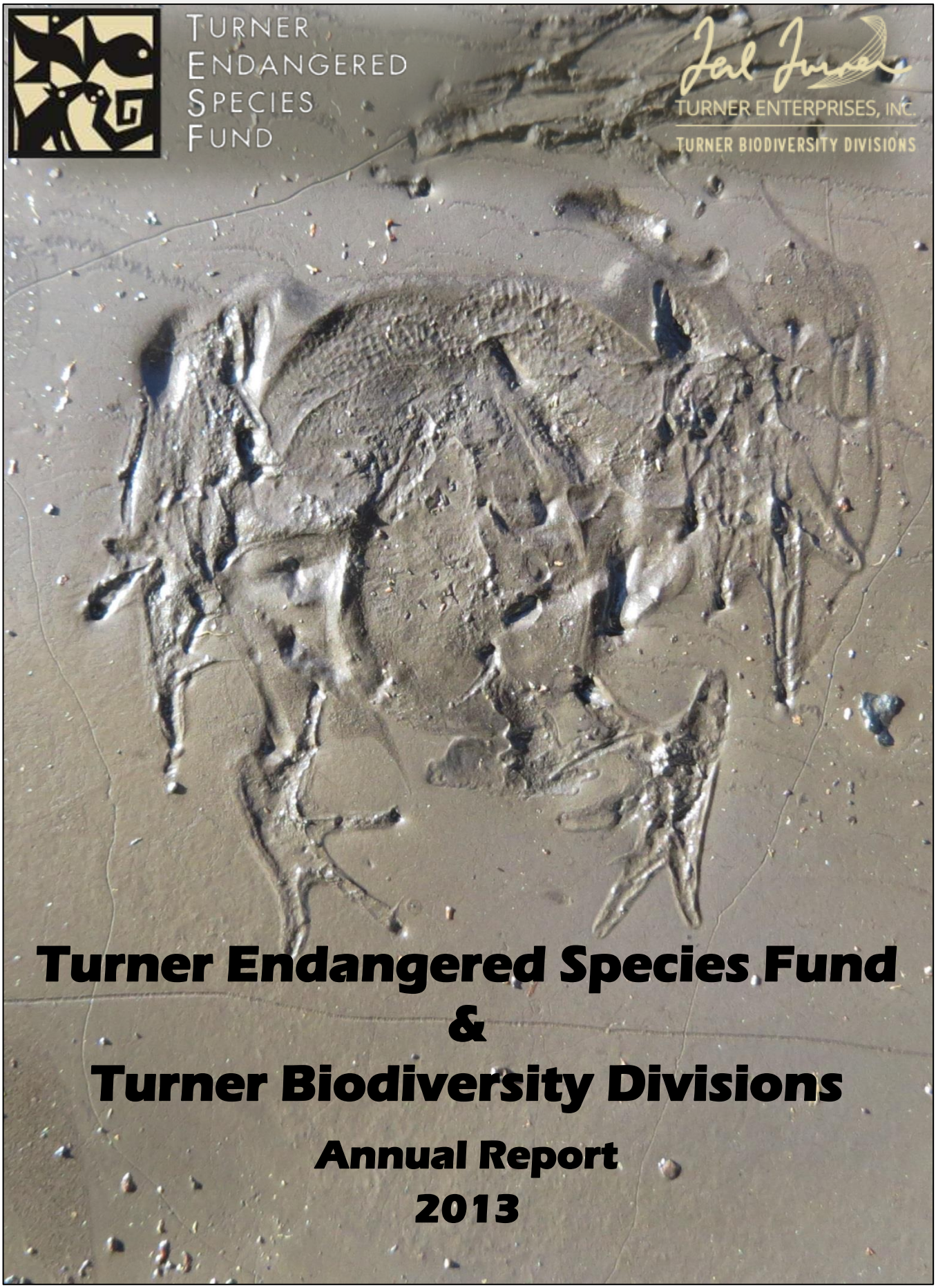


Turner Endangered Species Fund
&
Turner Biodiversity Divisions

Annual Report
2013

Turner Endangered Species Fund

&

Turner Biodiversity Divisions

Annual Report
2013

Mike Phillips, Carter Kruse, Dustin Long, Val Asher, Chris Wiese, Mackenzie Mizener, Hanne Small, and Magnus McCaffery

Turner Endangered Species Fund/Turner Biodiversity Divisions

1123 Research Drive

Bozeman, MT 59718

www.TurnerEndangeredSpeciesFund.org

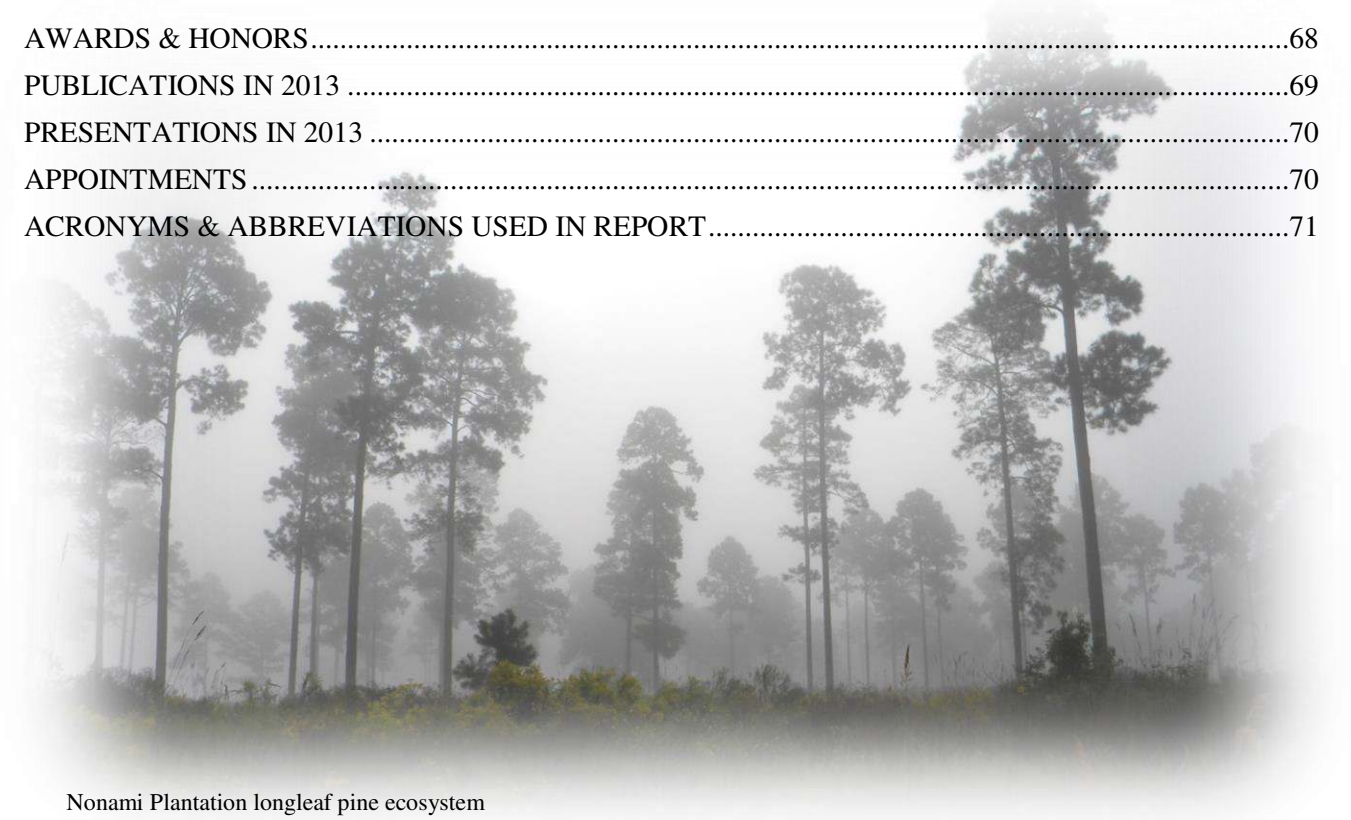
Suggested citation: McCaffery, M. and M. K. Phillips (Editors). 2013. Turner Endangered Species Fund and Turner Biodiversity Divisions: Annual Report, 2013. Turner Endangered Species Fund, Bozeman MT.

All photos not otherwise marked are TESF/TBD photos.

Cover photo: *A Chiricahua leopard frog mud-print. (Photo credit: Ross Hinderer)*

Contents

TURNER ENDANGERED SPECIES FUND/TURNER BIODIVERSITY DIVISIONS TEAM 6
BACKGROUND 7
PROJECTS 8
1. CHIRICAHUA LEOPARD FROG 8
FROG FIELD JOURNAL: 11
2. BOLSON TORTOISE 20
3. CUTTHROAT TROUT 30
4. BLACK-FOOTED FERRET 38
5. PRAIRIE DOGS 41
6. RED-COCKADED WOODPECKER 44
7. MEXICAN GRAY WOLF 46
8. ROCKY MOUNTAIN GRAY WOLF 51
9. SOUTHERN ROCKY MOUNTAINS GRAY WOLF 55
10. CHUPADERA SPRINGSNAIL 57
11. GOPHER TORTOISE 59
12. WESTERN PEARLSHELL MUSSEL 63
13. WESTERN LANDOWNERS ALLIANCE (WLA) 65
14. PLAINS BISON CONSERVATION 66
AWARDS & HONORS 68
PUBLICATIONS IN 2013 69
PRESENTATIONS IN 2013 70
APPOINTMENTS 70
ACRONYMS & ABBREVIATIONS USED IN REPORT 71



Nonami Plantation longleaf pine ecosystem

TURNER ENDANGERED SPECIES FUND/TURNER BIODIVERSITY DIVISIONS TEAM

Beau Turner

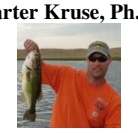
Beau is **Chairman of the Board of Trustees for the TESF**, and is **Director of Natural Resources and Biodiversity for Turner Enterprises, Inc.** Beau coordinates and oversees wildlife-related projects for the approximately 2 million acre operation. He serves as a Trustee for the Turner Foundation, Inc., and serves on the boards of the Jane Smith Turner Foundation and the Captain Planet Foundation. His greatest passion is getting young people outdoors and excited about nature and the environment. To achieve this, he founded the Beau Turner Youth Conservation Center in Florida.

Mike Phillips, M.Sc.

Executive Director, TESF; Coordinator, TBD ~ *mike.phillips@retranches.com*

Mike has served as TESF Executive Director and TBD Coordinator since he co-founded the efforts with Ted Turner and his family in 1997. Mike received his B.Sc. in Ecology, Ethology, and Evolution from the University of Illinois in 1980, and his M.Sc. in Wildlife Ecology from the University of Alaska in 1986. He has conducted wildlife research, with an emphasis on large carnivores, throughout the United States and Australia. Mike's career focuses on imperiled species recovery, integrating private land and conservation, ecological economics, and socio-political aspects of natural resource use. Mike was elected to the Montana legislature in 2006 and will serve in the state senate through at least December 2016.

Carter Kruse, Ph.D.



Senior Aquatics Biologist, TBD ~ *carter.kruse@retranches.com*

Carter has worked for the Turner organization since 2000. He has a B.Sc. in Wildlife and Fisheries Sciences from South Dakota State University, and a M.Sc. and Ph.D. in Zoology from the University of Wyoming. Carter manages a variety of projects from water rights to native species conservation. A current program of interest is water management and conservation on working ranches under a changing climate. Carter lives near Bozeman with his wife and five kids.

Dave Hunter, D.V.M.

