allow individual identification, and took a blood sample to test for disease (Table 7.2; Figure 7.5).

Figure 7.4. A live-trap set at the entrance of an occupied gopher tortoise burrow.

Table 7.2. Data from captured Nonami tortoise

Capture date	4/21/14
PIT #	982000190720763
Sex	Female
MCL (mm)	242
MPL (mm)	246
PC (mm)	5
Mass (kg)	2.5
ELISA titer (Mycoplasma agassizii)	<32 (neg.)
ELISA titer (M. testudenium)	<32 (neg.)

Figure 7.5. Taking measurements from tortoise captured on the Nonami Plantation in spring 2014.

GIS mapping

We used burrow survey data in conjunction with ArcGIS software to identify areas (>250 acres) of the Nonami Plantation with contiguous gopher tortoise habitat that could serve as Conservation Areas (CAs), where efforts to restore viable gopher tortoise populations could be focused (Figures 7.2 and 7.3).

Avalon Plantation

Burrow mapping and occupancy surveys

We conducted systematic burrow surveys in spring and autumn to map and assess occupancy of gopher tortoise colonies on the Avalon Plantation (Avalon Proper and Annex). The coordinates of each burrow located was recorded, and all burrows were visually evaluated as either active or inactive. In addition, where practical, each burrow was scoped with a burrow camera to assess whether a tortoise was present. Burrows were categorized as either occupied or empty, only if we were certain of tortoise presence or absence within the burrow. The burrow was classified as 'undetermined' for occupancy if we were unable to maneuver the camera to the end of the burrow (Table 7.3).

Table 7.3: Summary of 2014 burrow survey results at Avalon Annex and Avalon Proper.

BURROW STATUS	No. of burrows (Annex)	No. of burrows (Proper)
Active	164	11
Inactive	59	3
Occupied	101	8
Empty	67	5
Undetermined	55	1
Total burrows	**223**	**14**

Avalon Annex recipient site development

We implemented a GIS analysis using burrow survey results in conjunction with aerial imagery, Natural Resources Conservation Service (NRCS) soil data, and Cooperative Land Cover (CLC) map information to identify suitable areas on Avalon Plantation that could serve as recipient sites for tortoise translocations. Through this analysis, we delineated a 505 acre area of the Avalon Annex (Figure 7.6) to serve as Avalon's first *unprotected recipient site* for rescued gopher tortoises from across Florida in need of rescue relocation (due to human development of their habitat) under FWC's incidental take permitting (ITP) mechanism (see summary report on ITP and development issues on page 46).

Based on our burrow survey information, current tortoise densities on the Annex recipient area were estimated at 0.29 tortoises/acre. Therefore, the extant population of tortoises estimated to reside on the recipient site was 0.29×505 = 147. With a maximum recipient site stocking density of 3 tortoises per acre, the capacity for the 505 acre recipient was set by FWC at 1,515 tortoises. Minus the baseline population of 147 tortoises, the theoretical number of gopher tortoises the 505 acre recipient site on Avalon Annex can accept is 1,368. However, this represents a maximum allowable number and it unlikely that we would choose to stock tortoises at such high densities.

FWC requires that tortoises translocated to a recipient site must be confined in a temporary pen for a minimum of 6 months to acclimate them to their new environment. Therefore, in preparation for receiving ITP tortoises at the Avalon Annex recipient site, Avalon Plantation staff, headed up by Frank Purvis and Brad McLeod, used silt fencing to construct two acclimation pens: North Pen = 20 acres, South Pen = 16 acres (Figure 7.7). The maximum stocking density for these pens was 4.5 tortoises/acre, and therefore we had the capacity to accept up to 162 ITP tortoises in 2014. We also installed 65 starter burrows in the North Pen and 67 in the South Pen (Figure 7.8) to provide newly translocated tortoises an immediate place of refuge.

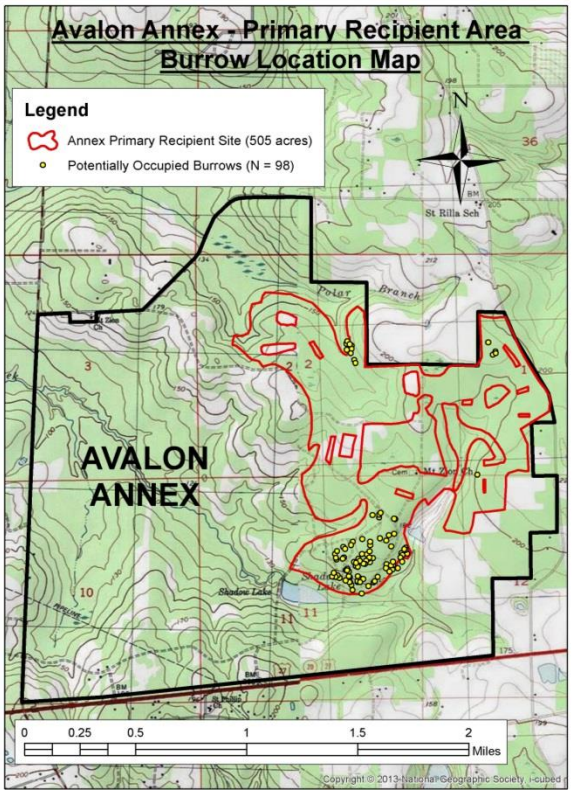


Figure 7.6. The 505 acre unprotected recipient site (red polygon) on the Avalon Annex, designed to receive translocated ITP tortoises from across Florida. Yellow circles represent all known potentially occupied burrows within the recipient site boundary prior to translocations.

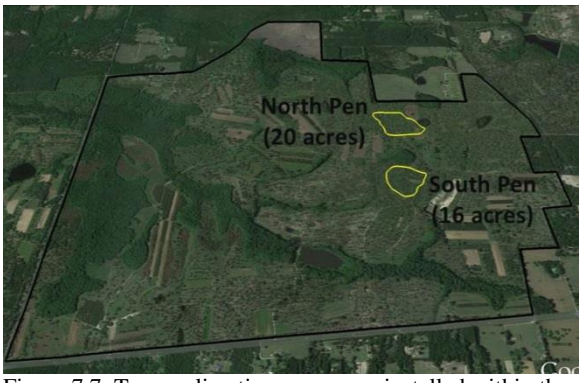


Figure 7.7. Two acclimation pens were installed within the Annex recipient site.

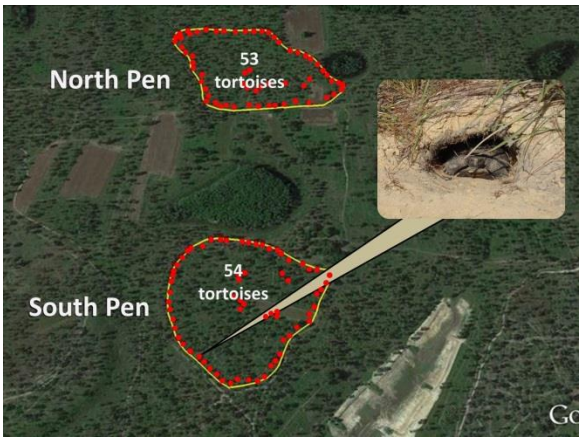


Figure 7.8. Starter burrows (red dots) were constructed within the north and south acclimation pens to provide translocated tortoises with refuge as they settled into their new surroundings. The total number of tortoises translocated into pens in 2014 is indicated. Inset picture show translocated tortoise inside starter burrow.

ITP tortoise translocations

We worked collaboratively with Carissa Kent (SFGT) and FWC (Figure 7.9) to translocate 107 ITP tortoises to the Avalon Plantation. Translocations occurred in 9 batches over a period of around 5 weeks in autumn 2014 (see press release on page 47).

Figure 7.9. A collaborative effort – Members of the Turner family, FWC, SFGT, and TESF took part in the Annex gopher tortoise translocations (From left to right: Magnus McCaffery (TESF), David Love (HSUS), Carissa Kent (SFGT), Beau Turner, Eric Seckinger (FWC), Rhett Turner, Derek Breakfield (FWC), Dustin Long (TESF).

Prior to releases into the Annex acclimation pens, we physically examined and measured (maximum carapace length, maximum plastron length, mass, plastron concavity, annuli count, examination for parasites and injury) each tortoise (Figure 7.10). Measurement data are summarized in Table 7.4.

Figure 7.10. Frank Purvis (Avalon Plantation manager; right), and assistant manager, Brad McLeod (left) counting the annuli to assess the age of an ITP gopher tortoise prior to its release on the Annex.

Additionally, tortoises that were assessed to have hardened carapaces and sufficient space on their marginal scutes were given an individual identification number by drilling a unique combination of small holes in the marginal scutes (Figure 7.11 and 7.12).

Figure 7.11. Rhett Turner (front left) marks an ITP tortoise with an individual ID number by drilling a series of small holes in the marginal scutes of the tortoise's carapace.

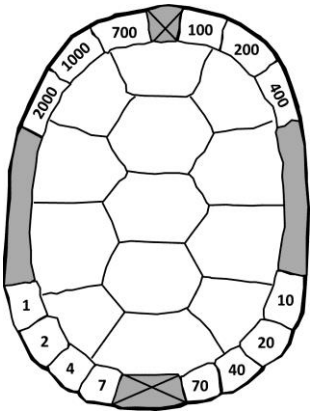


Figure 7.12. The marking scheme used to give each translocated gopher tortoise (with sufficient carapace hardness and space on marginal scutes) a unique identification number

Table 7.4. Summary data for gopher tortoises translocated to the Avalon Annex unprotected recipient site in autumn 2014.

	SOURCE LOCATION (permit number)											
	Trails End (CLA-067)				Ashford Mills (STJ-067)				Davenport Estates (POL-034)			
	♀	♂	Lge. J	Sm. J	♀	♂	Lge. J	Sm. J	♀	♂	Lge. J	Sm. J
No.	10	11	6	1	17	18	6	19	6	8	5	–
$\bar{x}$ CL	242	270	168	115	239	243	148	102	254	275	158	–

KEY:
No. = number of tortoises translocated to Avalon Annex recipient site
$\bar{x}$ CL = average Maximum Carapace Length (MCL) measurement (in mm)
♀ = female; ♂ = male
Lge. J = large juvenile (> 130 mm MCL). Sex undetermined.
Sm. J = small juvenile (< 130 mm MCL). Sex undetermined.

Following processing, ITP tortoises were released at starter burrows within an acclimation pen (Figure 7.13). In 2014, we translocated 53 tortoises to the North Pen, and 54 to the South Pen. The pens were monitored twice daily for two weeks following the release of a tortoise batch, and tortoise observations along the fence or in burrows were recorded. On occasions that we found a tortoise to be out of a burrow and along the fence line in the evening, that tortoise was physically placed into a starter burrow for the night to reduce the likelihood of predation.

Figure 7.13. FWC Executive Director, Nick Wiley (foreground), releasing a tortoise at a starter burrow.

Future Activities & Considerations:

Nonami Plantation

Our goal of restoring the tortoise population at Nonami is hampered by an inability to translocate tortoises easily to this property. Georgia does not currently require land developers to move resident tortoises prior to implementing building operations, and it is not currently possible to translocate displaced tortoises across the state line from FL. We will continue to work with our collaborators in FL and GA to identify options for translocating tortoises to Nonami, while continuing to monitor the extant population.

Avalon Plantation

We will remove the existing North and South acclimation pens (Figure 7.14) on the Avalon Annex in the spring of 2015, thereby releasing the ITP tortoises which were translocated into those pens in 2014. We will also install one or more new acclimation pens (Figure 6.13 shows potential locations for new pens) for implementation of another round of ITP translocations to the Avalon Annex in 2015.