Wildlife Veterinarian, TESF, TEI ~ *dave.hunter@retranches.com*

Dave has served as the veterinarian for TEI and TESF since October 1998. He graduated with a Doctor of Veterinary Medicine from Washington State University in 1976. He is an Adjunct Professor at Texas A&M University, and an Associate Professor of Research at Boise State University, University of Idaho, and Montana State University. He is a founding member of International Wildlife Veterinary Services, and on the Board of Directors of the International Wildlife Health Institute. Dave currently works on health issues at the interface of ecosystems, wildlife, livestock and humans.

Dustin Long, M.Sc.

Senior Biologist, TESF ~ *dustin.long@retranches.com*

Dustin began working for TESF in 1998 and is focused on recovering black-footed ferrets, their prey base, and habitats to Turner properties. He has a M.Sc. in Life Science from New Mexico Highlands University, and is affiliated with several professional organizations. He also proudly serves on the Maxwell Schools Board of Education. He lives on Vermejo Park Ranch, NM but also works extensively at the Bad River Ranches, SD and the Z-Bar Ranch, KS.

Magnus McCaffery, Ph.D.

Senior Biologist, TESF ~ *magnus.mccaffery@retranches.com*

Magnus is began working for TESF in 2010 and is the lead biologist on the Chiricahua leopard frog project, and is working with the bolson tortoise recovery team to develop a robust strategy for reintroducing the bolson tortoise to New Mexico. Magnus is a native of Scotland, where he graduated with a BSc in Marine Biology and an 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, B.S.

Field Biologist, TESF ~ *val.asher@retranches.com*

Val has served as wolf biologist for TESF since May 2000. Working closely with state and federal agencies, she was a wolf specialist in Montana from 2000-2009. In 2010, she began investigating how wolves affect ranched bison and wild elk populations on the Flying D Ranch. Val has chased wolves in Minnesota, Montana, Idaho, Arizona and New Mexico and was part of the capture team in Canada during the Yellowstone/Central Idaho wolf reintroduction. She is happiest when "out and about".

Hanne Small, B.S.

Field Biologist, TESF ~ *hanne.small@retranches.com*

Hanne has worked with the Turner Endangered Species Fund since April 2011. She is currently working on the Chiricahua leopard frog project at the Ladder Ranch in New Mexico. She earned her B.S. in Wildlife Science with a minor in Forestry from Virginia Tech. Before TESF, she worked with numerous species including swift fox, prairie dogs, pika, bats, treefrogs, aquatic invertebrates and wild mustang horses with U.S. Fish and Wildlife Service. Hanne is interested in conservation of wildlife, specifically bats and amphibians. In the future, she would like to pursue a degree in veterinary medicine.

Chris Wiese, Ph.D.

Senior Biologist, TESF ~ *chris.wiese@retranches.com*

Chris oversees the bolson tortoise and Mexican gray wolf projects on the Ladder and Armendaris Ranches in New Mexico. Prior to joining TESF in 2012, Chris was a cell biologist. She received her PhD in Cell Biology from the Johns Hopkins Medical School in 1996. In 2007, Chris decided to trade in lab coat and pipettors for snake chaps and sunscreen. Since then, she has focused her research efforts on the reproductive biology of desert tortoises, including the bolson tortoise.

Barb Killoren, B.S.

Office Administrator, TESF ~ *barbara.killoren@retranches.com*

Barb began her career with TESF in 2001. As office administrator Barb manages the day to day operations and provides comprehensive support to the Executive Director, project managers and field personnel. She takes pride in providing a warm, supportive work environment for all TESF/TBD members. Barb has a Bachelor of Science from the University of Wisconsin, Eau Claire. She enjoys camping, hiking and the Montana outdoors, and is proud to be a dedicated, valued member of the TESF team.

BACKGROUND

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 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 the crisis, Ted Turner, his family, and Mike Phillips launched the Turner Endangered Species Fund (TESF) and Turner Biodiversity Divisions (TBD) in June 1997. TESF focuses on species protected under federal and state endangered species laws, whereas TBD considers species that are at slightly less risk. These companion efforts are dedicated to conserving biodiversity by ensuring the persistence of imperiled species and their habitats with an emphasis on private land. Both organizations work on diverse ecological issues aimed at conserving individual species as well as restoring functional ecosystems. Our activities are guided by the principles of conservation biology, and we endeavor to contribute to the distribution of reliable scientific and policy information.

We invite collaboration, and work closely with state and federal agencies, universities, and private organizations. We operate on the belief that many minds wrapped around a problem builds a certain route to success. Whether we are managing an extant population or restoring an extirpated one, our goal is population persistence with little or no human intervention. We believe that persistent populations of native species are indicative of a healthy landscape, and a high degree of ecosystem integrity.

The Fund and the Divisions have achieved much and both are widely recognized as effective forces in conservation…..but more can be done! This work will be challenging because private stewardship of biodiversity is an evolving yet essential approach to conservation. The problems involved are complex, and effective solutions often require broad-based sociopolitical, biological, geographical, and fiscal considerations. Many of our projects will be controversial, slow to succeed, and fraught with uncertainty. Some will fail. The difficulty will come not because we were ill prepared or did not work hard but rather because restoration is complex and an imprecise process about which scientists as yet know little. But this will not diminish our substantial resolve. We believe that real solutions to the extinction crisis will come through the genius and determination of individuals. And we intend to contribute by establishing a new measure for private efforts to conserve the wondrous diversity of life on Earth.

PROJECTS

1. 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

Project Location: Ladder Ranch, NM

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

Grant Funding in 2013:
- TBD/TESF
- Partners for Fish and Wildlife ($24,900)

Project Goals and Objectives: We aim to work in partnership with the CLF Recovery Team to achieve range-wide recovery that results in the delisting of the species from the ESA. 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 1.1. The Ladder Ranch (red outline) is a CLF Management Area within Recovery Unit (RU) 8. In 2013, the Ladder's ranarium facility bred captive CLFs from key off-ranch populations, spanning three RUs.

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 the Mimbres-Alamosa CLF Recovery Unit (Figure 1.1). From a broader conservation perspective, the Chihuahuan Desert Ecoregion is a WWF Global 200 Priority Ecoregion, conservation of which will help maintain a broad diversity of Earth's ecosystems, and the Ladder Ranch itself is recognized as a Key Conservation Area by The Nature Conservancy.

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

conditions, CLF have been found to naturally colonize man-made livestock water tanks.

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

Project Activities in 2013:

Monitoring

We monitored all known sites occupied by wild CLF during 2013. Minimum count data from this survey work suggests that the Ladder Ranch population remains robust (Table 1.1). However, this population continues to be largely confined to a single drainage (Seco Creek). Our long-term strategy is to improve the likelihood of CLF persistence on the Ladder by augmenting existing populations and expanding the species' distribution through the creation of a network of natural and artificial wetlands. In 2013, we completed many of these wetland habitat improvement projects for planned CLF population expansion into Las Palomas drainage. During flood events this year, one of these sites in Las Palomas was colonized naturally by at least one adult CLF. In 2014 we aim to complete the remaining wetland improvement work and initiate translocations to these sites.

Table 1.1. Minimum CLF counts at wild sites in 2013.

	MIN. COUNTS IN 2013			
Site name	Egg mass	Tadpole	Metamorph	Adult
[a]Circle 7	3	11-20	4	12
[a]Avilas	0	0	0	1
[b]N. Seco	201	>100	296	320
[b]Pague	99	>100	271	76
[b]LM Bar	59	50-100	31	36
[b]Fish	7	>100	9	13
[b]Johnson	107	>100	113	289
[c]Ash Cany.	0	0	0	16
[c]Artesia	61	21-50	28	41
[d]Cave Cr.	1	1-10	3	2
[d]Animas	3	>100	61	6
KEY:				
a = *Site in Las Palomas drainage*				
b = *Site in Seco drainage*				
c = *Site in Ash Canyon drainage*				
d = *Site in Las Animas drainage*				

2013 habitat actions on the Ladder Ranch:

- Removed cattails at Artesia to maintain habitat quality for CLF.
- Installed field fence at Johnson, Fish and LM Bar to further exclude ungulates from CLF habitat to reduce trampling impacts.
- Completed re-lining ponds in Las Palomas at Circle 7 and Avilas, and improved the quality of the pond habitat at Rouse.
- Planted native grasses on the banks at Avilas and Rouse.
- Completed CLF habitat improvement work at Emrick Spring.
- Lined pond at South Well and installed an overflow pipe to ensure consistent water depth.
- Added algae overflow protection on steel tank pipes in Seco Well, Fox, and No. 2.
- We began installation of ungulate exclosure fencing at Davis Well and Sissel Well.

Captive refugia program

During 2013, we translocated CLFs into four captive refugia tanks designated for use by the USFWS (Table 1.2) to temporarily house frogs from off-ranch populations.

Table 1.2. USFWS captive refugia tanks stocked in 2013.

Refugia name	Source population	Egg mass	tadpoles	Meta/ Adult
Avant	Beaver Cr.	-	600	890
Seco	Divide Well/ Trick Tank	1	70	23
Wildhorse	Cuchillo X Seco	5	608	-
South	Cuchillo	-	82	19

Overall, refugia tanks designated for both Ladder Ranch and USFWS use produced 141 viable egg masses in 2013 (Table 1.3).

Table 1.3. Egg masses laid in captive refugia in 2013.

Refugia name	No. egg masses	No. Viable
Antelope	20	20
Seco	81	81
Wildhorse	11	11
South	0	0
Fox	5	5
No. 2	24	24

Captive breeding: ranarium program

In 2013, the ranarium housed adults from seven off-ranch source populations, spanning three CLF Recovery Units, as well as adults from two on-ranch populations (Table 1.4). Egg masses

produced in adult cages were transferred to the integrated tadpole rearing facility.

Table 1.4. CLFs in ranarium cages during 2013.

Cage No.	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.	4/1	-	3/19/11
	Alamosa W.S.	3/3	-	10/31/12
	Blue Cr.	2/0	-	5/2/13
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. = Creel
W.S. = Warm Springs
Spr. = Springs
LM = Long Mesa
Metas = metamorphs

The nine tadpole rearing tanks associated with the ranarium can hold approximately 1,000 tadpoles each. In 2013, 17 viable egg masses were transferred from adult cages to tadpole tanks (Table 1.5). Tadpoles (and in some cases metamorphs) from these masses were released into the wild, or into captive refugia holding tanks in consultation with the USFWS (Tables 1.5 & 1.6).

Table 1.5. Ranarium egg mass production and management in 2013.

Cage No.	Source pop.	No. egg masses	Egg mass entry date	Tadpole exit date	Destination
1	Seco Cr.	1	9/22/13	9/24/13	NMSU
2	Alamosa	1	6/17/13	9/29/13	Middle Well
	W.S.	1	6/25/13	9/29/13	Middle Well
3	Beaver Cr.	2	3/31/13	6/25/13	Fow/BV
		1	5/2/1	6/25/13	Fow/BV
		1	5/11/13	6/25/13	Fow/BV.
		1	6/1/13	6/25/13	Fow/BV.
		1	6/19/13	6/25/13	Fow/BV.
		1	6/25/13	9/10/13	St. Mesa
		2	7/20/13	9/10/13	St. Mesa
		1	9/2/13	9/10/13	Avant
		1	9/19/13	10/29/13	Fow/BV.
7	Moreno	1	4/22/13	7/23/13	Burro cien.
	Spr.	1	7/20/13	7/23/13	Burro cien.
9	Animas	1	9/23/13	10/28/13	Animas Cr.