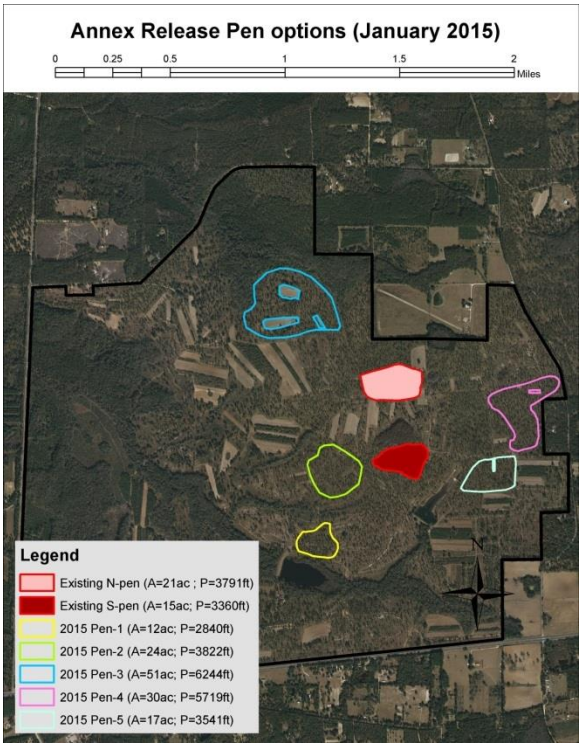


Figure 7.14. Existing (2014) pens, and potential sites for new (2015) acclimation pens on the Avalon Annex

We also intend to develop a strategy for restoring gopher tortoises to Avalon Proper. Preliminary GIS work suggests that there is excellent potential for several large tortoise conservation zones on Avalon Proper, that are largely coincident with TESF's red-cockaded woodpecker (RCW) project on the plantation (Figure 7.15). We will coordinate with the Turner family, Avalon Plantation management, FWC, and RCW biologists to finalize conservation zones for gopher tortoise restoration, and to identify locations for placing acclimation pens to receive tortoise translocations in late 2015 or 2016.

Figure 7.15. Preliminary planning for gopher tortoise conservation on Avalon Proper suggests that there are a number of potential Conservation Zones that would be appropriate for the restoration of viable gopher tortoise populations (center image). Conservation Zones (CZ) 3, 4, and 5 (surrounding images) may represent the best candidates for initial gopher tortoise work on Avalon Proper. Potential acclimation pen sites are shown as well as the proximity of RCW clusters.

SUMMARY REPORT ON DEVELOPMENT OF GOPHER TORTOISE HABITAT

Prior to June 2007, Florida did not require relocation or removal of gopher tortoises prior to construction activities, and landowners seeking to develop land in Florida could obtain an incidental take permit (ITP) which would authorize take (e.g. through entombment in burrows) of gopher tortoises. It is estimated that since I99I, the State's incidental take permit program allowed the destruction of around I00,000 gopher tortoises. A developer who obtained an ITP prior to June 2007, but delayed development activities, is not required by law to relocate tortoises. The non-profit group "Saving Florida's Gopher Tortoises", headed up by Carissa Kent, works with funding from the Humane Society of the United States to rescue gopher tortoises from these development sites that have grandfathered-in ITPs.

Following the implementation of new regulations in June 2007, gopher tortoises in Florida that are relocated off-site from occupied habitat that is slated for development must go to FWC-certified recipient sites. These recipient sites generally charge a market-driven fee for accepting tortoises, and create an opportunity for private landowners to establish a gopher tortoise conservation bank. This option is particularly attractive to conservation-minded landowners who have no plans for development, and want alternative income streams while maintaining existing land uses such as hunting on private lands. There are three recipient site categories that offer potential avenues for relocating gopher tortoises to the Avalon Plantation. These are:

OPTION I - Long-term Protected Recipient Sites: These recipient sites must have a codified ***habitat management plan***, and be protected by a perpetual ***easement*** that conforms to the standard format available from FWC (see Appendix 2). Conservation easements that were previously granted by landowners to other regulatory, governmental, or conservation entities may be acceptable to FWC if their conditions and restrictions provide habitat protection and management requirements for gopher tortoises and their habitats that are comparable to those contained within FWC's standard easement. However, those easements would need to be modified to designate FWC as a co-grantee. In addition, long-term recipient sites must have a ***financial assurance*** that generates adequate funds for the long-term management of gopher tortoise habitat within the recipient site (acceptable forms of financial assurance include: trust fund, performance bond, irrevocable letter of credit).

OPTION 2 - Short-term Protected Recipient Sites: These recipient sites have less stringent requirements in terms of easement placement, financial assurances, and minimum recipient site acreage. However, there are some enforceable protection commitments. FWC mitigation fees provide a ten-fold economic incentive for developers to use long-term recipient sites, and therefore a short-term recipient site could experience problems with obtaining tortoises.

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

PRESS RELEASE: Gopher tortoise translocation to Avalon Annex on September 26th, 20I4

Today, the Turner Endangered Species Fund (TESF) and the Florida Fish and Wildlife Conservation Commission (FWC) released 25 gopher tortoises, which are a threatened species, on Ted Turner's Avalon property in Jefferson County. Without intervention, these tortoises may not have survived because the land they were living on was slated for development. Through a voluntary agreement with the land developers, volunteers rescued the tortoises from a property in Clay County.

Ted Turner offered 505 acres on his Avalon property in Jefferson County to provide well-managed habitat for some tortoises in need of homes. Because it provides such ideal habitat, the FWC approved Avalon to receive more than I,000 tortoises. So far, a total of 43 tortoises have been released on the property.

Avalon provides optimal gopher tortoise habitat that can support a viable population of gopher tortoises. This longleaf pine ecosystem is already well managed, through the use of frequent prescribed burns, to benefit other wildlife that share similar habitat as gopher tortoises.

"I am honored that my land will be a secure home for gopher tortoises," said Ted Turner. "The species has been an important part of Florida's past and should be an important part of our great state's future."

As a threatened species, the gopher tortoise and its extensive burrows are protected under state law. As of 2007, the FWC's Gopher Tortoise Management Plan requires that gopher tortoises be relocated before development or land clearing occurs. However, some developers still have valid permits, received prior to this new regulation. Developers with these permits are not required to relocate tortoises.

"The release of these tortoises is an inspiring example of cooperative efforts by the FWC and partners like the Turner Endangered Species Fund to protect the threatened gopher tortoise," said Nick Wiley, Executive Director of the FWC. "We are grateful to landowners, developers and the many others in Florida who take pride in their efforts to help conserve a keystone species whose burrows provide habitat for hundreds of other species of wildlife."

Gopher tortoises are long-lived reptiles that live in high, dry, sandy places throughout Florida. They are considered a keystone species because the burrows they dig are used by more than 350 species of wild animals and insects that share the same habitat. These tortoises occur in parts of all 67 counties in Florida.

TESF is a non-profit operational charity dedicated to preserving nature by ensuring the persistence of imperiled species and their habitats with an emphasis on private land. The Fund was formed by Ted Turner and his family in June I997.

Relocating to Jefferson County

Gopher tortoises free to roam

19 endangered tortoises find new home on Turner land

By TaMaryn Waters

MONTICELLO — Florida's endangered gopher tortoise has a fighting chance for survival on 300 acres of perfect wire grass, longleaf pine ecosystem 20 miles from the state's Capitol.

Commendable efforts culminated Friday morning with the release of 19 gopher tortoises on media mogul Ted Turner's Avalon annex property in Jefferson County totaling 2,900 acres. The prehistoric species is the first to be released on the land.

Volunteers captured the tortoises from a property in Clay County with the approval of an agreement with land developers.

A caravan of biologists and officials representing the Florida Wildlife and Conservation Commission, Turner Endangered Species Fund and Saving Florida's Gopher Tortoises loaded into trucks and drove toward the targeted release site. Tortoises of varying size, age and gender were processed and weighed before each one was introduced to their new home.

Some tortoises didn't hesitate to enter previously dug burrows created in anticipation of the release. A few paused before entering and others rejected the holes, which is normal as the animals get used to new surroundings.

Gopher tortoises are a keystone species because their burrows are used by more than 350 species of wild animals and insects that share the same habitat.

The docile creatures can be found statewide and they thrive in high, dry, sandy places throughout Florida. But survival is imperiled when development bleeds into their environment.

Saving Florida's Gopher Tortoises began in 2006 and the foundation works with activists, developers and private land owners in pursuit of humane relocations. This allows volunteers to go in the field and capture tortoises so they won't be killed during development, said foundation founder Carissa Kent.

The project partners with FWC and it receives funding and logistical help from Humane Society of the United

MORE ONLINE

To see a video about gopher tortoises, go to Tallahassee.com/news

See GOPHERS • 5A

Front page of the Tallahassee Democrat (27th September 2014 edition).

8. GRAY WOLVES

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

PROJECT STATUS:
Ongoing

Principal biologists:
Chris Wiese
Mike Phillips

Conservation problem: Lethal control by humans resulted in Mexican wolf extirpation in the wild. Current challenges include political pressures against wolf releases, illegal shootings, and lack of human tolerance for population expansion. Due to the small founder population, diminished genetic diversity may be affecting fecundity and survival of wolves in the wild.

Conservation Status:
- Listed as endangered under the ESA in 1976

Project Location: Ladder Ranch, New Mexico

Project Partners:
- U.S. Fish and Wildlife Service
- Mexican Gray Wolf Species Survival Plan

Project Funding:
- TESF
- U.S. Fish and Wildlife Service Cooperative Agreement ($29,000)

Project Goals & Objectives: We support USFWS-led recovery efforts by operating a pre-release facility with the following objectives: (1) to breed wolves in captivity, (2) to provide transitional housing and acclimation care for wolves selected for wild release as well as for wolves that have been removed from the wild.

Project background: Mexican gray wolves (MGW) are a wolf subspecies that roamed the southwestern US and Mexico until their eradication in the wild through government-sponsored predator control campaigns. Wildlife biologists captured the last five wild wolves and began a captive breeding program. Restoration of MGWs to the Blue Range Wolf Management Area (BRWMA), spanning eastern Arizona and western New Mexico, began in 1998.

The Ladder Ranch joined the MGW recovery effort with the construction of the Ladder Ranch Wolf Management Facility (LRWMF) in 1997. This Ladder's wolf facility operates in tandem with the USFWS's Sevilleta Wolf Management Facility (SWMF), and as one of only three pre-release facilities, it supports wolf reintroductions by providing pre-release care and acclimatization for animals eligible for wild release. The LRWMF also assists with specific management needs associated with reintroductions in the BRWMA by serving as a "halfway house" between the wild and traditional holding facilities (e.g. zoos) 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.

We are a member of the Mexican wolf species survival plan (SSP), and adhere to the guidelines that standardize captive management in both the US and Mexico. The SSP's mission is to contribute to MGW recovery through captive breeding, education, and research. The SSP uses several criteria to determine the eligibility of a wolf for release, including genetic makeup, reproductive performance, behavior, and physical suitability. It is important that release candidates exhibit natural behaviors, especially fear and avoidance of humans. We therefore prevent socialization or habituation of wolves at the LRWMF. In accordance with SSP recommendations, we reinforce the wolves' natural avoidance behavior to humans by providing privacy and as little disturbance as possible. This includes minimizing captivity time and avoiding contact with humans during husbandry and maintenance events.

Strategies to achieve successful wolf release to the wild are: (1) subjecting wolves to conditioned taste aversion treatment to deter them from feeding on domestic livestock, and (2) pairing and breeding wolves to "anchor" the released adults, with small pups, to the release area for improved monitoring and management.

MGWs produce pups once a year, generally breeding in February or March, with whelping of 2-6 pups occurring in April or May. Breeding pairs are carefully chosen using a number of

criteria, including genetics. Any paired wolves not chosen for breeding in a given year are separated during the breeding months, and wolves selected for pairing are brought together before the breeding season to allow time to bond. Pairing decisions are made during the annual SSP meeting in July, and wolves are shuffled between pens and facilities during the months following. Ideally, wolf transfers and pairings are completed by the end of the year.