KEY:
Cr. = Creel
W.S. = Warm Springs
Spr. = Springs
Pop. = population
NMSU = NM State University
Metas = Metamorphs
Fow/BV = Fowler/Beaver Creek
St. Mesa = Steer Mesa
Cien. = Cienaga

Table 1.6. Production and disposition of offspring produced at the ranarium in 2013.

Ran. pop.	Ran. Exit date	No. tadpole	No. metas	Release type	Release site
Beaver Cr.	6/25/13	1,526	-	Wild	Beaver Cr.
Beaver Cr.	6/25/13	320	-	Captive	Avant
Moreno Spr.	7/23/13	89	35	Wild	Burro cien.
Beaver Cr.	9/10/13	425	1	Wild	St. Mesa
Beaver Cr.	9/10/13	290	-	Captive	Avant
Alamosa W.S.	9/29/13	99	1	Captive	Middle Well
Beaver Cr.	10/30/13	600	-	Wild	Beaver Cr.

KEY:
Ran. = Ranarium
Pop. = Population
Cr. = Creel
W.S. = Warm Springs
Metas = Metamorphs
St. Mesa = Steer Mesa
Spr. = Springs
Cien. = Cienaga

Movement patterns

Beginning in 2013, TBD funded a graduate student position to investigate key 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 this project. During the 2013 field season, 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 monsoon season (see Ross's field notes on page 12). This project will continue in 2014.

Spot recognition and tagging

The spot pattern arrangement on the dorsal surface of CLFs is putatively unique to an individual frog. We are testing this assumption in an attempt to validate a novel method of individual identification of CLF. In 2013 implemented 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). To do this, we selected two captive refugia tanks (Fox and No. 2) on the Ladder Ranch in which to perform PIT tagging and SPI techniques. We hope to repeat this fieldwork in 2014 to increase our sample size and to conduct a mark-recapture analysis that directly compares the results of these two methods.

FROG FIELD JOURNAL:

Week of June 24th 2013

I recently started my first season of fieldwork for my MS at Montana State University. My project is a study aimed at understanding the movement habits and dispersion patterns of the Chiricahua leopard frog (Lithobates chiricahuensis). This frog is federally listed as "threatened" and is only found in Arizona, New Mexico, and parts of northern Mexico. Its historical habitat included streams that dried down to isolated pools between rains. Most of these historic systems are no longer supporting frogs, for a variety of reasons including loss of water due to human intervention (livestock use, irrigation, pumping of groundwater), invasive species, and disease (especially the amphibian chytrid fungus). New Mexico's frogs in particular are in a pretty dire situation. Their last large, robust population in the state is on Ted Turner's Ladder Ranch. The Turner Endangered Species Fund is bankrolling my project on the Ladder, with the aim to better understand how the frogs use their fragmented landscape to survive in a place that doesn't exactly seem hospitable for an animal that needs water in all stages of its life. The specific technique I'll be using is one that is utilized for studies across a variety of animal systems. I'll be attaching radio transmitters to individual frogs, allowing me to assign each animal an individual radio frequency and home in on that frequency with a handheld receiver, thus locating the frog. By plotting the locations of frogs across time, I hope to be able to find some patterns in how far they move, where they move, or what causes them to move. I'm collecting frogs using a pitfall trap design, wherein I will encircle two ponds with drift fence (in my case, landscape fabric) that the frogs cannot jump over. I'll bury buckets in the ground (Photo 1) on both the inside and outside of the fence, so that when a frog runs into

Photo 1: Pitfall trap - The wood cover is for shade and to keep non-target animals out.

the fence, he'll hop along it until he runs into a bucket, falls in, and is found by me later. He'll then be outfitted with a stylish fanny pack radio transmitter, which is sure to be the envy of all his friends (pictures to come). Previous work has suggested that Chiricahua leopard frogs move during rainstorms, since this is the only time when the ground is wet enough that they won't immediately mummify in the hot desert sun. Rain in this region of New Mexico generally falls in monsoons during the late summer, so I've got to be ready for frogs to start leaving the ponds and ending up in my traps before the rain starts very soon.

I left for the field on 23rd of June. As I neared the Ladder, there was a thick cloud of smoke from a wildfire burning on the northeast side of the Ladder. Because the fire is so close to the ranch, close enough to cause some serious smoke problems, I'm going to be staying at headquarters, where there are very nice living arrangements for guests like hunters, scientists, and friends of the Turner family. My digs are pretty sweet, including such field luxuries as refrigerator, stove, and indoor plumbing. There's even air conditioning! I'll stay here as long as it takes for the fire to move on. After that, I'll be staying at Lobo Camp, a block structure in the middle of the ranch that is closer to both my field sites. That means that at the moment I need to make a 40-minute drive to the closer of the two field sites. The other site is still too near the fire line for work, but hopefully I'll be able to get there soon. The 25th was an organizing day. I helped catch tadpoles in the captive rearing facility so they could be transported to their new home, and then I got to work figuring out what I'll be doing the next couple weeks. Unfortunately, right now that includes such glamorous scientific tasks as digging holes and trenches to bury my pitfall traps and drift fence.

I'm working with a technician named Seth Hall, who is young, energetic, and grew up here, so knows how to deal with the heat. That's a good thing, as it's been over 100F every day since I've been here. We started burying traps at Johnson Well on the 26th, and that's what I've been doing up until today the 30th. Seth only works 40 hours a week, so I'm stuck by myself on Friday-Sunday. I usually love working by myself, but to be honest, running a shovel

and pick is definitely a task where more hands are appreciated. Because of the risk of valley fever (a fungal infection of the lungs, found in soil) and Hantavirus (a serious hemorrhagic fever carried by rodents), I'm wearing a respirator as I work (Photo 2).

Photo 2: Respirator – If you come across a guy looking like this in the desert, you should be alarmed.

It's hot, but better than carrying a fungus in my lungs the rest of my life. There are a lot of frogs in this pond, and it's fun to see an imperiled species so frequently as I work (Photo 3).

Photo 3: The rare and enigmatic Chiricahua leopard frog

I also get frequent visits by critters as they come to the pond to drink. There are gaps in the pipe fence encircling the pond to let animals come and go, but the rest of the edge is fenced off for frog habitat. There's an alarming difference in the vegetation between where large grazers can get and where they can't. It's really funny to remember how long I spent with a telephoto lens in Yellowstone trying to get a picture of a bison calf. Here they hang out at the salt licks where I park.

That's it for now. All the traps are still closed until I finish installing the fence tomorrow. I'm also in the process of making belts that hold the radio transmitters on frogs. When I start getting frogs in traps the belts should be ready to stick on them. Hopefully we'll be cleared to work at North Seco Well, my second site, this week. I also need to get those traps installed, and every afternoon it almost looks like it could rain.

FROG FIELD JOURNAL:

Week of July 1st 2013

This week continued the digging frenzy of 2013. Seth and I got the last of the Johnson well fence and buckets installed (Photo 4).

Photo 4: This is what the finished fence looks like. I left the water gaps unfenced because I didn't want to have to repair fences every time a herd of bison came down to the water to drink.

It felt really great to get my project off the ground. Unfortunately, the traps were not opened for the first of the summer rains. I was still staying at Headquarters when the first real monsoon I've ever seen rolled onto the Ladder. It really looks just like in the cartoons, when a raincloud hovers and drops a ton of water (Photo 5). The whole time during the storm I was getting more and more nervous,

Photo 5: First rain – What an impressive storm! It went from sunny to absolute mayhem in no time.

imagining all the frogs at Johnson and North Seco heading for the hills while the rain was falling. Fortunately, just as Johnson was wrapping up we were cleared to work on the other side of the ranch (where the fire was before). The next day Seth and I opened the pitfall traps at Johnson and headed to North Seco to start digging again. Oh! And I forgot to mention the best part of the day. Four-wheelers. ATVs make rough ranch roads into a tourist's dream. No more rattling my teeth in a pickup over rocks and ruts, and my drive time between the two sites has been reduced from about an hour to 20 minutes. It also makes my commute to work pretty epic (Photo 6). There's not much room for cargo, of course, so we still needed to use the trucks to haul in supplies for building traps.

Photo 6: Ridge road - Not a bad commute to work every day!

Anyway, traps at Johnson were open for three days while we got everything installed at North Seco. By this point my body was feeling pretty beaten down. The worst part is digging the trench to bury my drift fence in the ground. I planned on long days while construction was going on, so it was a little frustrating to be slowed down by exhaustion, blisters, and broken shovels. This second site's install went a lot easier though, since we knew a little better how the process worked. North Seco is absolutely chock-full of Chiricahua leopard frogs. Every day that I walk up to the pond, frogs leap off the bank in such numbers that it's difficult to count them all. Not surprisingly, garter snakes are also plentiful and very well-fed (Photo 7). Watching the interaction in the pond between dragonflies, frogs, and garter snakes is like a lesson on predator-prey relationships. I'm convinced that if the scale was a little larger, you'd be seeing these species on Animal Planet along with cheetahs and wildebeest and lions. Cool side note- when dragonflies and frogs are in their larval stage (nymphs and tadpoles, respectively), dragonflies munch on tadpole limbs and possibly even whole animals. When they grow up, however, dragonfly adults make up a large portion of a frog's diet. Now THAT is a beautiful interspecies interaction, and the sort that makes me love what I do.

I got my first amphibian capture in a pitfall trap on Wednesday! Unfortunately it wasn't a leopard frog, but it was a very nice adult tiger salamander. That's no help for my project, but it was nice to see that the pitfall traps are actually functioning as intended. In preparation for the capture of buckets of leopard frogs, I tested some transmitter belts on captive frogs in the Ladder Ranch ranarium (yes, a ranarium is a place to rear frogs in captivity). The belts seemed to work great, and I now have an idea what sizes I'll need for wild frogs (Photo 8).

Photo 7: It's hard to tell, but this was a huge frog. I don't think there's any way the snake actually got it down.

Photo 8: One very confused ranarium frog, with a telemetry transmitter attached for practice.

The last bit of digging at North Seco went off without a hitch, if you don't count the massive rocks in the way. We opened the traps afterwards, so now both my sites are up and running. For now my only task is to check the traps to see if we've caught any frogs of a sufficient size to be given a transmitter belt. I'm limited to putting belts on that make up no more than 10% of the frog's body mass, so I'll need animals that are about 2 years old. In the first couple days of trap checks, I ran across a new species for me that is sure to be a common one this summer. A huge western diamondback rattlesnake has decided that he likes my drift fence, and set up a nice little hangout spot right next to one of my traps (Photo 9).

Photo 9: Rattler – What a beaut! I love seeing snakes, but I have a feeling this guy and I will have some go-arounds.

Sunday was an interesting day. The night before, the creek in front of Headquarters ran about a foot and a half deep. There hadn't been any rain nearby, but water from higher up in the Gila National Forest washed

down onto the ranch, loaded with ash and charcoal left over from the fire. The water looked like dark chocolate milk, and some of the creek crossings on my way to the sites were a little hairy in a pickup. Nevertheless, with the help of Ladder employees Hanne and Beau, I made it to check traps at North Seco in the morning and found.... a frog! He was in the first trap I opened and got me really excited, until I realized that he was about half the size I needed to attach a transmitter. Subsequent traps held about 10 more frogs, which were all the same size. These are young from earlier this year, just metamorphosed, and are the most likely to disperse and colonize new habitats. Even though there was no rain near their pond, I have a feeling they knew that the creek nearby was flowing with water, and wanted to go check it out. Unfortunately the water is quite possibly toxic due ash from the fire.

Overall, a very successful week! Traps are catching frogs (at least at one site) and I'm prepared for belting and tracking, if I ever get any frogs large enough. Now I'm just waiting for more movement to start the tracking and the main data collection for my project.

FROG FIELD JOURNAL:

Week of July 8th 2013.

The theme of this week is rain, rain, rain! It's hard to think of this place as a desert after the week we've had. Sunday night there was a big storm at Lobo Camp, Seth's and my home on the range in the middle of the ranch (Photo 10).

Photo 10: Lobo Camp – Home sweet home. The dead cottonwoods out front and pile of antlers and bones really lends it that "crazy desert person" cachet.

The morning was cool, wet, and breezy, and sure enough I caught plenty of frogs in the North Seco traps. Seco creek comes up every day when there's rain the night before. Because of the fire upstream, the creek runs very dark and is full of ash and chunks of charcoal. The rain also filled several small dirt pools around Lobo Camp, including one right near our house. Monday night we heard amphibians calling, and went to investigate. We found the pond full of Mexican spadefoot toads (Spea multiplicata). This is another new species for me, so I was pretty excited. They were in a breeding aggregation, which they form when there's enough rain to fill small pools in the desert (Photo 11).

Photo 11: Spadefoot amplexus – Love these guys. One of their distinguishing and very cool features is their vertical pupils.

These incredible animals spend most of their lives burrowed underground, waiting for the conditions to be right so that they can emerge, feed, and breed. Because of the very short window in which they can metamorphose, their eggs hatch in just a few days and the tadpoles grow extremely quickly.

The rain kept falling for the rest of the week. I have continued to find frogs in traps at N. Seco, but they're still too small to carry transmitters. The biggest news of the week is that I actually caught frogs at Johnson. They were again too small for transmitters, but at least it seems like the frogs may want to disperse a little. On the same day I also caught another tiger salamander and a really cool red-spotted toad (Photo 12).

Photo 12: Red-spotted toad.

The rain seems really helpful in getting amphibians to move around, but still hasn't inspired any adults to leave the ponds and end up in my traps. One thing the rain definitely complicates is travel on the ranch. I have to cross Seco creek to get to my traps at Johnson, and sometimes the road conditions assure that's just not possible (Photo 13). It's really strange to me that even if there's no

rain at my sites, water flowing down from upstream is enough to get the creek flowing out of its banks. That's life in monsoon country.

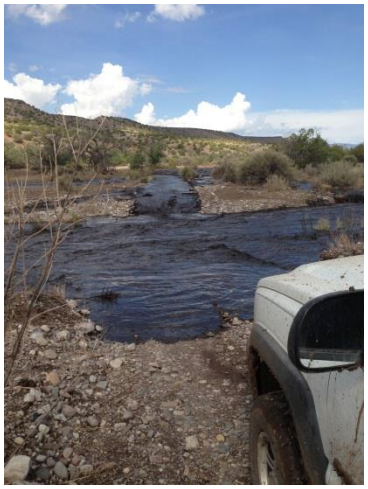


Photo 13: Johnson road – it was at this point that I turned around.

I've also seen some interesting arthropods. A new one for me is the vinegaroon, a relative of the scorpion that doesn't have a stinging tail but secretes a potent acid that reeks of vinegar (Photo 14).

Photo 14: Vinegaroon – Creepy? Yes.

Life at Lobo is good. We get visitors from all sorts of animals, including bison, pronghorn, and elk. When it's hot, we even have our very own swimming pool in the storage tank just out the door (Photo 15). The storm clouds that form every afternoon make for some epic landscapes, especially on Johnson Mesa.

Photo 15: Jumping in the pool – A little refreshment, not what you'd expect from an old cowboy camp.

That's all on my end. I'm going to keep hoping for big frogs to stick transmitters on, especially since I'm only on the ranch for about 6 more weeks. If you have any friends within the Southwest anuran community, I would be much obliged if you told them to pack their bags and get a move on.

FROG FIELD JOURNAL:

Week of July 15th 2013.

You may have already heard the news, and let me just tell you, it's true. I put a transmitter on a frog! Is that as exciting to you as it is to me?!

This week started off pretty mellow. I've still been capturing plenty of juveniles in the traps at North Seco, none big enough for a transmitter. I've got my system down so that if I don't catch much in the traps it only takes me about 3 hours to check both sites on the 4-wheeler. I need to do that twice a day, but it gives me a nice break to eat lunch and relax for a bit before I go back out.

On Saturday I was just cruising along, measuring little froggies, and found a small adult in one of my traps! Interestingly, it was on the outside of the fence at North Seco. I had noted earlier that the creek was dry, because there was a period of a few days without any rain. My guess is that he was hanging out in the creek, and when the water dropped he hiked over towards the pond and instead ended up in my bucket. I slapped a transmitter on that dude and released him on the pond side of the fence. That afternoon, he was still in the pond. Saturday night, however, we got a deluge. This was the longest-lasting storm since I've been here, and both my sites got over an inch of rain overnight. I went to track my frog in the morning, and his signal was not coming from the pond. I immediately thought he must have been eaten or carried off by something. How could he get out of the pond without being re-caught in my traps? Oh no, that guy was fat and happy in the creek about 250 meters away (Photo 16).

Photo 16: Frog in the creek – The first transmittered frog, at his first location!

Although this is exciting, it troubles me greatly. I've definitively shown that at least one frog is moving between the pond and the creek, but my assumption was that there

wouldn't be movement that wasn't captured in pitfall traps. The idea of the drift fence encircling the ponds was to be able to see every animal as it left or entered the pond. Obviously my fence is not as frog-proof as I had hoped.

It's continued to rain and the creek is still up, and my little frog is moving but staying in the creek. We'll see what the future holds for frog# 184976.

Another cool tidbit from Frogland - breeding has begun in earnest. I've heard males calling and acting rowdy for a few weeks, but I just saw some egg masses in North Seco (Photo 17).

Photo 17: Frog eggs- Three fresh Chiricahua leopard frog egg masses. They're laid as a tightly-packed bundle, and the gelatin layer outside the eggs expands when it contacts water.

Because of the warm climate, these frogs can reproduce nearly year-round. When I was on the Ladder in March there were spring egg masses in the same pond. The frogs seemed to be cued to lay by the spring warm-up and by the summer monsoons. In areas where the water is geothermally warmed, they actually do breed year-round, laying multiple clutches per female. I know the eggs don't look all that exciting, but it's always great to see evidence that an imperiled species is reproducing and doing well. That's about it from my end. I'm still hoping that I get a few more large adults soon, since I'm running up against the end of my time here already. Hard to believe!

FROG FIELD JOURNAL:

Week of July 22nd 2013.

I started off this week with another adult frog captured in a pitfall trap. Very exciting, especially as this was a 114g adult female behemoth. I almost thought she was a bullfrog when I opened the trap. After quickly building her a plus-sized transmitter belt, I released her on the outside of the fence, where she promptly hopped directly into one of the exterior pitfall buckets. Oh well, I thought, I'll see her this afternoon at my second trap check (I only empty each trap once per check, counting anything caught immediately after I look as a separate trapping event, and I'll record it on the next check, e.g. in the afternoon). I came back in the afternoon, opened the bucket, and found...nothing! I checked her transmitter frequency, and she was in the pond. This means that this frog had escaped her pitfall bucket, and then either jumped over or got around the fence somehow, and made it back into the pond. Proving, beyond a doubt, that not only is my fence crossable by adult frogs, but also that the traps may not be holding any adults they catch! This is alarming news, of course, as my study design assumed that frogs could not do either of these things. Once again I'm surprised by the resourcefulness, agility, or possibly intelligence of these animals.

Knowing this, I decided to change strategies slightly. I think that it now makes sense to put transmitters on several frogs in each pond, so that I can track their movements and find out whether or not they are leaving the pond and coming back unbeknownst to me. This means I'll need to capture them by hand, instead of relying on the ineffective pitfall traps.

To that end, Ladder Ranch biologist, Hanne, volunteered her time and one of her technicians to help out with a big capture effort. We started out walking the edges of Johnson tank. I thought this would be the way to go, since I always see plenty of frogs basking on the edges that leap into the water when I walk by. Once again, I underestimated this species. These frogs are far too wary for those kind of tactics, and by the time you walk the bank to one it's already in the water and probably buried in the mud a few feet below the surface. Instead, the way that worked best was getting in the pond up to our shoulders (or necks, depending on technician height) and bringing a net up slowly beneath frogs as they float on the surface of

the water. Luckily it was a gorgeous day, the water was fine, and there do not seem to be any leeches in these ponds. We ended up putting belts on 9 frogs in one morning, which I was very happy with. None of them have moved in the last few days, but we'll see what the future holds.

Photo 18: Pond swimming – This is what all aquatic biologists love, no matter what they say. You know it's been a good day when you stink of pond scum at the end.

FROG FIELD JOURNAL:

Week of July 29th 2013.

This has been a pretty exciting week for me down here on the Ladder Ranch. For one, the monsoons have started again in earnest. After a few weeks of gentle rain showers overnight, we're now seeing the hard storms and lashing rain that I've come to expect. That's a great thing for the landscape, as one can easily see looking around. The hills around Lobo camp look like a scene from New Zealand, minus the bison. It complicates my trap checking schedule, as it's not safe for me to be in the creek canyons when the water is coming up quickly after rain upstream.

Flash floods are pretty incredible. One of the more startling examples I've seen of their speed happened this week. I crossed a trickling Seco creek on my 4-wheeler, drove about 200m up the road, and attempted to cross the creek again. It had become a torrent of muddy water. I was just on the leading edge of the flood as it came down the canyon. Luckily I made it through quickly, and that was my last creek crossing for the day.

Late on Tuesday night, I drove out to the highway to meet my lady-friend Samantha, who came down to the ranch to visit for a few days. Having her around was a ton of fun. With a new set of eyes it really gets you to appreciate what you see every day. Not to mention she happens to be a master frog-spotter, which came in handy when we walked Seco creek to catch new frogs to fit with transmitters. For some reason having her around was also good luck for all my wildlife viewing.

A quick species list for the 3.5 days Sam was here:

- Bison, of course
- Pronghorn/Elk/Deer
- Tiny horned lizards (Photo 19)
- Western diamondback rattlesnakes
- Gopher snake
- 2 species of garter snake
- Coyote
- Badger
- Metamorph spadefoot toads
- Leopard frogs, of course
- Tiger salamander
- Phoebes and kingbirds
- A huge desert spiny lizard
- Plenty of zebra-tailed lizards and whiptails
- Puma tracks (although no kitty)

Photo 19: Tiny Phrynosoma – A very tiny horned lizard.

We ended up having very good luck in our Seco creek surveys. We put belts on two more adult frogs in the creek, and they've been moving like crazy the last few days. This is great for my project, as I haven't seen that much movement by animals with transmitters. It will be interesting to see how far these frogs go in the last few weeks I'm here.

Samantha left on Saturday, and I went back to my normal pattern of morning and afternoon trap checks and tracking. My days are getting long, which isn't a bad thing, as I'm walking the creek for fairly long distances following my little moving frogs. It's a wonderful way to spend the afternoon. The creek canyon is cool, and wildlife congregate at the water. The muddy creek banks are also the perfect substrate for showing the prints of any animals who have come by.

FROG FIELD JOURNAL:

Week of August 5th 2013.

We're really headed for the finish now, folks. Time is flying at this point, and I think the frogs are trying to make it interesting for me.