Although not a holding facility for breeding pairs since 2007, the LRWMF has played an important role in the overall program as a holding facility for non-breeding wolves that need to be separated during breeding season, and as a receiving facility for wolves removed from the wild due to nuisance behaviors.

Project Activities in 2014:

Wolves held at LRWMF in 2014

A total of 13 wolves were housed at the LRWMF in 2014 (Table 8.1), with a maximum of seven wolves at the facility at any one time.

During the 2014 breeding season, the LRWMF received four wolves from the wild: F1056 and M1344 were captured because they were implicated in livestock depredations, and M1282/F1295 were temporarily placed in captivity because the pair had established territory outside of the BRWMA - an offense that requires capture and return to within the boundaries of the BRWMA. As the pair was discovered just prior to breeding season, they were held at the LRWMF with the goal of releasing the whole family after the pups were born. However, it appears that F1295 did not become pregnant in 2014. The pair was released back into the BRWMA in June.

Table 8.1. Management of wolves at the LRWMF in 2014.

Wolf ID	Arrived at LRWFM from:	Left LRWMF to:
F1126	Blue Free Acc	SWMF, then BRWMA
M1051	Blue Free Acc	SWMF, then BRWMA
F858	BRWMA, then SWMF	SWCC
M1133	SWMF	NY WCC
F1056	BRWMA	Still at LRWMF
M1344	BRWMA	Still at LRWMF
F1295	Outside of BRWMA	BRWMA
M1282	Outside of BRWMA	BRWMA
F1226	SWMF	SWMF
M1130	SWMF	SWMF
F1202	SWMF	Mexico
M1274	SWMF	Mexico
M1228	CWC	SWMF

Former LRWMF residents in the wild

The alpha female of the Coronado pack (F1126) made history in 2014 after she became the first MGW whose pups were successfully cross-fostered into the wild (Figure 8a.1).

See story at:

- http://www.fws.gov/southwest/es/mexicanwolf/CEBRWRA.cfm

Figure 8a.1. The alpha male of the Coronado pack, M1051, with one of F1126's puppies. (Photo Courtesy: USFWS).

A second wolf pair (M1215/F1033) held at the LRWMF in 2013 also achieved fame in 2014 for becoming the first wild wolf pair living in Mexico to produce pups in over 30 years.

See story at:

- http://phys.org/news/2014-07-mexico-litter-wolf-cubs-wild.html
- http://www.conanp.gob.mx/difusion/comunicado.php?id_subcontenido=710).

Food & feeding

Mexican gray wolves held at the LRWMF are fed a combination of foods recommended by the SSP. These are: Mazuri® Exotic Canine Diet (aka "kibble"), Central Nebraska classic canine diet (aka "carnivore logs"), and native prey species (e.g. mule deer, oryx, elk, and bison provided as meat scraps/bones salvaged from hunts on the Armendaris and Ladder ranches.

Observations

We regularly observed LRWMF animals to ensure their health and wellbeing. Informal observations took place during scheduled

feedings, where we obtained a visual of each animal and checked for signs of injury or illness.

Formal observations were made every 4 – 6 weeks from a blind positioned near the facility. No medical problems were documented for the 13 wolves held at the facility in 2014.

Health care (Figures 8a.2 and 8a.3)

All wolves received thorough health checks, vaccinations, and anti-parasite medication before arriving at the LRWMF. Similarly, all wolves removed from the LRWMF received deworming and anti-parasite medication (ivermectin, revolution, and praziquantel) before leaving the facility and received vaccinations as warranted. Both wolves in the facility at the end of December 2014 were current on their vaccinations and treatments.

Figure 8a.2. Vaccinating and collaring Coronado pack pups prior to their release in the BRWMA.

Figure 8a.3. USFWS wildlife personnel carry darted, muzzled, and hobbled M1282 from the helicopter to a processing station where he was examined, vaccinated, weighed, photographed, measured, and crated before being transported to the LRWMF.

Off-site Activities and Outreach

- We assisted with wolf captures and health checks at the SWMF.
- We assisted with transferring wolves to Mexico or from the BRWMA to captivity.
- We participated in a wildlife handling workshop at Wolf Haven International in Tenino, WA (October 27-30. 2014).
- We served as ground crew during helicopter surveys (March 27-29, 2014).
- We gave lectures about the MGW program to Ladder Ranch guests, and students.
- A wolf pair whelped pups in the wild in Chihuahua, Mexico. Val Asher traveled to the region to train our Mexican counterparts in wolf trapping and handling (Figure 8a.4).

Figure 8a.4. The Mexican wolf recovery team in Mexico.

Future Activities & Considerations:

We plan on continuing our support of USFWS-led efforts to recover the MGW in the Southwest. In this capacity, we will continue to serve as caretakers of wolves deemed valuable o the program, and to assist with hands-on activities (captures, health checks, transfers, surveys, etc.). Moreover, the LRWMF is well situated to serve as potential host for wolf handling sessions, and to serve as a Mexican wolf breeding facility.

The USFWS recently made a number of changes to the rules, status, and recovery area of the MGW. These changes may increase the number of wolf releases in the coming years, which could be critical for improving the genetic diversity of the wild population. With this change in strategy the number of wolves moving through our facility might increase, thereby elevating the importance of the LRWMF to MGW recovery efforts.

8(b) Rocky Mountain gray wolf *(C. lupus)*

ESA listing: DELISTED in Montana

PROJECT STATUS:
Ongoing

Principal biologists:
Val Asher
Mike Phillips

Conservation Problem: Wolves continue to be a polarizing issue in the west, limiting expansion in its historical range.

Conservation Status:
- Delisted under ESA in 2011
- MT: listed as a "species in need of management"

Project Location: Flying D Ranch, MT

Project Partners: None

Project Funding:
- TESF/TBD

Project Goals & Objectives: To promote wolf persistence on the Flying D Ranch, and to understand their relationship with ungulate prey.

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 nine years with the daily implementation of wolf recovery and management. With delisting imminent, our efforts shifted in 2010 to the Flying D Ranch, where we now focus on promoting the ranch's wolf population and understanding how they affect the bison ranching and elk hunting operations.

Due to the successful gray wolf recovery program that we were a party to, wolves are now widely distributed in the northern Rocky Mountains. After some legal wrangling, which involved wolf delisting then relisting, wolves were finally delisted in Montana in April 2011, and reclassified statewide as a "species in need of management." This designation allows for flexibility in managing wolves while addressing wolf-livestock conflicts.

In 2009, MTFWP implemented a wolf harvest with a quota of 75 wolves, which was met. Due to litigation, the wolf harvest was postponed in 2010. In 2011 the state set a quota of 220, with 166 wolves harvested by the end of the season. The quota remained the same for 2012 with 225 wolves harvested by seasons end. In 2013, wolf tags were available at five per hunter with no wolf management area quotas set, except for areas around Yellowstone and Glacier National Parks, and in that year 150 wolves were harvested statewide. In 2014, the state removed quotas around Yellowstone and Glacier National Parks and allowed up to five tags per person in those areas as well, with a resulting 2014 statewide wolf harvest of 132.

Project Activities in 2014:

Wolf population on the Flying D Ranch

Prior to 2001, single wolves had been known to travel through the Flying D, but it was not until 2002 that the Beartrap pack established a territory that included the ranch. The pack was reduced to about three wolves in 2004 after a control action took place near Ennis Lake in response to livestock depredations. At its peak in 2011, this pack comprised 24 wolves making it a notable large pack. A total of 22 wolves occupied the ranch in 2014, but is now split into two groups. The Beartrap pack consists of 17 individuals and the Tanner Pass pack, a total of 5 individuals (Figure 8b.1). Both packs occupy the ranch, although the smaller Tanner Pass pack spends most of their time on the south and west sides of the ranch and adjacent National Forest.

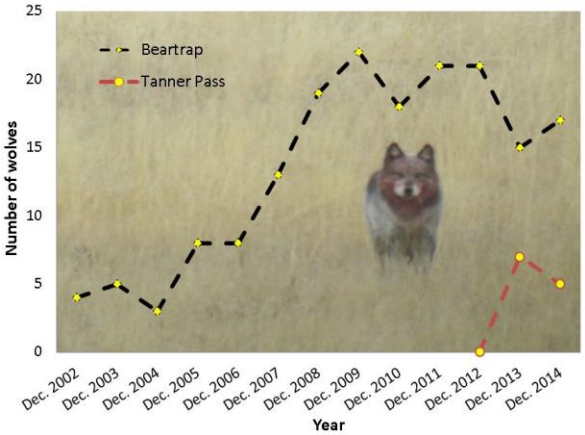


Figure 8b.1. Numbers of wolves in the original Beartrap pack and the newer Tanner Pass pack that occupy the Flying D Ranch.

Wolf predation study on the Flying D Ranch

A total of 898 carcasses were investigated on the Flying D from 2010-2014. Known causes of prey mortality included bloat, fence mishaps, culling by ranch staff, hunter or rut wounded animals, and predation. Cause of death was determined by skinning out the carcass to examine for hemorrhaging under the skin, bite marks and feeding pattern. Categories used to classify suspected cases of wolf predation were "confirmed", "suspected", and "unknown". Due to a small sample size confirmed and suspected were combined to look at prey composition.

A total of 291 predator kills were documented from 2010-2014. 204 were attributed to wolves, while the remainder comprised kills by: coyotes (48), mountain lions (8), bobcats (2), bears (5) and unknown predators (24). A breakdown of the number of confirmed and suspected wolf kills during this time period reveals that wolves were likely responsible for killing 135 elk, 51 bison, 12 white-tailed deer (WTD), 2 moose and 3 coyotes (Figure 8b.2).

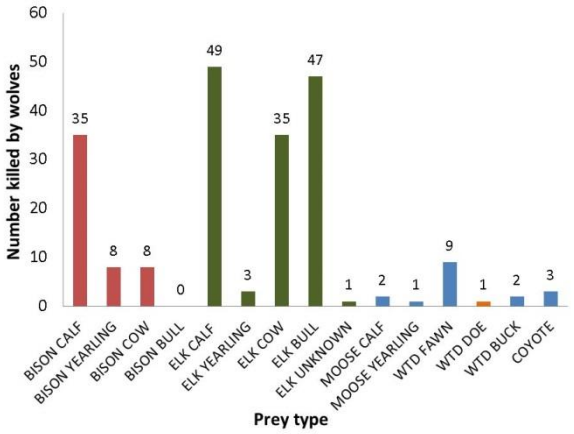


Figure 8b.2. Confirmed/suspected wolf kills.

One generalization that tends to hold true for most wolf-prey systems is the tendency for wolves to select prey that are disadvantaged such as young, old, sick/injured, or weak individuals. Age, health, environmental traps, maternal behavior and injuries also influence an animal's predation risk.

Concerning predisposition to predation, we evaluated the health of prey species by looking at femur marrow of elk and deer killed by wolves. In wildlife, the femur has been used as a standard when evaluating bone marrow fat content. The femur is used because it is readily obtained, has large marrow content, an abundant blood supply, and is one of the last fat sources to be utilized. The bone marrow of a normal healthy animal is solid, white and waxy due to the high fat content. In a state of malnutrition, the bone marrow is red, solid, and slightly fatty to the touch. In an advanced state of starvation, the bone marrow is red to yellow, gelatinous, and glistening and wet to the touch due to the high water content. Femur marrow of prey species were collected and categorized as "white/waxy", "red/firm" or "red/gelatinous" (Figure 8b.3). Of the 147 elk and deer kills, marrow was collected from 129 carcasses. Of the 125 (says 129 above) samples (68%) of deer and elk were in marginal to poor health condition.