The storms are keeping up here on the Ladder. This week I got really rained on for the first time since I've been here. Of course I was miles from home, and on a 4-wheeler. Let me tell you, rain pelting you in the face as you're racing to get home feels more like gravel. Luckily creek crossings have been uneventful for a while. It really doesn't matter how much rain we get at my sites to change the creek level. It actually needs to rain far upstream in the Black Range to make the creek uncrossable. All the rain has inspired my creek frogs to run wild. I've been finding them in different locations just about every day. A surprising find has been how they seem to love getting out of the creek. More often than not they're up on the bank or under a rock out of the water when I find them. An interesting behavior, and I'm not sure why they do it. It may have something to do with feeding, as there are probably more insects up on the bank than in the creek bed. They may also be looking for a place out of the stream current, so they don't get washed downstream every time a flood comes through.

The big task for this week was trying to capture all 11 frogs that are carrying transmitters in both Johnson and North Seco. I need to check their body condition and determine if the transmitters and belts are causing any abrasion to their skin. This turned out to be much more difficult than anticipated. The frogs in the creek are easy enough to grab. Since the creek is shallow and not very wide, I can localize their radio signal to within a foot or so and just reach down and feel for the frog, if I can't see it. In the ponds, however, the search becomes much more difficult. Both of them are pretty full of floating algae and submerged vegetation. This makes perfect habitat for frog basking (Photo 21) but also makes locating SPECIFIC frogs with transmitters a really interesting endeavor. If the water is 4 or 5 feet deep (or even deeper), my locating a transmitter to within a foot means that the animal can be anywhere from the surface to under mud at the bottom. The only way to find out is by very careful exploration by hand or blind scoops with a net – both of which are not very accurate methods. To make it even more interesting, if the transmitter is no longer attached to a frog for some reason, I'll actually be looking for a 1 cm long piece of gray epoxy with a very fine black wire attached.

The first night of this effort saw Seth and I taking a night trip to

Photo 20: Pond Frog – This little fella is basking in Johnson tank on a typical mat of floating algae and potamogeton. In just a split second he can be underwater and swimming all the way to the other side of the pond, evading all attempts at capture.

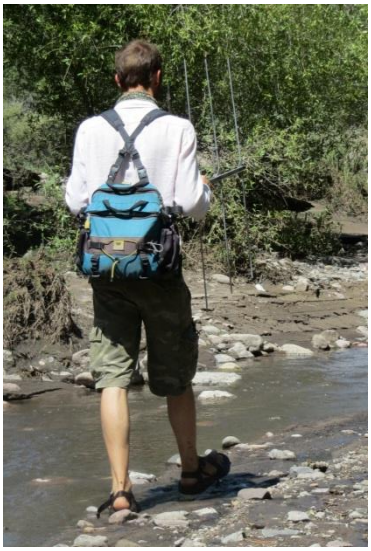
North Seco. We found both of the two transmittered frogs in that pond fairly quickly, and even the catching went spectacularly well. I managed to totally fill my waders with slimy water, but if you've worked with me you know that's not rare. The next step was trying to get a hold of the nine frogs in Johnson. At first, Hanne (Ladder biologist), Makenzie (her ranarium tech), and I tried our luck during the day. Just like when we placed the transmitters, we ended up wading up to our necks and netting up three of the critters. It was very slow going, so we decided to wait till dark and try again, when the frogs are less wary and you can hold a spotlight on them to prevent their seeing you. The night survey was, as usual, a lot of fun. During the day frogs flee when you come within 20 or even 30 feet. At night with a good headlamp, you can walk up and lift a frog out of the water by hand. It's a much more efficient way to find animals, but it was still tough to get a good shot at frogs that are under water or hidden in the mud. We captured three more, for a total of six. 6/9 in one day seems pretty insignificant, but I was happy with the results. If we were just trying to get any frog, we could have had bucketsful during the night surveys.

This coming week will be a fun one. It's time for the yearly mark-recapture effort, which means all hands on deck for a four-day frog catching extravaganza in my two sites. Some Turner folks from Bozeman are even coming down to help out. By capturing as many animals as possible, marking them for future identification, and doing the same thing on subsequent days, it's possible to gain a well-supported population estimate for the ponds. Mark-recapture is an awesome tool for wildlife studies that allows inference into something that's really impossible to measure directly, short of draining a pond and counting all the frogs present. We'll be using a fairly experimental method for this study, called spot pattern recognition. Instead of comparing photos of spots by hand, this software allows researchers to use the computer software to match photos of previous captures to the current photograph. The idea of using spot pattern identification is that it's relatively non-invasive. Other methods used to mark and identify amphibians include toe clips, visual-implant elastomer (VIE), and PIT tags. Toe clips actually remove a piece of specific toes in an arrangement that can be referenced when the animal is captured later. VIE is an injectable, non-toxic colored plastic that is visible under the surface of the skin and can be color coded for later ID. PIT tags or passive integrated transponders are small glass-encapsulated coils of wire which hold a unique code that can be read by exciting the coil with a handheld reader – this sends an electrical pulse to the tag and reads the bounced signal. PIT tags are also injected under the skin of the study animal. As you've noticed, all of these methods rely on minor surgery to be implemented. Although they've been shown to be safe in most cases, there is an understandable hesitance to use any marking method that may result in harm to the species studied. I'm interested to see how easy and effective spot recognition is in our study. I'll be looking at a lot of frog pictures this fall, so I'll learn pretty quickly.

If anyone else is interested in taking part in the frog wrangling effort, we'll see you at Johnson well around 0800 on Friday the 16th. Bring your waders, swim suit, and a dip net.

Till next year!

Ross Hinderer



Tracking – This is what I get to do for my job. Certainly can't complain about that.

2. BOLSON TORTOISE

Gopherus flavomarginatus
– ESA listing: ENDANGERED

PROJECT STATUS: *Ongoing*

Principal biologists:
- *Chris Wiese*
- *Scott Hillard*
- *Mike Phillips*
- *Magnus McCaffery*

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

Conservation status:
- Listed as federally 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 (integral to success):
- Living Desert Zoo and Gardens State Park in Carlsbad, NM (LDZG)
- El Paso Zoo, El Paso, TX
- Dr. Jim Jarchow, DVM
- Taylor Edwards, University of Arizona
- The Appleton Family

Project Funding in 2013:
- TESF
- Funding and in-kind support from: LDZG, El Paso Zoo, Appleton Family, private donations (via the Tucson Herpetological Society).

Project goals and objectives: Our overall goal is to establish independent, free-living, minimally managed Bolson tortoise populations in the northern portion of the Chihuahuan Desert, which constitutes their prehistoric range. To this end, we aim to:

- Increase bolson tortoise population size through robust captive breeding and head-start programs that protect juveniles until they reach a predator-resistant size.
- 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 is thought to have once lived throughout most of the Chihuahuan desert, but its current range is restricted to a small area in north central Mexico where the states of Durango, Chihuahua, and Coahuila meet. Due to a suite of political, social, economic, and personal safety issues, the current status of the bolson tortoise in the wild is largely 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 since decreased significantly. 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.

Our starting point for the northern Chihuahua bolson tortoise reintroduction project was a group of 30 bolson tortoises that were collected and bred over a period of nearly 40 years by a private individual from Arizona. Ms. Appleton's collection was donated to TESF in 2006, and 26 adult (plus 7 hatchlings) tortoises were moved from Arizona to the Armendaris Ranch to serve as a captive breeding colony for our reintroduction program. Four tortoises (2 males, 2 females) were donated to the LDZG, where they are on exhibit. Successful breeding programs on the Armendaris and at the LDZG have hatched over 400 juvenile tortoises since 2006. Hatchlings and juveniles are being kept on native forage in outdoor, predator-proof enclosures until they are large enough to be released (about the size of the native box turtle, or ~110 mm shell length). Tortoise growth rates depend both on the weather and on forage availability. It typically takes between 3 and 7 years or more for a hatchling bolson tortoise to reach 110 mm.

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 2013:

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

The objectives for the 2013 hatchling production portion of the tortoise project were threefold:

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

Bolson tortoise adults and subadults

The captive bolson tortoise group on the Turner Ranches in New Mexico consists of 25 adult bolson tortoises, 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. It remains to be determined if EP will become part of the breeding program in the future. Three additional subadults (2 females, 1 male) were transferred to the El Paso Zoo from the Turner Ranches. All adult and subadult tortoises appeared in excellent health in 2013.

Table 2.1. Adult and subadult bolson tortoises in the 2013 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

2013 Egg collection

As in previous years, we used a combination of radiography, ultrasound, weight monitoring, and direct observations to determine number and maturity of eggs carried by each female tortoise. This work was also key to timing the transfer of females to a smaller enclosure (to increase the chance of finding the nest) and/or to the "Turtle House" on the Armendaris to induce egg laying. Table 2.2 summarizes the eggs produced and collected (and hatchlings hatched) for each of the adult females in the Turner group of the captive population. Out of a total of 134 eggs produced in 2013, 126 were collected intact and placed in incubators. This is a record number of eggs, and it resulted in a record number of hatchlings (87) produced in a year (Table 2.2 and Figure 2.1).

Table 2.2. Egg production and hatching success in 2013 for each female in the Turner group of the captive population.

ID	No. of eggs in successive clutches (1st / 2nd / 3rd)	No. of eggs recovered & incubated (2013)	Total offspring production (2013)	2013 hatching success rate
1	4 / 6 / 6	15	10	67
2	4 / - / -	4	2	50
4	1 / 5 / -	5	4	80
A	7 / 6 / 3	15	9	60
F	4 / 4 / -	8	4	50
G	9 / 7 / -	16	10	62
J	5 / 3 / 4	12	4	33
K	3 / 5 / 4	9	8	89
L	4 / 7 / 6	17	14	82
P	5 / 3 / -	8	7	88
S	6 / 4 / -	8	6	75
T	3 / 6 / -	9	9	100
X	-	-	-	-
TOTAL	**55 / 56 / 23**	**126**	**87**	**-**
MEAN	**4 / 5 / 2**	**10**	**7**	**69**

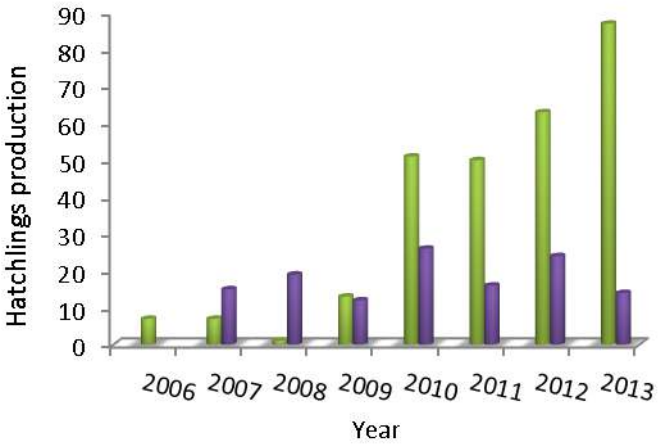


Figure 2.1. Number of hatchlings produced each year. Green bars show hatchlings produced in Arizona (2006) and on the Armendaris (2007 - 2013). Purple bars show hatchlings produced at LDZG.

Egg incubation

As in previous years, the recovered eggs were distributed into 5 separate incubators that were held at constant temperatures ranging from 30.4˚C to 32.2˚C in an attempt to generate male (cooler temperatures) and female (warmer temperatures) offspring (see section on endoscopy below). Eggs remained in the incubators until shortly before hatching, at which point they were placed into

individual, labeled trays and were transferred to another incubator (the "pipping chamber") in which they stayed for up to two weeks to finish hatching and absorb residual yolk.

Hatchlings

Following complete absorption of the yolk, hatchlings were weighed, measured, and marked with a unique tag. We also generated a photographic record and drew a drop of blood for banking from each hatchling. Processed hatchlings were placed in outdoor holding tanks (Figure 2.2, 2.3) as soon as possible.