Figure 8b.3. Femur marrow helps determine the condition of a prey species.

Bison

Bison are the dominant ungulate on the Flying D, estimated at 3300-5400 individuals over the last four years. With a bison population almost twice as large as that of elk, we can

assume that encounter rates between bison and wolves are higher than encounter rates between elk and wolves. However, with the data collected to date, wolves appear to be more successful at killing elk, or are actively selecting elk to prey upon (Figure 8b.4).

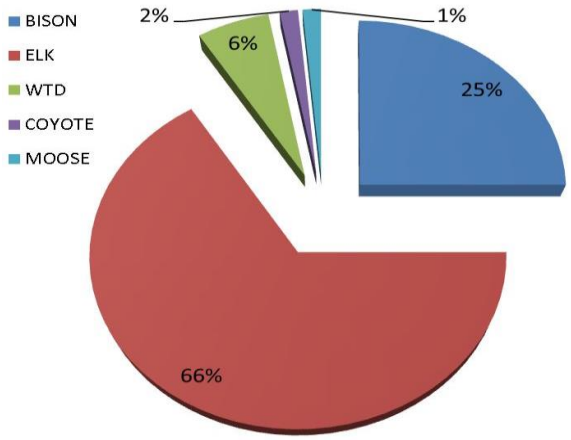


Figure 8b.4. Percentage of wolf kills by prey species.

For bison, calves (68%) were most often preyed upon followed by yearlings (15%), and cows (15%). We have not seen wolves preying on bull bison. Given their large size, herd behavior, and willingness to confront predators, healthy adult bison are relatively immune to wolf predation. Bison calves are less vulnerable to predators than elk calves due to adult group defense. The testing of bison by wolves has been observed numerous times on the ranch. When wolves are near, cow bison tend to stand still with a head/tail up posture, or initiate a group defense with calves in the middle and cows facing outward. We have also seen cows with no calves charge wolves while cows with calves used the distraction to vacate the area. Bison are usually aware of when wolves are in the vicinity, often observing the wolf as it passes through the herd, without exhibiting defensive or escape behaviors (Figure 8b.5).

Figure 8b.5. Encounters between wolves and bison are numerous, though do not always lead to testing or a predation event.

Body language of each species likely plays a central role in the outcome of encounters. Bull bison have been observed in a head/tail up position in response to wolf presence, but most often continue to graze with wolves several meters from them. The most notable reaction of a bull bison to wolf presence, that we have observed, occurred when bulls are resting. In this circumstance, wolf presence (estimated to be within > 10m) causes the bull to get to its feet. Studies have shown that wolf predation of adult bison typically occurs when extenuating factors (e.g., injury, depleted energy reserves due to a hard/long winter, old age, etc.) have predisposed the bison to predation.

Our efforts to monitor the bison herd increased in 2011-2014 when we had one to three individuals riding pastures an average of five days per week. Detection of smaller prey items like calves is challenging since they can be consumed quickly and completely. Thus, our count of wolf-killed fawns and calves is a minimum estimate. In 2014 we analyzed four years of wolf scat data. Elk were the main food source for wolves, which coincided with our kill data (Figure 8b.6). 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 leading us to believe that bison are the best livestock type to be ranching in wolf country. Moreover, in 2013and 2014, the ranch had unusually high production of bison calves despite the fact that two wolf packs occupied the ranch throughout these two years.

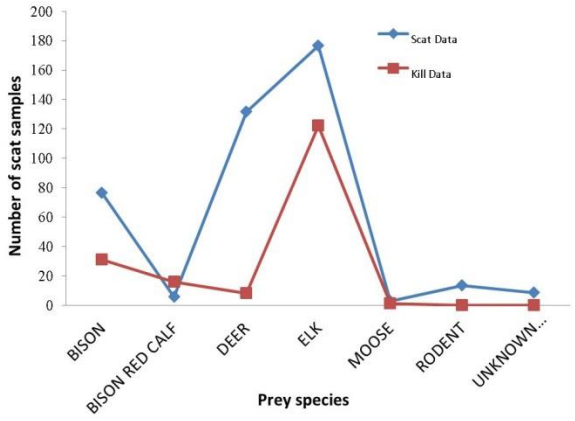


Figure 8b.6. Comparison of wolf scat data to observed verified wolf kills.

Elk

The Flying D's elk population has ranged from 1,100 – 2,400 since wolves established there. These numbers have remained relatively stable over the last few years, with small elk groups usually spending part of the winter on neighboring ranches. There now appears to be a trend of larger elk groups leaving the ranch during the winter, influencing our annual counts (Figure 8b.7). These larger group movements began in 2010, alternating years until 2013/2014 when the majority of the Flying D's resident cow herd moved north across highway 84. We suspect that wolves are influencing this trend along with factors such as herd knowledge, varying winter conditions, logging activity, and forage conditions on neighboring ranches. Including elk that are north of the ranch, population estimates range from 2,600 – 2,700.

Wolf predation on elk in 2014 comprised 35% bulls, 36% calves, and 29% cows. In comparison more deer fawns (75%) were killed than adult deer (25%).

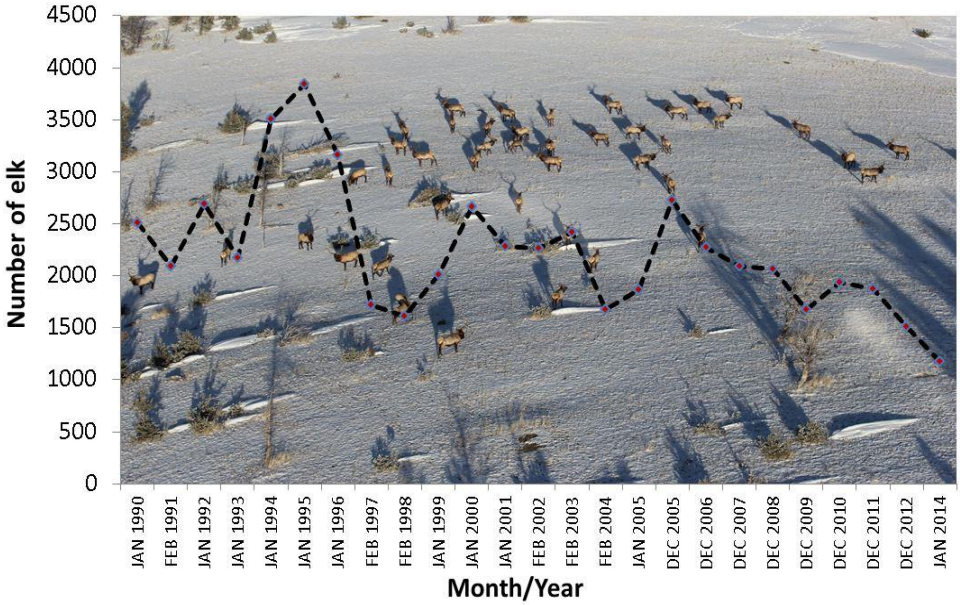


Figure 8b.7. Elk abundance estimates on the Flying D provided by the Flying D and Montana Hunting Company.

Research suggests that wolves can influence elk herd sizes and habitat use, and FWP consider wolves to be a major factor affecting elk populations and hunter success. A study in the Gallatin Canyon reported smaller elk group sizes and presence closer to vegetative cover when wolves were present compared to when wolves were absent. Other studies have found no effect of wolves on herd size. On the Flying D, we see both large and small herds, but data suggests that these differences in group size correlate better with seasonal changes rather than wolf presence.

In the spring 2014 we assisted FWP with the deployment of GPS collars on cow elk as part of a brucellosis study. The goal of the study is to understand disease dynamics between and within elk populations, and how elk movements may facilitate spread between populations and the risk to livestock. Though wolves are not part of this study, the movement data, as seen from one collared elk whose collar dropped prematurely, (Figure 8b.8) we may acquire some insight on how cow elk on the Flying D are moving in space and time. Collars are expected to drop in January 2015.

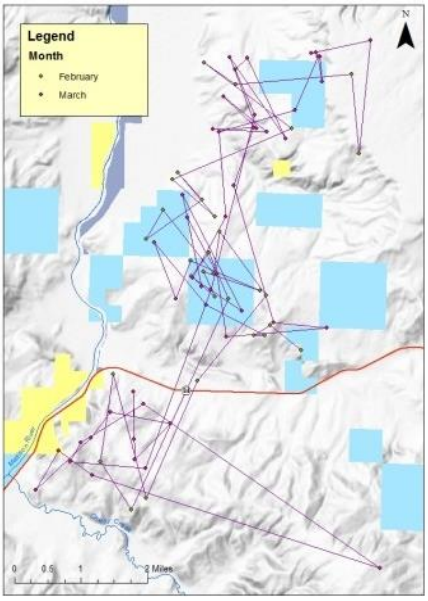


Figure 8b.8. Movements of a cow elk captured north of the Flying D ranch in January 2014.

Future Activities & Considerations

- We are investigating the use of a wolf vocalization software program to identify animals at the individual level. This effort may give insight to the immigration/emigration of individuals to the Flying D over time. In addition, this could be a useful tool to see if individuals of each pack are visiting one another, which has been difficult to achieve visually.
- We will continue to assist National Geographic with their 100 year celebration of the Greater Yellowstone area. This issue should be published in November 2015.
- We will assist Audio Acoustics with building a library of western sounds for Montana State University.
- There was some speculation that wolves were a primary factor of the 2011 mycoplasma outbreak in the bison herd. A fecal cortisol (stress hormone) study was initiated by Dr. Dave Hunter. Preliminary results showed that wolves were not a significant factor to bison stress. We suspect that having to work the bison in the corrals twice in 2010 proved to be a more likely stress factor. We will continue to collect fecal samples from cow bison who have had known encounters with wolves. We hope to measure the duration of elevated and decreasing hormone levels over time after an encounter.

8(c) Southern Rockies gray wolf *(C. lupus)*
ESA listing: ENDANGERED

PROJECT STATUS:
Ongoing

Principal biologist:
Mike Phillips

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 (Figure 8c.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.

Figure 8c.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 (Figure 8c.2). A 2001 opinion poll revealed that 71% of Coloradans supported wolf restoration. Majority support was widespread among various demographic groups.

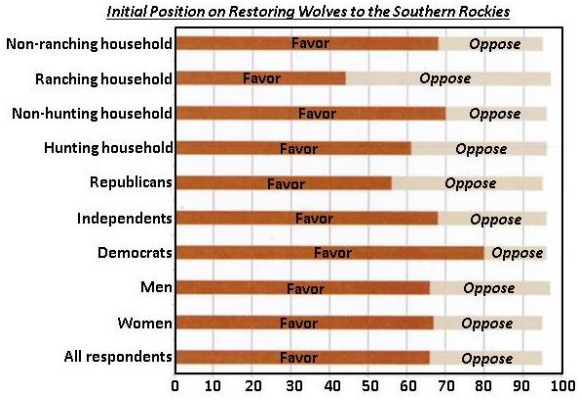


Figure 8c.2. Results of a 2001 public opinion survey revealed widespread support for restoring wolves to the Southern Rockies. Source: Decision Research, 2001.

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 2014: TESF hired noted pollsters Bob Meadow (Lake Research Partners) and Lori Weigel (Public Opinion Strategies), and top election law attorney Mark Grueskin (Recht Konrnfed, PC) to develop, conduct, and interpret a non-partisan public opinion poll concerning a state led effort to restore the gray

wolf to western Colorado. The live-interviewer, 19-minute phone survey among 600 likely Colorado voters in the November 2016 election was conducted in February.

Voters said that the wolf, although needlessly exterminated from Colorado long ago, is part of the state's heritage and natural landscape. **Voters want to see wolves back in Colorado**. In the simplest of terms, voters were asked whether they favor or oppose re-establishing wolves in Western Colorado. In response, nearly two-thirds (64%) said they favor re-establishment (Figure 8c.3).

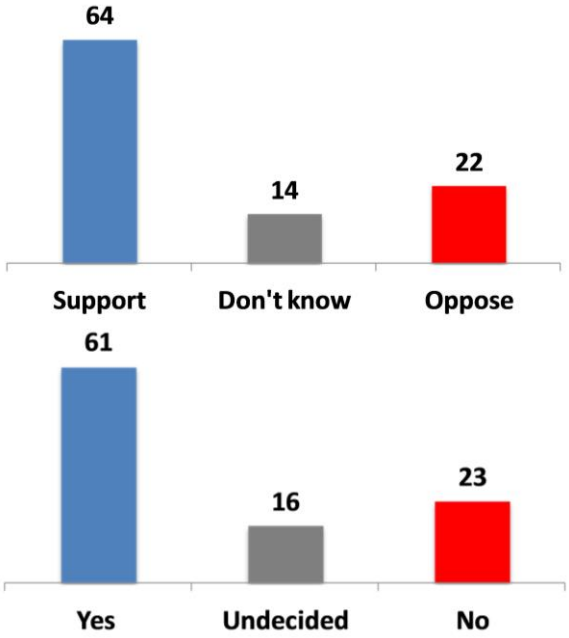


Figure 8c.3. Top: Support or Oppose re-establishing wolves in western Colorado. Bottom: Combined wolf restoration ballot measure.

Support for restoration is more than a concept among voters, it is an important value and most would use their vote to promote that value. There is majority support for re-establishment across every demographic group, including men and women, Republicans, Democrats, and independents, every age group, and hunting and non-hunting households. There is majority support in every region of the state, including the rural Western Slope.

Due to the USFWS's chronic insistence that there is no mandate per the ESA to restore wolves to the SRE, a state led effort now represents the most viable option for advancing the idea. Given the favorable biological and socio-political attributes of Colorado for large carnivores and the allure of restoring a wolf population that stretches from the high arctic to the Mexican border, we are keenly interested in advancing the idea.

A successful state led effort on behalf of gray wolves would also have value by reminding the conservationists that approaches besides those based on federal legislation can advance important wildlife conservation matters (e.g., plains bison restoration in Montana).

The results of our survey are encouraging, and with adequate financial support advocates of re-establishment could implement a campaign capable of convincing a majority of Coloradans to support restoration. Defeating a restoration effort would require an anti-wolf opposition to outspend and out-communicate proponents.

The pronounced level of public support and other favorable factors make clear that the next two years are ideal for launching research and educational efforts to advance the wolf's return to the wildlands of Colorado.

If the path for restoring gray wolves is successfully navigated, restoration to Colorado will flow as water down a hillside. A wolf population there would serve as the last piece of a 40-year puzzle to reestablish the species from the High Arctic to Mexico. Nowhere else in the world is there such an opportunity to restore an iconic, yet maligned, animal at the continental scale. For those of who celebrate the importance of wild and self-willed nature, this is an opportunity we must seize.

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

Aldo Leopold

9. LESSER PRAIRIE-CHICKEN

Tympanuchus pallidicinctus
ESA listing: THREATENED

PROJECT STATUS:
Ongoing

Principal biologists:
Dustin Long
Carter Kruse

Conservation Problem: Species decline across its range due to habitat loss and fragmentation.

Conservation Status:
- Petition for federal listing in 1995 resulted in a finding of "warranted but precluded". Habitat and population losses since then led to federal listing as threatened in 2014.

Project Locations: Z Bar Ranch, KS

Project Partners:
- Western Association of Fish and Wildlife Agencies (WAFWA)
- Natural Resources Conservation Services
- Kansas Department of Wildlife, Parks and Tourism
- U.S. Fish and Wildlife Service

Project Funding:
- TESF
- Turner Enterprises Inc. (TEI)
- Western Association of Fish and Wildlife Agencies

Project Goals & Objectives: To support TEI in returning the mixed grass prairie of the Z Bar to conditions suitable for lesser prairie-chickens (Figure 9.1), and to enhance populations by managing for a mosaic of breeding, nesting and brood rearing habitats, through:
- Frequent prescribed fire to improve brood rearing habitat and control woody vegetation.
- Mechanical removal of woody vegetation (e.g. eastern red cedar (*Juniperus virginiana*)) from uplands to limit avian predation and enhance lesser prairie-chicken habitat (Figure 9.2).
- Implementing a grazing strategy which results in a mosaic of lightly grazed pastures with robust standing vegetation (nesting habitat) and heavily grazed pastures with minimal standing vegetation (breeding sites).

Figure 9.1. The lesser prairie-chicken.

Figure 9.2. Mechanical removal of invasive eastern red cedar trees and other woody vegetation.

Project Background: The lesser prairie chicken project is our newest project, and in late 2014 TESF and TEI finalized a10-year lesser prairie-chicken conservation plan with WAFWA for which the Z Bar will be compensated to manage for lesser prairie-chicken habitat. This agreement requires implementation of prescribed grazing and burning plans and brush removal in the uplands.

Future Activities & Considerations:

We will manage this new project adaptively to determine optimal management and survey strategies. At a minimum, in 2015 we will:
- develop and implement a grazing plan,
- develop a prescribed fire plan (implementation dependent on weather and fuel conditions),
- begin upland woody vegetation removal,
- establish long-term survey strategy,
- develop a vegetation monitoring plan, and
- consider developing a translocation plan to introduce birds from elsewhere to augment the ranch's population.

10. PLAINS BISON

Bison bison
ESA listing: NOT LISTED

PROJECT STATUS:
Ongoing

Principal biologist:
Mike Phillips

Conservation Problem: Wild plains bison are exceedingly rare.

Conservation Status: ESA – not listed; IUCN Red List – near threatened in 2008; state governments – some list species as livestock, others confer dual wildlife/livestock status.

Project Location: Plains bison historical range, with emphasis on Montana and the Rocky Mountain west.

Project Partners: Various state, federal, tribal, private, and non-governmental conservation organizations are actively involved in plains bison conservation

Project Goals & Objectives: To conserve wild plains bison without negatively impacting the bison livestock industry.

Project Background: The plains bison (Figure 10.1) once had the widest distribution of any large herbivore in North America, ranging from the arid grasslands of Mexico to the meadows of interior Alaska. By the late 19th century the species had nearly been driven to extinction. By then, wild bison only persisted in two locations: south of Great Slave Lake in what is now Wood Buffalo National Park, and in the remote Pelican Valley in the Absaroka Mountains.

While fitful conservation efforts throughout the 20th century prevented the species' total extinction, by the early part of the 21st century plains bison remained extiprated throughout all but a small fraction of its historical range.

Figure 10.1. American plains bison.

In May 2013, Mike Phillips secured support from Mr. Turner to take new steps to advance conservation of wild plains bison. Specifically, Phillips accepted an invitation to join the IUCN/SSC Bison Specialist Group. Such Groups, including several others that Phillips belongs to, are credible bodies of scientific and practical expertise on the target species or issue. The IUCN (International Union for the Conservation of Nature) is the world's oldest and largest environmental organization. An important arm of the IUCN is the SSC (Species Survival Commission) which is a large, science-based network of expert volunteers from nearly every country of the world. The SSC works to achieve "*A world that values and conserves present levels of biodiversity*." The IUCN/SSC Bison Specialist Group aims to improve the conservation status of wild bison.

Project Activities in 2014:

Since 2013 Phillips has also served on a bison discussion group convened by Montana Fish Wildlife and Parks (MTFWP). The group aims to help MTFWP improve the conservation status of wild plains bison in Montana. During 2014 Phillips attended two group meetings, one in July in Billings and one in October in Great Falls. Before and after the meetings Phillips worked with MTFWP and others to advance progress, which is slow but perceptible.

11. PRIVATE LANDS INITIATIVES

11(a) Western Landowners Alliance (WLA)

PROJECT STATUS: *Ongoing*

Principal biologist: *Mike Phillips*

11(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)** Global

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, gone forever, leaving humanity slightly more impoverished. From food to medicines to important ecological services that are provided free of charge – like soil formation, flood control, water purification, and pollination of flowering plants – it is the wondrous diversity of life that sustains humankind. To illustrate the global scale of this issue, the IUCN Red List of Threatened Species contains 55,926 species, of which at least 18,351 are threatened. Of these, over 1,000 occur in the U.S. Under the U.S. Endangered Species Act (ESA), 1,973 species are listed as threatened or endangered and several hundred others are being considered for listing. For Mexico, a mega diversity country only a fifth of the size of the U.S., 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 U.S. Endangered Species Act (ESA) contains many common sense components to promote the participation of private landowners such as through enrollment in programs such as 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 tracts of private land to serve as beachheads of security for imperiled species, and as strategic components of large scale conservation initiatives, have only grown more acute over the past 17 years. Anthropogenic pressures on wild places and species have increased and it is clear that the need greatly exceeds the capacity of solitary efforts or small-scale collaborations amongst landowners. Recruiting other owners of large tracts of land or convincing high net worth individuals to invest in land to join the fight to save vanishing species is an urgent task. To this end we have worked with other landowners and leading conservation scientists to help found the Western Landowners Alliance (WLA; Figure 11a.1).

At the national level, the WLA advances policies and practices that sustain working lands, connected landscapes, and native species. As such, the WLA 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.

Figure 11a.1. WLA founding group.

During 2013, Mike Phillips joined the Board of Directors of the WLA, and has since provided support to ensure the growth of the organization (details at www.westernlandownersalliance.org). In 2014, Phillips worked with the WLA on a variety of issues related to imperiled species conservation and improvement of restoration activities on federal land.

We realized that the ongoing work and successes that have been achieved by the WLA could be replicated at a global level, leading to the establishment of the Global Landowners Initiative for Conserving Imperiled Species (GLI). In 2014, Phillips worked to enlist the participation of the Renanti Recanati-Kaplan Foundation, Panthera, Orianne Society, Mohammed Bin Zayed Species Conservation Fund, and the E.O. Wilson Biodiversity Foundation (EOWBF) in this new endeavor.

Future Activities & Considerations:

In 2015 we will begin planning two pioneering gatherings to be held in 2016 to strengthen the establishment and forward momentum of the GLI. To maximize impact, these prestigious meetings could be held in Washington, D.C. and Mexico City, and would aim to create a community of landowners, scientists, governmental and non-governmental organizations, and inspiring leaders committed to redressing the extinction crisis by harnessing the potential of private land. This community would be challenged to gain the support of those willing to commit their land holdings, as well as their social and financial influence, to conserve the wondrous diversity of life upon which humanity depends (see early TESF information and planning document on page 62).

GLOBAL LANDOWNERS INITIATIVE FOR CONSERVING IMPERILED SPECIES

INFORMATION AND PLANNING FOR TWO PIONEERING GATHERINGS IN 2016

LOCATIONS: Washington, D.C. and Mexico City
AIM: To create a community of landowners, scientists, governmental and non-governmental organizations, and inspiring leaders committed to redressing the extinction crisis by fully exploiting the potential of private land.

INFORMATION:
Given the gravity of the extinction crisis, the inspiring role of private individuals and private land, and the involvement of luminaries, both gatherings would be extensively covered by national and international media thus magnifying their impact.

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

Initially a small team of conservation scientists and experienced administrators would be needed to assume responsibility for managing the myriad details and collaborations that would be required to maximize the benefits of each new project which would, of course, grow the momentum from the pioneering gatherings to catalyze yet more new projects.

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

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

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

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

By advancing the role of private lands in imperiled species conservation, willing landowners can act on the sentiment offered by E. O. Wilson: *there can be no purpose more inspiriting than to begin the age of restoration, reweaving the wondrous diversity of life that still surrounds us.*

12. 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 creating pronounced fragmentation.