Figure 2.2. Sunken stock tank, pictured in early July 2013, provides burrows, shade, and forage for hatchlings.

Figure 2.3. Hatchlings bask in the sun in the sunken stock tank. An expanded mesh cover provides shade and excludes predators.

A total of 87 hatchlings hatched at the Armendaris in 2013. However, two hatchlings died within days of hatching, and an additional six drowned during a severe flood event in September 2013. Thus, the official number of hatchling entering the captive population in 2013 is 79, bringing the total number of tortoises produced by the Appleton tortoises to 416 (Figure 2.4).

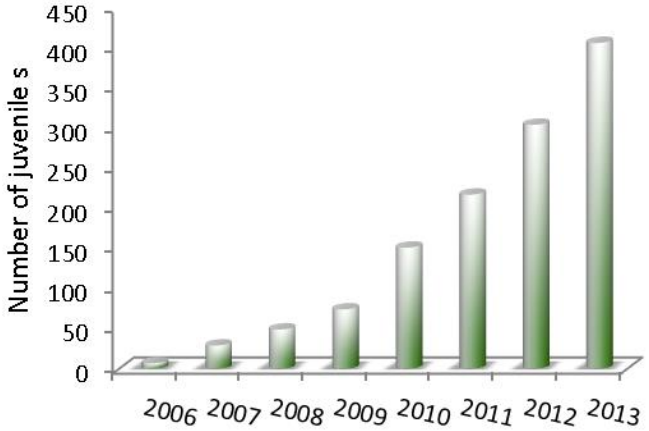


Figure 2.4. Number of tortoise juveniles in the captive population from 2006 – 2013.

An important "first" this year is the production of four hatchlings by the adult bolson tortoise, Pancha (ID # = 4). Pancha is a new addition to the Turner breeding group, and is now an integral part of the breeding program.

Hatching success rates

As we have observed in the past, the overall hatching success rate varied widely between females, and for a given female between years, but remained relatively constant for the last 4 years (Table 2.3). In general, hatching success rates are higher for the larger, older females compared with the smaller, younger females.

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
TOTAL	**251**	**394**	**34**	**-**
MEAN	**63**	**98**	**8**	**64**

We dissected any eggs that remained unhatched in the incubators and found that the majority showed little or no development. This suggests that most eggs were infertile. We envision three possible reasons for this: (1) the eggs were provisioned with insufficient resources to support development, (2) potential infertility of one or more of male tortoises, or (3) a potential manifestation of inbreeding depression in the captive population.

Contribution of each female to hatchling production

Differential fecundity and hatching success rates among female bolson tortoises has as the consequence that females contribute unequally to the captive population (Fig. 2.5). Aside from the two LDZG females who have produced the largest number of offspring to date, the female with the largest number of live offspring is Tortoise L. Females 2 and 4 have fewer than 5 live hatchlings each, and Tortoise X has never produced eggs even though 2012 trail camera images showed her mating (primarily with male tortoise N).

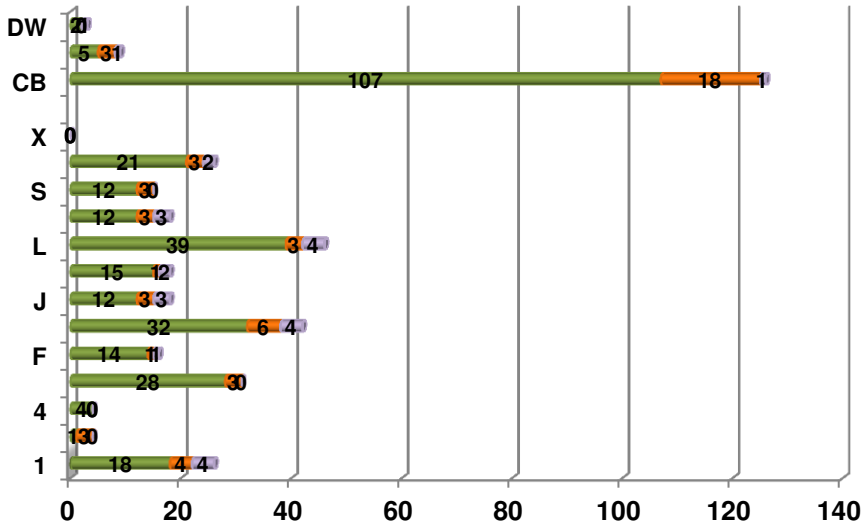


Figure 2.5. The contribution (x-axis) of each adult female (y-axis) to the overall production of juveniles. Green = number of living juveniles; orange = number of juveniles confirmed dead; purple = number of juveniles not found during the last survey. Juveniles discovered at Deep Well (DW) and Cedar Tank (CT); CB = juveniles produced at LDZG by two adult females.

Juvenile headstarting

The objective of the headstarting portion of the captive program is produce large numbers of tortoises for eventual release by maximizing juvenile survival rates until individuals attain a size that is relatively resistant to predation (putatively at ~ 110 mm shell length. This involves:

- Holding juveniles in a covered, predator resistant enclosure.
- Provision of supplemental food (mostly native forage) and water as needed.
- Surveying juvenile tortoises twice a year (spring/fall) to monitor growth rates and health.
- Determining the sex of the juvenile tortoises.

Since 2006, our captive population has grown by over 950%, with at least 350 adult and juvenile tortoises in population at the end of 2013. Turner Ranches currently house around 330 of these individuals (Table 2.4). LDZG currently holds 39 juveniles and 4 adults, but the juveniles will eventually be transferred to the Turner Ranches.

The persistent severe drought that extended into the early part of 2013 was replaced in August and September by heavy rains and severe flooding. Thus, management of juveniles required various throughout the year. During the early, dry part of the year, we watered pens about once a week, transplanted vegetation (e.g. globemallow, portulaca) into headstart pens, and supplemented native forage diet with hay (i.e. mixed grasses and alfalfa).

During the months that followed the rains, our biggest challenge was to keep abreast of the weeds that cropped up: tumbleweeds (Russian thistle) in the Armendaris juvenile pen, and desert holly in the Ladder headstart pen.

Table 2.4. Locations of juveniles in winter 2013/14.

Location	# found in 2013	# not found in 2013
LDZG	39	
El Paso Zoo	4	
ARM-TP-CB	13	1
ARM-TP-T	72	19
ARM-ST	21	
ARM-CT-JUV	18	1
LAD-HS	59	7
LAD-OWT	79	
LAD-BP	25	
MORTALITY	58	
TOTAL	**416**	**28**

KEY:
ARM-TP-CB = Armendaris Truett Pen – CB section
ARM-TP-T = Armendaris Truett Pen – Turner section
ARM-ST = Armendaris stock tank (infirmary)
ARM-CT-JUV – Armendaris Cedar Tank Pen (juveniles)
LAD-HS = Ladder Headstart Pen
LAD-OWT = Ladder overwinter tanks (hatchlings)
LAD-BP = Ladder Big Pen

Tortoise Surveys and Health Checks

We surveyed tortoises in spring and fall of 2013, and invited Dr. Jim Jarchow, DVM to perform health checks on our captive population. The 2013 health checks revealed few major issues, but they did identify two individuals with eye infections that required treatment. Overall, all of the juveniles and adults are in good or excellent health. Both the health checks and growth surveys allowed us to identify juveniles that might need additional management to attain their full growth potential. Such individuals were placed into stock tanks on the Armendaris, and their diets supplemented with leafy greens and frozen peas.

During growth surveys, we measure tortoise weight, as well as shell length, width, and height. These measurements allow the calculation of growth rates, and we gain a measure of survivorship. These surveys are our first line of defense against problems such as malnutrition, dehydration, and disease.

During the fall surveys and health checks we found ~330 juvenile tortoises alive and well, but could not locate 28 individuals and found several dead animals. Comparisons between spring and fall measurements of shell length allow us to calculate growth rates.

Overall, our efforts to manage forage for captive juveniles provided the animals with sufficient nutrition to attain, on average, an 11% increase (range: 1.8 – 25.3%) in shell length at the Ladder headstart pen and a 10% increase (range: 0.8 – 25.3%) in the Armendaris pen, during 2013 (Figure 2.6). These are acceptable growth rates that show that our 2013 management strategies were successful.

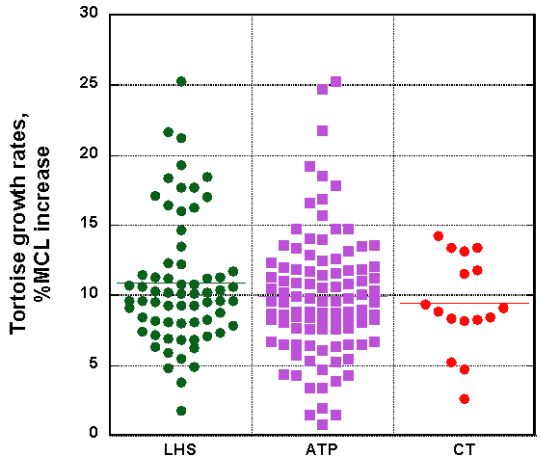


Figure 2.6. Juvenile tortoise growth rates (spring to fall, 2013) in the Ladder Headstart pen (LHS), the Armendaris Truett pen (ATP), and the Cedar Tank pen.

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, keeping track of the temperatures experienced by each individual. In 2013, 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. Members of the bolson tortoise recovery team were trained in this endoscopy procedure by world-renowned reptile endoscopist, Dr. Steve Divers, DVM. This involved:

- Collection and sorting of tortoises.
- Soaking tortoises in tepid water one or two days ahead of the scoping day.
- On scoping day, tortoises were again briefly soaked in tepid water immediately prior to anesthesia to encourage them to empty their bladders – a technique which greatly facilitated the endoscopy procedure by ensuring that the bladder was not in the way.
- Tortoises were weighed and their heart rate monitored before being anesthetized.
- Each animal was given an analgesic in addition to the sedative.
- Once fully anesthetized (i.e., unresponsive to painful stimuli; this took between 10 and 30 min), the incision site was scrubbed and prepared for surgery (injected with the pain killer lidocaine).
- The veterinarian made a small incision in the prefemoral space and inserted the endoscope (Figure 2.7).

Figure 2.7. El Paso Zoo veterinarian, Dr. Vikki Milne, using endoscopy to determine the gender of this juvenile bolson tortoise.

Once the sex of an individual tortoise was determined the veterinarian sutured the incision, and the tortoise was given a reversal of the anesthesia to speed up recovery. Tortoises were then placed in a warm chamber and monitored for movement and heart rate. Most tortoises recovered within 30 minutes.

The tortoises were allowed to recover indoors and were monitored over the next two to three days. We examined incisions and suture sites for redness, swelling, and persistence of the suture before releasing them near their home burrows.

We scoped a total of 175 juvenile tortoises during 4 separate endoscopy sessions between February and September of 2013. Of the 175 tortoises scoped, only one tortoise's gonads appeared too immature to assign sex. We identified 84 tortoises as female and 90 tortoises as male. As expected, the tortoises incubated at warmer temperatures were mostly female, while tortoises incubated at cooler temperatures were male (Figure 2.8).