Conservation Status:
- Listed as endangered under the ESA in 1973.

Project Location: Avalon Plantation is located in Jefferson County, Florida approximately 35 km east of Tallahassee (Figure 12.1). It is the southern-most plantation in the Red Hills physiographic region of north Florida and South Georgia. The plantation presents an excellent opportunity to restore the red-cockaded woodpecker.

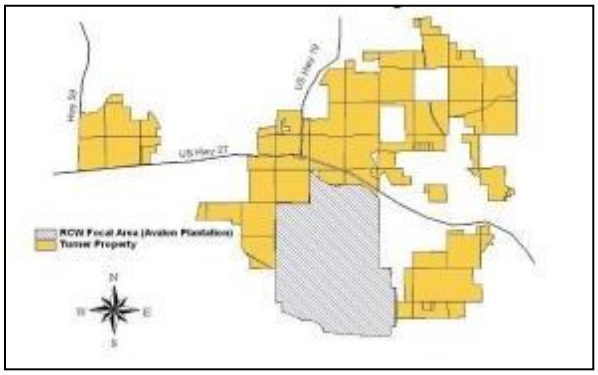


Figure 12.1. Avalon Plantation showing RCW project area.

Project Partners:
- U.S. Fish and Wildlife Service
- Florida Fish and Wildlife Conservation Commission

Project Funding:
- TESF
- U.S. Fish and Wildlife Service Wildlife Cooperative Enhancement Agreement - $7,500

Project Goals & Objectives: The goal of this project is to restore 20 – 25 breeding groups to the Avalon Plantation that can persist with minimal management. Once the population goal is achieved, it is TESF's intent for Avalon to become a donor site for the species' Southeastern Translocation Strategy.

To achieve these goals, 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:

The red-cockaded woodpecker (RCW) depends 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, and 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 and more recently has become stagnant. A comprehensive assessment of cluster status was undertaken in December 2011 and January 2012. It was determined the population consisted of 13 active groups, 2 inactive groups, and 7 abandoned groups (an abandoned group is defined as not showing any evidence of RCW activity for three years or more). However, by November 2014 the population had expanded to 15 active groups (3 previously abandoned groups have become active as a result of management activities in 2014) (Figure 12.2). Unfortunately, a previously active cluster went inactive during 2014.

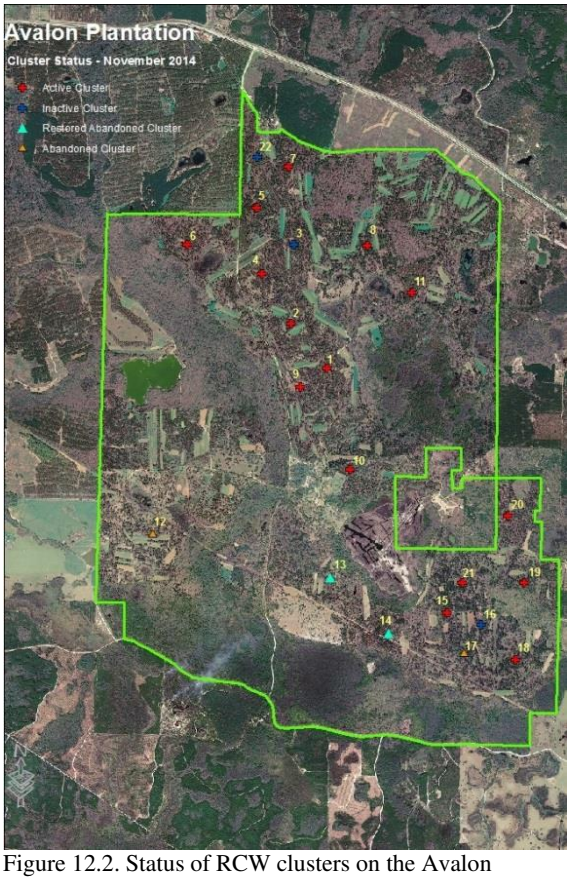


Figure 12.2. Status of RCW clusters on the Avalon Plantation in 2014.

Project Activities in 2014:

Artificial cavity construction

Due to the large diameter of trees on Avalon Plantation and their relatively young age (60 -70 years old) we exclusively use artificial cavities (inserts). We ensure that there are a minimum of four inserts in each abandoned and recruitment cluster. Abandoned cluster restoration occurs at the original location of the abandoned cluster site. On average, recruitment clusters are established in suitable areas (sparse understory <1 m, adequate foraging habitat, and spatial relationship to existing sites), and are normally located within 0.4 – 1 km of an established cluster.

Due to some significant weather events in 2014, a cursory cavity inventory was undertaken in advance of any abandoned cluster restoration or recruitment cluster formation. We found that five cavity trees were lost in three clusters in 2014 due to natural causes (wind, lightning or natural mortality). We installed supplemental cavities (Figure 12.3) in the three clusters to ensure that each cluster contained the required minimum of four suitable cavities.

Figure 12.3. Artificial supplemental cavity.

In addition, a single previously abandoned cluster was restored during 2014 (Cluster 14) (Figure 12.2). This cluster was restored at its original location, and involved the installation of four artificial cavity inserts.

Cavity tree Management

Cavity tree management is focused on identifying and protecting all cavity trees from prescribed fire and minimizing threats from other land management activities. All cavity trees (active, inactive and abandoned) were marked and mowed in advance of burning. Care was taken to minimize soil disturbance and compaction, while maximizing the removal of fuel loads. There remained enough fine fuels (pine needles, grass, etc.) to safely allow prescribed fire under the cavity trees. This approach to fuel management allows the fire to maintain a consistent burn throughout the area which effectively controls mid-story hardwood encroachment while protecting RCW cavity trees.

All clusters (active, inactive and abandoned) were mowed in mid-February – early March in advance of the 2014 burning season (Figure 12.4). Approximately 44 acres were mowed during the reporting period (2 acres/cluster). No cavity tree mortality or scorch was experienced throughout the entire burning season. In addition, all cavity trees were marked (pink flagging) throughout the entire property, and prior to any activity within or near cluster sites, operators were reminded of the location of cavity trees.

Prescribed fire

Approximately 65% of the property was burned during March and early April 2014.

Cluster monitoring

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

Figure 12.4. Top image shows a cavity tree prior to mowing. Bottom image shows the same cavity tree after mowing.

13. RED HILLS WETLAND AND ASSOCIATED UPLAND HABITAT RESTORATION

PROJECT STATUS:
Ongoing

Principal biologist:
Carter Kruse
Dustin Long

Conservation Problem: Agricultural development and eastern red cedar invasion leading to wetland loss and grassland fragmentation, with a likely corresponding decline in biological diversity.

Project Location:
Z Bar Ranch – Barber County, KS

Project Partners:
- US Fish and Wildlife Service

Grant Funding:
- 2014 Partners for Fish and Wildlife ($24,666)
- 2014 Kansas Grazing Land Coalition ($6,420)

Project Background & Objectives:

The Red Hills physiographic region, located in south central Kansas, contains the second largest tract of native prairie remaining in KS (behind the Flint Hills region) and provides habitat for a number of wildlife species dependent on native grassland. Unfortunately, land management practices (e.g., agriculture, degraded rangelands), development, and invasive species (e.g., eastern red cedar), have fragmented the native prairie and lead to the decline of many grassland obligate species such as the lesser prairie-chicken (see Section 9), which have dropped over 90% in number since the 1800's. Wetlands in the Red Hills, while never large in extent provide important habitat for shorebirds, wading birds, and waterfowl in the central flyway. These habitats have declined with agricultural development in the Red Hills.

The US Fish and Wildlife Service Partners for Fish and Wildlife Program in KS has listed the Red Hills as a focus area for upland, wetland, riparian, and river restoration. In 2013 TBD initiated conversations with administrators of the Partners Program about restoring a 65 acre wetland site located in an abandoned oxbow along the Salt Fork of the Arkansas River (Figure 13.1). The wetland site had previously been drained and farmed prior to Turner ownership, and is strategically located between the Salt Plains and Quivira NWR. The objectives of this project include: a) restoring and managing a wetland complex of up to 65 acres; b) developing up to 287 acre-feet of ground water rights to support wetland management; and c) improving rangeland conditions on around 3,000 acres of grassland surrounding the wetland by installing an additional livestock drinker; controlling eastern red cedar; managing grazing; and controlled burning. The project should benefit both wetland and prairie species and is a companion effort to our work on lesser prairie chickens (Section 9).

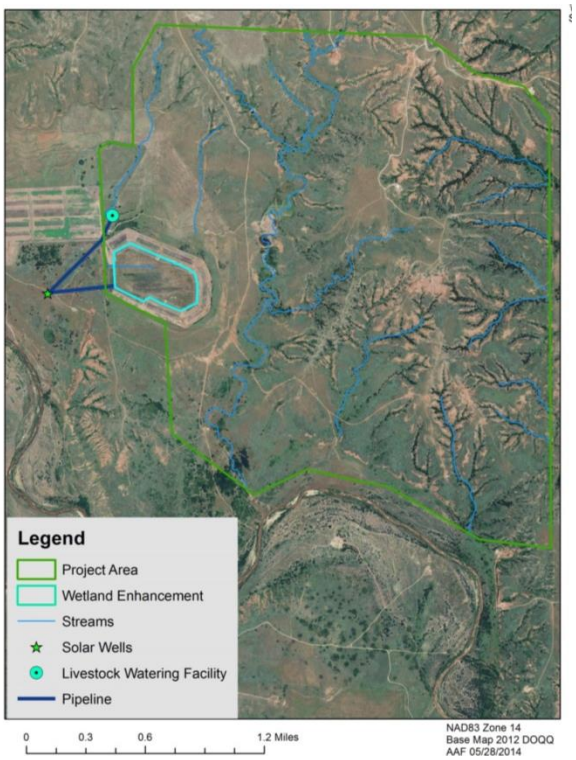


Figure 13.1. Location of the proposed wetland and upland restoration on Z-Bar Ranch.

In 2013, we applied for a permit to drill three ground water wells to augment flow from an existing well near the wetland site (Figure 13.2). Water produced by these four solar pumped wells will be used to provide livestock watering at multiple sites and to augment natural runoff into the wetland basin.

Figure 13.2. Initial, solar pumped, groundwater well near the wetland basin in February, 2013. Wetland basin located in background of picture.

Project Activities in 2014: In June the Kansas Department of Agriculture, Division of Water Resources approved our application to install three additional groundwater wells near the wetland and pump up to 287.08 acre-feet of water for recreational (wetland) use. The USFWS Partners Program agreed to cost share $31,086 of the project. The Z Bar Ranch drilled three additional groundwater wells, and installed solar pumps and new pipelines to wetland and drinker sites, as well as a water metering device. By late fall, initial test pumping of water to the wetland was implemented. The test water allowed a visual assessment of how water would flow across the wetland basin. These initial pumping results will be used to develop a wetland infrastructure (dikes and water control structures) and management (seasonal flooding) plan that will be implemented in 2015 (draft shown in Figure 13.3).

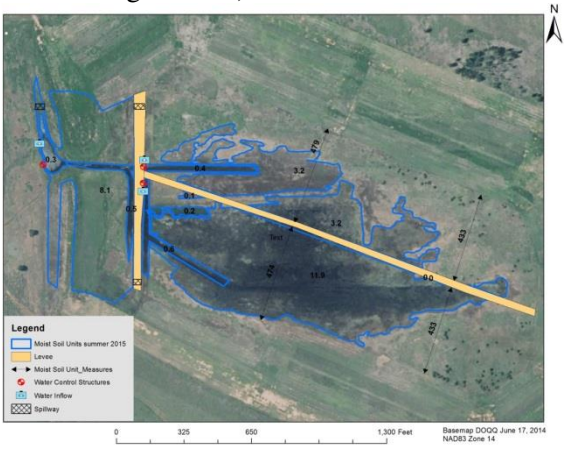


Figure 13.3. Draft wetland infrastructure plan.

14. SANDHILLS WETLAND/WET MEADOW HABITAT

PROJECT STATUS:
Ongoing

Principal biologists:
Carter Kruse
Eric Leinonen

Conservation Problem: Loss of Sandhills wet meadow and wetland habitat due to ditching and draining for hay and grazing production. Perhaps as much as 40% of Sandhills wetlands have been lost due to agricultural development.

Project Location:
McMurtrey Ranch – Cherry County, NE

Project Partners:
- US Fish and Wildlife Service
- NE Game and Parks Commission
- Sandhills Task Force

Grant Funding:
- 2014 Partners for Fish and Wildlife ($15,000)
- 2014 Native Ecosystem Project Grant ($60,000)
- 2014 NE State Wildlife Grant ($100,000)

Project Background & Objectives:

The Sandhills Region of north-central Nebraska encompasses 19,600 square miles of grassland, and contains vast surface and groundwater resources. The grass covered sand dunes of the region act like giant sponges that absorb precipitation, which is then discharged as streams, wetlands, and wet meadows in interdunal valleys. Around 1.3 million acres of wetlands (Figure 14.1), formed by groundwater discharge, are scattered throughout the region, supporting a rich ecological diversity.

Figure 14.1. A typical Sandhills perennial wetland.

Beginning in the early 1900's, draining and ditching of wetlands and wet meadows became commonplace as ranchers looked to increase grass production and develop hay meadows (Figures 14.2 and 14.3). With drain installation, the hydrologic balance between groundwater and surface wetlands becomes disrupted. With drained wetlands no longer buffering groundwater discharge, a continual flow of water occurs into drains and natural streams. With added flow, channels become incised in the fine soils, capturing more ground water, lowering the local water table and ultimately reducing productivity of the surrounding area. In this way, an around 40% of wetland habitat have been lost to agricultural development.

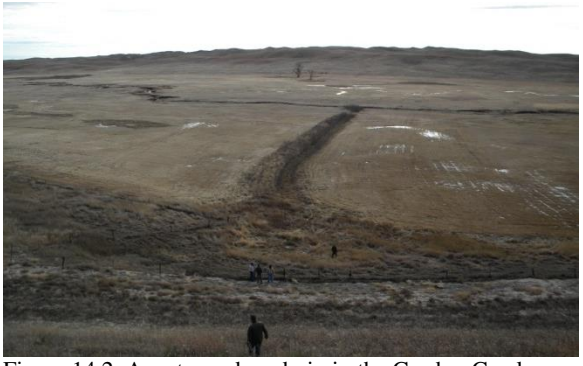


Figure 14.2. A wet meadow drain in the Gordon Creek project area. The drain was installed years ago to allow development of hay and pasture land along Gordon Creek.

Figure 14.3. Gordon Creek within the project area showing the down cutting of the channel bed due to draining and ditching of wetlands and the stream in the project area.

A Sandhills Task Force (STF), made up of interested and diverse natural resource and ranching stakeholders, was formed in 1990 with a goal "*to enhance the sandhill wetland-grassland ecosystem in a way that sustains profitable private ranching, wildlife and vegetation diversity, and associated water supplies*" – a goal that mirrors the mission of Turner Enterprises, Inc. One strategy of the STF is to provide technical and financial assistance for improvement and restoration of wetlands, riparian habitat, and upland habitats in the Sandhills. After several months of informal discussions, we partnered with STF in 2014 to restore around 4 km of Gordon Creek to a more natural (prior to ditching and draining) channel alignment and streambed elevation, which will improve or restore approximately 140 ha of associated wetland and wet meadow habitat in the Gordon Creek valley bottom (Figure 14.4). If successfully implemented, this project will be the largest Sandhills stream and associated wetland restoration projected ever completed.

Figure 14.4. Channelized sections of Gordon Creek (dark line) will be realigned to a meander pattern (red line). The creek bed will be raised to elevate groundwater levels and fill wetland basins (shown as lighter shades of green).

Project Activities in 2014:

Several field planning visits were conducted at the site in 2014, but activities over the past year focused on completing a project design, navigating permitting requirements, and finalizing agreements and contracts. A near final project design was completed in August (Figure 14.4), allowing the project to go out for bid. Due to the remoteness of the project location and availability of work elsewhere, only three contractors attended the site and bid meeting, and only one contractor submitted a reasonable bid. A Partners Agreement among USFWS, STF, and TBD, that includes financial commitments, was drafted in August but signing was delayed until December to allow for resolution of permitting questions. Earthwork was to be initiated in October, but was pushed to 2015 due to contracting and agreement uncertainties.

15. WESTERN PEARLSHELL MUSSEL

Margaritifera falcata
ESA listing: NOT LISTED

PROJECT STATUS:
Ongoing

Principal biologists:
Carter Kruse
Eric Leinonen

Conservation Problem: Range-wide declines are thought to be primarily due to water quality concerns (sedimentation, agricultural run-off, increasing temperatures), habitat fragmentation (dams, water diversion), and declines or loss of suitable host fish species (native salmonids).

Conservation Status: Historically found across the northwestern US, the species remains widespread in geographic area, but regional and localized declines are concerning. Idaho, Oregon, California, and Montana all consider the species either potentially at risk or at risk due to limited or declining population numbers (S2 or S3 NatureServe Conservation ranking). The species is likely extinct in Utah. Numbers appear more secure in Washington, but declines are suspected. The US Forest Service Region 1 considers it a Sensitive Species and Montana Fish Wildlife and Parks has designated it a Species of Greatest Conservation Need.

Project Location: Southwestern Montana; Cherry Creek, Flying D Ranch, MT

Project Partners (integral to success):
- Montana Fish Wildlife and Parks
- David Stagliano

Project Funding:
- TBD

Project Goals & Objectives: The goal of this project is to establish a large and persistent population of Western pearlshell mussels (WPM) in Upper Cherry Creek that can provide individuals to other WPM restoration projects. This effort includes three primary objectives:
- To conduct the necessary research to establish WPM translocation and restoration protocols.
- To establish a reproducing population of > 250 WPM in upper Cherry Creek.
- To provide WPM for restoration elsewhere in the Madison basin.

Project Background:

The WPM is Montana's only cold water mussel and is found in streams with low to moderate gradient and stable sand/gravel substrates. They are primarily filter-feeders and strain organic matter out of the water column. Successful reproduction depends on the presence of suitable host fish. WPM glochidia (larvae) attach to the gills of a host fish and develop for several weeks before dropping off (Figure 15.1). Population persistence requires suitable habitat and water quality, males and females in close proximity, and presence of a host fish species.

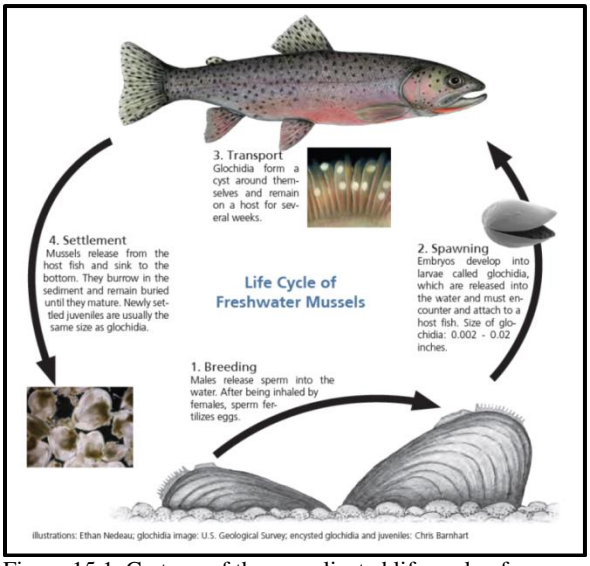


Figure 15.1. Cartoon of the complicated life cycle of western pearlshell mussel.

In Montana, the native westslope cutthroat trout (WCT) is the preferred host fish, although WPMs also use bull, brook and rainbow trout. As WCT populations have declined and habitat has been fragmented, WPMs have become at risk. WPMs can be relatively long-lived (50-60 years) and presence in a stream does not necessarily indicate population viability as many populations are now dominated by older individuals at risk of extirpation from stochastic events and lack of reproduction. In Montana, WPMs have experienced significant range reductions over the last 100 years and are currently known from about 85 populations, with only about 20 expected to be viable over the next century. Of 51 stream reaches recently

surveyed in the Madison River basin, only one (Duck Creek) had a viable WPM population; while lower Cherry Creek contains a small, old, declining population of WPMs.

The successful establishment of WCT in the upper 100 km of Cherry Creek on the Flying D Ranch provides a suitable backdrop against which to implement a WPM conservation effort. In 2012, TBD partnered with the Montana Natural Heritage Program to assess habitat suitability in the Butler and Cowboy Canyon reaches of Cherry Creek for WPM. Results suggested that multiple creek sections might support WPMs if the species was introduced.

Duck Creek or lower Cherry Creek are the only two WPM populations that are currently being considered for translocation to upper Cherry Creek, a disease free introduction site. In 2013, at least 50 salmonid fishes, a disease surrogate for WPMs, were collected from both these sites to verify disease status. Lower Cherry Creek tested positive for whirling disease, the pathogen of most interest, and Duck Creek was negative. Consideration has been given to quarantine and treatment of individuals to be translocated in order to clear or kill any diseases that WPM might carry between donor and introduction sites; however a quarantine period with bleach treatment has not worked well when tried on an experimental basis.

Alternatively, since larval WPMs are carried for several weeks by the host fish, perhaps adult WPMs do not have to be translocated to establish a new population, but rather "exposed" fish could be moved and the glochidia would fall off in the new habitat. To test this possibility, in 2013 TBD collected all visible WPMs in lower Cherry Creek and grouped those 43 remaining mussels in one location (Figure 15.2). Evidenced by lack of young WPMs, reproduction by WPMs has not occurred in lower Cherry Creek for at least two decades, likely due to the wide spatial distribution among individuals and lack of suitable host fish. By grouping the remaining mussels TBD hoped to encourage natural reproduction in Lower Cherry in 2014, but also provide a location to hold disease free cutthroat trout on a mussel bed and see if they are infected with glochidia.

Figure 15.2. Western pearlshell mussels placed in a "group" in lower Cherry Creek. Note the fish in the center of the image.

Project Activities in 2014:

Once daily water temperatures in lower Cherry Creek exceeded 10°C (June 30th, 2014) we introduced 75 naïve (never exposed to WPM) WCT into wire cages surrounding the lower Cherry Creek mussel beds – 22 mussels in one bed, 21 in another (Figure 15.3). WCT were examined on a weekly basis for presence of glochidia. A final check occurred in late August when 42 WCT were captured and removed from the cages. No glochidia were found on any WCT at any time, nor were any gravid WPM observed. Further, it appeared that the cages negatively affected WPM behavior, and perhaps reproduction, by slowing water velocities in the cages and increasing deposition of fines on the mussel beds. Only 11 and 17 WPM were visible in the two cages by the end of the experiment.

Much additional work needs to be conducted to better understand the disease risks associated with WPM and how to translocate the species. TBD and the project partners will continue to work on developing appropriate translocation techniques, including conducting a similar exposure experiment in Duck Creek in 2015 and looking outside the Madison River drainage for WPM source populations.

Figure 15.3. Cages used to hold juvenile westslope cutthroat trout on the mussel beds in 2014.