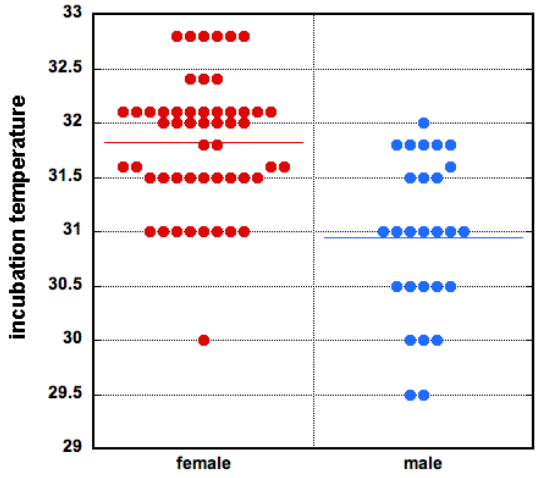


Figure 2.8. Results of endoscopy work showing that eggs incubated at higher temperatures tend to develop into females, while cooler incubation temperatures produce more male hatchlings.

Pseudo-release studies

To ensure that we have as much information as possible for designing a release strategy for establishing wild populations we implemented a pseudo-release study of juvenile bolson tortoises in September 2012. This involved transferring juveniles from a predator resistant headstart pen (Truett pen) to an 18 ha, predator accessible adult enclosure (Cedar Tank pen) and following their movements.

In fall 2012, we fitted 10 juveniles (minimum shell length = 110 mm; Figure 2.9) with radiotransmitters (Figure 2.10) and translocated them to the Cedar Tank adult holding pen on the Armendaris.

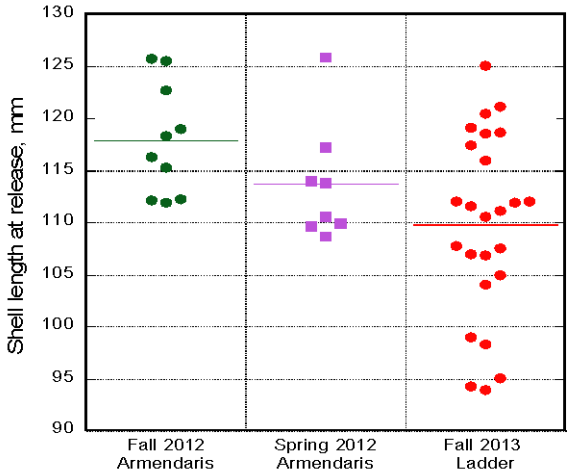


Figure 2.9. Shell length of juveniles transferred to predator permeable enclosures as part of pseudo-release study.

Figure 2.10. Juveniles fitted with radiotransmitters prior to transference to predator permeable enclosures.

We determined that all of the juveniles located or constructed overwintering burrows by late October 2012. Nine of the 10 juveniles emerged in spring 2013, but one juvenile died during the winter. We excavated the carcass and determined that the mortality was not attributable to predation. Our concerns about the protective properties of three of the overwinter burrows that were particularly shallow (see the 2012 annual report) were unfounded: all three juveniles of concern (08-CB19, 09-CB37, and 10-CB49) were still alive at the end of 2013. Indeed, 08-CB19 is still in the same location but deepened his burrow once the rains started and made the soil soft enough to dig. 09-CB37 and 10-CB49 have relocated since they emerged in the spring, and are spending the 2013/14 winter in well-constructed burrows.

In spring 2013, we fitted a second cohort of 8 juveniles with radiotransmitters and transferred them to the Cedar Tank enclosure on the Armendaris. Initially, we monitored these juveniles frequently to ascertain their safety, as the daytime temperatures were beginning to approach lethal levels for exposed tortoises, but decreased the frequency of tracking to once a day – and eventually to once a week – as the juveniles began to settle into burrows.

The second tortoise cohort transferred to Cedar Tank in spring 2013 was doing well, but in mid-July we discovered the remains of one of the juveniles that had apparently been predated (Figure 2.11). This predation event appears to have been an isolated case, and the remaining juveniles survived to the end of the 2013 active season.

Figure 2.11. Predated carcass of 10-CB56 which had been transferred to the Cedar Tank enclosure in spring 2013.

We tracked both release cohorts throughout the summer and fall of 2013, until they settled into overwinter burrows in early November. All overwinter juvenile burrows being used during the 2013/14 winter were well-constructed, and only one juvenile (08-CB19) is using the same overwinter burrow as the previous year. These juvenile pseudo-releases allowed us to conduct preliminary analyses on factors relevant to designing a strategy for true releases in the future.

All but one of the Armendaris pseudo-released juveniles were endoscoped in the fall of 2013; these animals were found to comprise both males and females. We examined potential gender differences in extent of movement. In all comparisons, the metric we used was the linear distance between release site and overwinter burrow or between the year-1 overwinter burrow and the year-2 overwinter burrow (Figure 2.12). There appeared to be no difference between the distances moved by males or females. Overall, juveniles transferred to the large Armendaris enclosure moved on average 53.0 +/- 41.2 m (range: 0 – 168.6 m; Figure 2.13). All but one individual of the fall 2012 CT release cohort moved to a different site for the 2013 winter, but distances between overwinter burrows were shorter than distances between the release site and the first overwinter burrow (Figure 2.12).

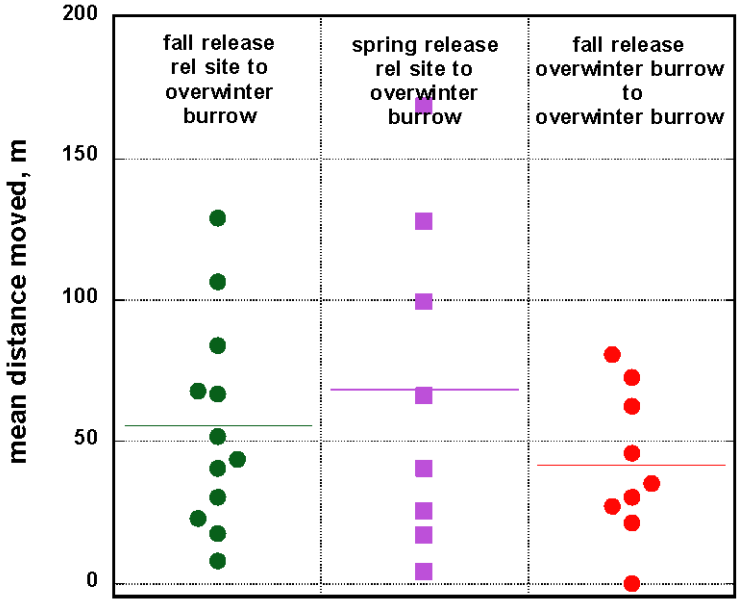


Figure 2.12. Summary of pseudo-release results. Distances between release sites and first overwinter burrows, and the distance between the first and second overwinter burrows. Each data point indicates an individual juvenile's movement. Averages indicated by horizontal lines.

To evaluate the effects of this "no management" strategy on the pseudo-released tortoises, we surveyed all tortoises in the spring and fall of 2013. We found that the first cohort of juveniles, transferred to the Cedar Tank pen in fall 2012, had an average growth rate of 7.4% (range: 2.7 to 14.3%; Figure 2.14).

Juveniles released in the spring exhibited even stronger growth, with an average increase in shell length of 10.8% (range: 8.2 to 13.4%). Fall 2013 health assessments showed that all juveniles examined were healthy and in "excellent" body condition, with the exception of 09-CB35, who was in "good" body condition. These growth rates are comparable to those recorded in the heavily managed headstart pens.

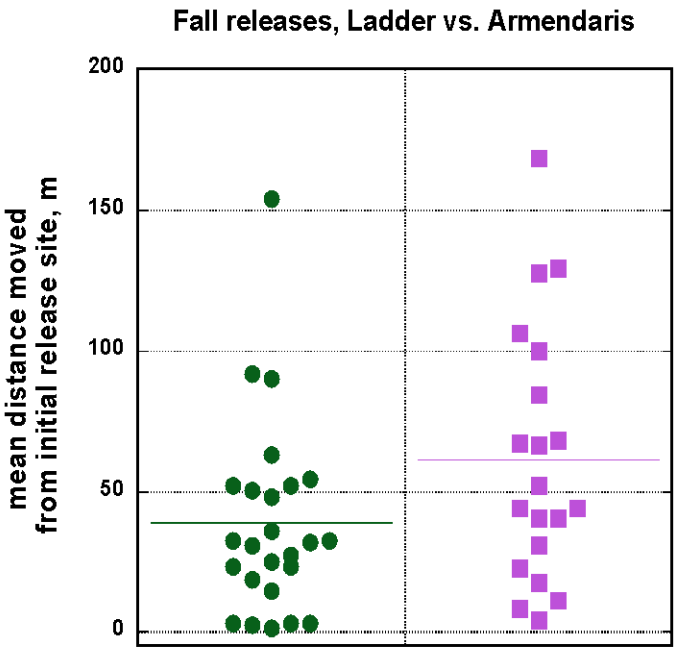


Figure 2.13. Distances moved by animals released on the Ladder or the Armendaris.

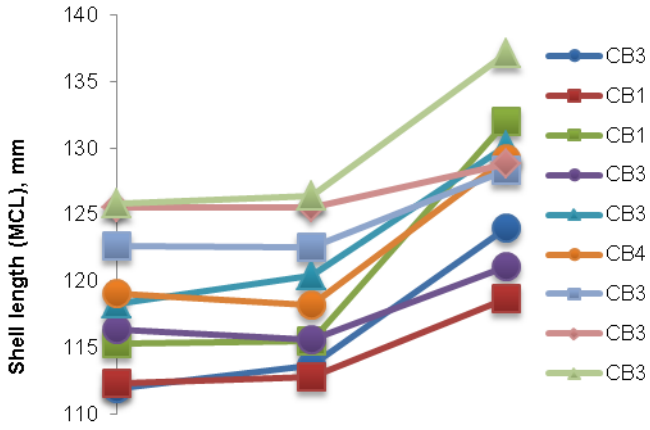


Figure 2.14. Growth curves (since pseudo-release) for juveniles transferred to the Cedar Tank pen in fall 2012.

In 2013, we expanded our pseudo-release study to include the large, predator permeable tortoise enclosure on the Ladder Ranch. We transferred a total of 25 transmittered juveniles to this "Ladder Big Pen". The strategy we employed on the Ladder was to "release" all animals within a few dozen meters of each other. We also included relatively smaller animals in the Ladder pseudo-release cohort: 5 animals were 90 to 100 mm shell length and 6 animals were 100 to 110 mm. In contrast, all animals released on the Armendaris were at least 110 mm long). To limit the number of variables, we released only male juveniles in the Ladder Big Pen.

We made the following observations and drew the following conclusions from our pseudo-release studies thus far:

- Juveniles explore their surroundings, but tend to settle within ~70m of their release site.
- Juveniles are capable of digging their own burrows, but will readily take advantage of existing rodent burrows as well.
- Juveniles use a number of different burrows in a given year, but rarely return to a previous burrow location.
- We were surprised to find that all but one of the first pseudo-release cohort chose new overwinter burrows for their second winter.
- Juveniles appear to be aware of the locations of their conspecifics, and visit each other and share a burrow for a night or for a winter. However, each juvenile appears to have a preferred burrow of its own to which it tends to return. While three juveniles shared one overwinter burrow at Cedar Tank during their first winter, all juveniles went on to occupy separate burrows during their second winter. On the other hand, there are four groups of at least two juveniles in a burrow on the Ladder.
- Juveniles tend to settle near each other.
- Juveniles appeared to exhibit no homing behavior during the first year following pseudo-release.
- Releasing tortoises in clusters appears to reduce the distance they travel before settling into a burrow.
- Fall releases seem safer for the animals as maximum daytime temperatures start to cool down rather than heat up. The disadvantage of a fall release might be a relatively short time for the tortoises to prepare for hibernation in a new environment.
- It may not be necessary to confine released tortoises inside temporary enclosures to prevent them from dispersing (i.e. soft-release).
- We detected no difference in the distance moved by male and female juvenile tortoises.
- It will be interesting to see whether bolson tortoises begin to disperse when they reach sexual maturity.