PUBLICATIONS IN PRESS OR PUBLISHED IN 2014

Blackburn, J., **Asher, V.J.**, Stokke, S., **Hunter, D**., and Alexander, K.A. 2014. Dances with Anthrax: Wolves (*Canis lupus*) Kill Anthrax Bacteremic Plains Bison (*Bison bison bison*) in Southwestern Montana: Journal of Wildlife Diseases, 50(2):393–396

Carroll, C., D. J. Rohlf, Y. Li, B. Hartl, **M. K. Phillips**, R. F. Noss. 2014. Connectivity conservation and endangered species recovery: a study in the challenges of defining conservation-reliant species. Conservation Letters. (online Early View).

Edwards, T., E. Canty-Cox, V. Buzzard, **C. Wiese**, L. S. Hillard, R. W. Murphy. 2014. Genetic assessments and parentage analysis of captive Bolson tortoises (*Gopherus flavomarginatus*) inform their "rewilding" in New Mexico. PLoSOne 9(7).

Phillips, M. In press. Are gray wolves still endangered? International Wolf, 25:14-16.

Sasmal, I., K. Honness, K. Bly, **M. McCaffery**, K. Kunkel, J. A. Jenks, and **M. K. Phillips**. In press. Release method evaluation for swift fox reintroduction at Bad River Ranches in South Dakota. Ecological Restoration.

Smith, J. B., D. Walsh, E. Goldenstein, Z. Parsons, R. Karsch, J. Stiver, J. Cain III, K. Raedeke and J. Jenks. 2014. Techniques for Capturing Bighorn Sheep Lambs. Wildlife Society Bulletin 38(1):165-174.

Sweikert, L., and **M. Phillips**. In press. The effect of supplemental feeding on the known survival of reintroduced aplomado falcons: implications for recovery. Journal of Raptor Research.

Turner, T.T., M.J. Osborne, M.V. McPhee, and **C.G. Kruse**. 2014. High and dry: intermittent watersheds provide a test case for genetic response of desert fishes to climate change. Conservation Genetics. (online Early View).

Wiese, C. and L. S. Hillard. 2014. Restoration of the bolson tortoise in the northern portion of its prehistoric range. In P.S. Soorae, ed. Global Re-introductions Perspectives: 2015. More case studies from around the globe. Gland, Switzerland: IUCN/SSC Re-introduction Specialist Group.

Yablonski, K. K. 2014. Cherry Creek Revisited. The efforts of Turner Enterprises and the Montana Fish, Wildlife and Parks prove successful with the Westslope cutthroat. Big Sky Journal. February 2014.

PUBLICATIONS IN PREP OR REVIEW IN 2014

Andrews, T.C., B.B. Shepard, A.R. Litt, **C.G. Kruse**, M.L. Nelson, and P. Clancey. In review. Performance of juvenile cutthroat trout translocated as embryos from five populations into a common habitat. North American Journal of Fisheries Management.

Hubert, W.A., **C.G. Kruse**, J. Skorupski, J. Jacobi, and K. Patten. In prep. Macroinvertebrate response to rotenone application in two New Mexico streams. Intended journal: PLoSOne.

Kruse, C.G., K. Patten, E. Leinonen, and A. Burgad. In prep. A comparison of salmonid population structure before and after native cutthroat trout restoration. Intended journal: Biological Conservation.

Sasmal, I., and **M. K. Phillips**. in prep. Swift Fox Reintroduction at Bad River Ranches, South Dakota, USA. In P. Soorae, ed. Global Re-introductions Perspectives: 2015. More case studies from globe. Gland, Switzerland: IUCN/SSC Re-introduction Specialist Group.

Sweikert, L., and **M. K. Phillips**. in prep. Reintroducing captive bred juvenile northern aplomado falcons to south-central New Mexico, USA. In P. Soorae, ed. Global Re-introductions Perspectives: 2015. More case studies from globe. Gland, Switzerland: IUCN/SSC Re-introduction Specialist Group.

PRESENTATIONS IN 2014

Asher, V.J. 2014. Update on Flying D wolves. Turner Foundation meeting. June.

Burgad, A., C. Williams, and **C. Kruse**. 2014. Recovery of a restored native cutthroat trout population after watershed renovation. Poster Presentation, 2014 Annual Meeting, Dakota Chapter of the American Fisheries Society, Chamberlain, SD. February 25-27.

Clancey, P., **C. Kruse**, and B. Shepard. 2014. The Cherry Creek, Montana, westslope cutthroat trout introduction project: the impetus for a paradigm shift within 20 years. Oral Presentation, 2014 Annual Meeting, Western Division of the American Fisheries Society, Mazatlán, Mexico. April 7-11.

Hinderer, R. K. A. R. Litt, R. A. Garrott, and **M. McCaffery**. 2014. Understanding movement patterns of Chiricahua leopard frogs (*Lithobates chiricahuensis*) to promote species persistence in desert ecosystems. Poster Presentation, Montana Chapter of The Wildlife Society, Bozeman, MT. March 4-7. (**See Appendix 1**)

Kruse, C., and G. Austiguy. 2014. Engineering cutthroat trout conservation: an evolution in fish barrier design. Oral Presentation, Western Division of the American Fisheries Society, Mazatlán, Mexico. April 7-11.

Kruse, C., S. Barndt, P. Clancey, K. Patten, and B. Shepard. 2014. Collaborative efforts to restore aquatic species on private land: a story of habitat, genetics, disease and … (mostly) sweat. Oral Presentation, Wildlife Disease Association, Albuquerque, NM. July 28-August 1.

Kruse, C.G. 2014. Large scale aquatic conservation efforts on private lands: can we make a difference? E.O. Wilson Biodiversity Foundation sponsored Oral Presentation, Nicholas School of the Environment, Duke University, Durham, NC. September 16.

McCaffery, M. 2014. Imperiled species: private conservation. Invited lecture. Wildlife Biology Department, The University of Montana, Missoula, MT. March 6.

McCaffery, M. 2014. A private lands model for imperiled species conservation and recovery. E.O. Wilson Biodiversity Foundation sponsored Oral Presentation, Nicholas School of the Environment, Duke University, Durham, NC. September 16.

Phillips, M. K. 2014. Leveraging partnerships for conserving biological diversity. Invited Lecture, Nicholas School of the Environment, Duke University, Durham, North Carolina.

Phillips, M. K. 2014. Wolf restoration: many matters of concern. Invited Guest Speaker, Sevilleta National Wildlife Refuge, New Mexico.

Phillips, M.K. 2014. Politics, science, and wildlife conservation. Invited Plenary Lecture, Meeting of the Montana Chapter of the Wildlife Society, Bozeman, MT.

Phillips, M.K. 2014. Politics, science, and wildlife conservation. Invited plenary presentation, Meeting of the Montana Chapter of The Wildlife Society, Bozeman, Montana.

Phillips, M.K. 2014. Private working lands: important settings for conservation of imperiled species. Invited talk, Congress for Wildlife and Livelihoods on Private and communal Lands: Livestock, Tourism, and Spirit. YMCA of the Rockies, Estes Park, CO. September 7-12.

Phillips, M.K. 2014. The Past and Future of Wolves in the West: A Review of Social and Ecological Factors Shaping Wolf Restoration. Invited talk for "Building Common Futures for Western Wildlife Through Socio-Ecological Science". YMCA of the Rockies, Estes Park, Colorado. October.

Phillips, M.K. 2014. Wolf restoration: a lens to many matters of concern. Invited Banquet Lecture, Meeting of the Montana Chapter of the Wildlife Society, Bozeman, Montana.

Phillips, M.K. 2014. Wolves, falcons, and trout: private land and wildlife conservation. Invited banquet presentation, Meeting of the Montana Chapter of The Wildlife Society, Bozeman, Montana.

Phillips, M.K. 2014. The Extinction Crisis: A Loud and Clear Call for Action. Invited Keynote Remarks, 11th Annual American Renewable Energy Day, Aspen, Colorado.

Phillips, M.K. 2014. Conservation biologists and politicians: necessarily one and the same. Plenary Presentation, NA Congress for Conservation Biology, Society for Conservation Biology. University of Montana, Missoula.

Wiese, C., L. S. Hillard, **McCaffery, M.**, and **M. K. Phillips.** 2014. Restoration of a Pleistocene Relict: The Bolson Tortoise in Southern New Mexico. Oral presentation, International Conference of the Wildlife Disease Association. Albuquerque, NM. July 28-August 3.

Wiese, C., and L. S. Hillard. 2014. Translocating Bolson Tortoise (*Gopherus flavomarginatus*) juveniles on Turner's Armendaris Ranch: Lessons learned for Eventual Releases. Oral presentation, 12th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles. Joint Annual meeting of the Turtle Survival Alliance and IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. Orlando, FL. August 4-7.

APPOINTMENTS IN 2014

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

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
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
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
WPM = Western pearlshell mussel
WWF = World Wildlife Fund
WY = Wyoming

APPENDIX 1. Poster presentation given at the 52nd Annual Conference of the Montana Chapter of the Wildlife Society, March 4 – 7th 2014.

Understanding Movement Patterns of Chiricahua Leopard Frogs (*Lithobates chiricahuensis*) to Promote Species Persistence in Desert Ecosystems

Ross K. Hinderer, Andrea R. Litt, Robert A. Garrott (Montana State University), and Magnus McCaffery (Turner Endangered Species Fund)

Introduction

- Chiricahua leopard frogs (*Lithobates chiricahuensis*) are native to the US southwest and north Mexico
- Populations have declined rapidly due to land use changes, invasive species, and disease. The species is listed as "threatened" under the Endangered Species Act
- Chiricahua leopard frogs are now mostly confined to anthropogenic surface water (eg livestock tanks) and their patterns of dispersal between disjunct water sources are not well understood
- Movements in this species are thought to be tied to monsoon rainfall in late summer when creeks are flowing
- Managing habitat for these animals relies on an understanding of their dispersal abilities
- The Ladder Ranch has the largest population of Chiricahua leopard frogs in New Mexico

Photos by RK Hinderer

Methods

Trapping

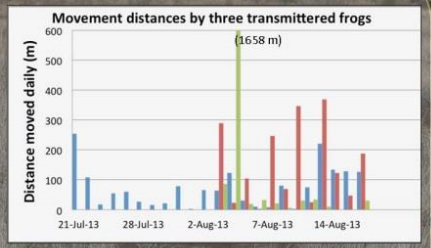
- Encircled 2 stock tanks on the Ladder Ranch with drift fences and pitfall traps

Tracking

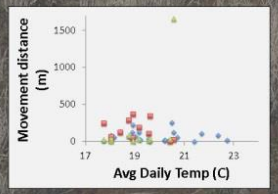
- Placed radio transmitters on adult frogs (*n*=14) to track movement
- A nearby ephemeral creek provided a potential travel corridor

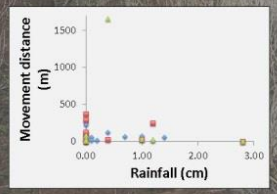
Results

- Frogs transmittered in the creek (*n*=3) moved long distances (up to 1658m/day)



- Movement distances do not seem to be tied to temperature or rainfall





- Frogs transmittered in stock tanks (*n*=11) remained in source ponds throughout the tracking period

Discussion

- Distances traveled by transmittered frogs indicate potential for movements between widely spaced livestock tanks
- Frogs utilized non-aquatic habitats (banks, vegetation, detritus) more frequently than expected
- This project will inform future reintroductions of frogs in other drainages

- Tanks typically are separated by arid landscapes
- Most creeks contain water only during monsoon season
- Managers can modify availability of surface water to enhance metapopulation connectivity

- In 2014 we will increase sample sizes and tracking periods to reveal patterns of movement across the landscape
- We will explore how landscape attributes and frog characteristics influence movement patterns

- Multiple land uses dictate that management strategies are adequate for both livestock and aquatic fauna
- As surface water becomes more scarce in the desert Southwest due to climate change, aquatic animals may require human intervention to persist in their extant ranges