The "wild" one lives?

In 2012, we captured an image of an unmarked juvenile tortoise on one of the trail cameras deployed in the Cedar Tank pen. Subsequent attempts to locate this individual have since proven unsuccessful. In summer 2013, we captured another image of an unmarked juvenile tortoise with a trail camera (Figure 2.15). Because the 2012 and 2013 photographs were taken of different sides of the tortoise, we are unable to determine whether they are of the same individual. However, it is exciting to have confirmation that juveniles that have hatched out naturally in the Cedar Tank pen, and can survive undetected for years. We continue to be on the lookout for unmarked tortoises in the adult pen.

Figure 2.15. Two images captured on trail cameras in August 2012 (top) and June 2013 (bottom) suggest that at least one un-marked, juvenile bolson tortoise roams around in the Cedar Tank adult pen.

Husbandry strategies: adult tortoises

Our preferred approach to managing the adult breeding colony is to manage as little as possible and allow the tortoises to live with minimal human disturbance and interference. Towards this end, we survey the group twice a year in the spring and in the fall but otherwise leave them alone. However, we do currently intensively manage adult females during nesting season (April – July).

The spring 2013 health survey revealed that most of the tortoises seemed lightweight and possibly slightly dehydrated. We therefore repeatedly and intentionally flooded small sections of the adult enclosure, and then extracted (adult) tortoises from their burrows and placed them directly into the puddles to give them a drink (Figure 2.16). In addition to providing direct relief from the extended drought for the tortoises, the irrigation water also allowed native forage plants to grow and provide ample food for the tortoises for weeks before the summer monsoons greened up the rest of the area. Thus, the flooding greatly extended the foraging season for all of the adult tortoises and thus likely contributed to the overall excellent health and wellbeing of the adult tortoises - as well as the robust egg production by the females.

Figure 2.16. An adult tortoise taking a drink.

A potential downside of this strategy (and something that needs to be carefully monitored if this strategy is to be employed on a regular basis) is that "focalizing" water and forage in this manner has the potential to attract predators. However, the relatively close proximity to several water-filled dirt tanks probably helped to alleviate this pressure on the tortoise enclosure.

Husbandry strategies: juvenile tortoises

Our approach to juvenile management is to house young tortoises in predator-resistant enclosures (headstart pens) until they are deemed large enough to have a measure of resistance to predation. This requires ensuring the availability of adequate forage. In the headstart pens on the Armendaris and the Ladder, this has meant regular and frequent irrigation and transplanting large numbers of forage plants (globe mallow, portulacas, grass sod) into the pens. In principle, each pen can support large numbers of tortoises given the availability of sufficiently large supplies of forage. In reality, supplying forage in the required amounts is very challenging in the desert, especially during a drought.

Two factors compelled us to overwinter the 2013 hatchlings not outside where they can hibernate, but to keep them up and continue to feed them through the winter: space issues in the juvenile holding facilities, and a compounding

gopher problem in the Ladder headstart pen. We constructed a greenhouse-like tortoise overwintering facility from dirt-filled tubs and clay tiles. Each tub holds up to 20 tortoises. The tortoises are fed a combination diet of leafy greens (collards, kale) and frozen/thawed peas as well as grass hay and ZooMed grassland tortoise diet, and they are watered every other day (no standing water in the tubs). Heat lamps and self-ballasted MegaRay UV bulbs supply basking spots and UV light. The tortoises will remain in these tubs until the outside temperatures are sufficiently warm for juveniles in the outdoor pens to emerge from hibernation (expected in April 2014).

What we hope to accomplish with this intensive management strategy is to raise a cohort of tortoises that reaches a releasable size in less time, thus spending overall less time in the predator-resistant enclosures and consequently requiring less management over their lifetime.

Husbandry strategies: Kinship analysis to ensuring optimal genetic make-up

Our ongoing collaboration with Taylor Edwards at the Genetics Core of the University of Arizona in Tucson will inform our management strategies regarding optimal combinations of breeding pairs. To date, the genetic analysis has yielded information about both genetic diversity and paternity. Now that the tortoises located on the Turner Ranches are contributing to the captive population (albeit not yet equally – see Figure 2.5), the good news is that the genetic diversity of the group is largely being maintained. The analysis also showed that, unfortunately, most of the offspring coming from the LDZG are sired by only one of the males there (Mr. B.). Combined with the endoscopy results, these results suggest that the breeding program at the LDZG is preferentially generating male Mr. B. clones (about half of whom have Mrs. B. as a mother and the other half, a tortoise we named CBF for "Carlsbad female"). Our recommendations for the LDZG are to sequester Mr. B. away from the females, and to elevate the temperature of at least some of the tortoise egg incubators to increase the proportion of females (n.b., the cohorts produced at the LDZG in 2007 and 2008 are exclusively female and approximately 50% female, respectively; starting in 2009, tortoise cohorts are mostly (2009) or exclusively (2010 onward) male). Alternatively, the LDZG may decide to suspend their breeding program for now.

Our goal for the paternity analysis is to generate a graph for the male tortoises similar to the graph we show in Figure 2.5 for female tortoises. Ultimately, the goal is to use these charts to identify the most genetically diverse tortoises and choose unrelated individuals as founders for the future reintroduced populations on the Armendaris and the Ladder Ranches.

Proposed Future Activities and Considerations: Our main objectives for 2014 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. These releases will be informed by information gained from the pseudo-release studies begun in 2012 that involved translocating juveniles into the large adult enclosures on the Armendaris and Ladder Ranches and following their survival and movements (contingent on funds and federal and state permits).

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

- Collecting eggs and incubating these in incubators to ensure maximum hatchling production.
- Surveying the tortoise population twice a year.
- Monitoring forage availability.
- Enhancing available forage.
- Using endoscopy on the remaining "eligible" juveniles to refine our understanding of incubation temperature and population sex ratio.
- Obtaining additional kinship information to complete the studbook (contingent on funds).
- Exploring the potential of the Armendaris Truett pen to function as a maternity pen.
- Transferring juveniles to large, adult pens to free up space in the headstart pens.
- Monitoring pseudo-released juveniles to determine survivorship and movements (we may supervise a graduate student or intern to study tortoise home ranges).

3. CUTTHROAT TROUT

Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) – ESA listing: NOT LISTED

Rio Grande cutthroat trout (*Oncorhynchus clarkii virginalis*) – ESA listing: CANDIDATE

PROJECT STATUS: *Ongoing*

Principal biologist:
- *Carter Kruse*

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 (additional information):
- RGCT were listed as a federal candidate species under the ESA in 2008 and are currently undergoing another status review for listing determination. The subspecies is considered a Species of Greatest Conservation Concern/Need by the New Mexico Department of Game and Fish and Colorado Parks and Wildlife.
- WCT are not listed under ESA, but 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, MT – WCT
NF Spanish Creek, Flying D Ranch, MT – WCT
Green Hollow Creek, Flying D Ranch, MT – WCT
Greenhorn Creek, Snowcrest Ranch, MT – WCT

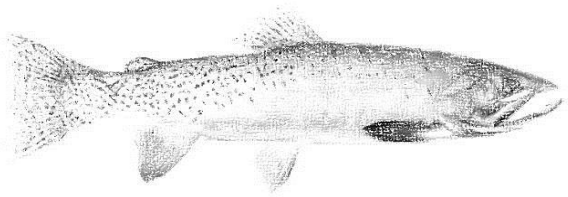
Table 3.1. Cutthroat trout conservation projects on Turner Ranches under the TBD Cutthroat Trout Initiative

Stream	Ranch	Species	Project length (km)	Status
Cherry	FD	WCT	100	Trt. complete: 2012 Restock. complete: 2013 Res. & Mon.: ongoing
Spanish	FD	WCT	30	Plan. & develop.: ongoing
Green Hollow	FD	WCT	4	1-2 yr from complete eradication (90%)
Bear Trap	FD	WCT	8	Under consideration
Greenhorn	SC	WCT	32	Trt. 50% compete
Costilla	VPR	RGCT	175	Trt. 60% compete Restocking underway
Las Animas	LAD	RGCT	48	Advanced planning Trt. in 2014
Vermejo	VPR	RGCT	32	Removal effort: complete Chronic maint. required

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

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

Grant Funding:
- 1999 Partners for Fish and Wildlife ($20,000)
- 2003 TU Embrace-A-Stream ($5,000)
- 2005 USFW Private Stewardship ($31,300)
- 2006 NFWF ($100,000)
- 2008 MT AFS Resource Action Fund ($2,000)
- 2009 Partners for Fish and Wildlife ($35,000)
- 2009 NM State Wildlife Grant ($100,000)
- 2010 NM State Wildlife Grant ($100,000)
- 2010 MT FWP ($5,000)
- 2010 US Forest Service ($2,500)
- 2011 USFS Res. Advisory Council ($20,000)
- 2011 MT FWP Future Fisheries ($81,983)
- 2013 Partners for Fish and Wildlife ($24,900)



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 and 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 cold water stream habitat within the historical range of WCT and RGCT. In conjunction with neighboring public lands these ranches encompass entire stream headwaters, an important consideration when prioritizing and securing restoration sites. Although small restoration projects (e.g., <15 km of stream) are important to preserve presence and genetic variability on the

landscape, cutthroat conservation projects most likely to succeed over the long-term are those that encompass large areas allowing expression of multiple life histories and connecting multiple, local sub-populations – inferring a better chance of withstanding localized extinctions and changing habitat conditions. Through the *RGCT* and *WCT Range-Wide Conservation Working Groups*, TBD has partnered with public agencies and other private organizations to implement two of the largest cutthroat trout restoration projects ever undertaken in the United States.

The Costilla Creek Native RGCT Project on Vermejo Park ranch in New Mexico and Colorado is the most ambitious watershed renovation project ever initiated on behalf of any cutthroat trout, encompassing approximately 175 km of stream habitat (50% on Vermejo Park Ranch) and 18 lakes (Figures 3.1). Initial project planning in 1998 included only 25 km of stream and four lakes; but with successful application of piscicides (2002) and population recovery by 2004 (Figure 3.2), the project area was expanded in 2007 to its current size. An expanded project, with a larger area and more diverse habitat, improves the likelihood that restored RGCT in Costilla Creek will persist long term. Using temperature as an example, this one habitat variable demonstrates the importance of larger restoration areas; if Costilla Creek temperatures warm to levels intolerable for RGCT they will still be able to persist in Casias Creek, which is significantly cooler. A smaller project, which included only upper Costilla Creek (as the original project plan called for), might have proven unsustainable under a warming climate scenario (Figure 3.3).

The project is complicated due to its unprecedented size, regulatory requirements, need for at least seven man-made, temporary fish movement barriers to facilitate treatment in "phases", a 15,700 AF reservoir, and socio-political pressures. To date over 100 km of stream have been chemically renovated, with 48 km of the approximately 85 km of suitable stream habitat on Vermejo Park Ranch completed (Figure 3.1). If this project is fully implemented as scheduled by 2020 it will represent a 20% increase in the amount of stream genetically pure RGCT currently occupy within their historical range. This project would not have been initiated without Turner support and is the flagship restoration effort on behalf of RGCT for the NM Department of Game and Fish. Planning and implementation of the Costilla Project is largely responsible for the development of consistent NM state guidelines regarding the use of piscicides, and for re-development of the Department's native cutthroat trout hatchery broodstock; both important steps for range-wide conservation of the species.

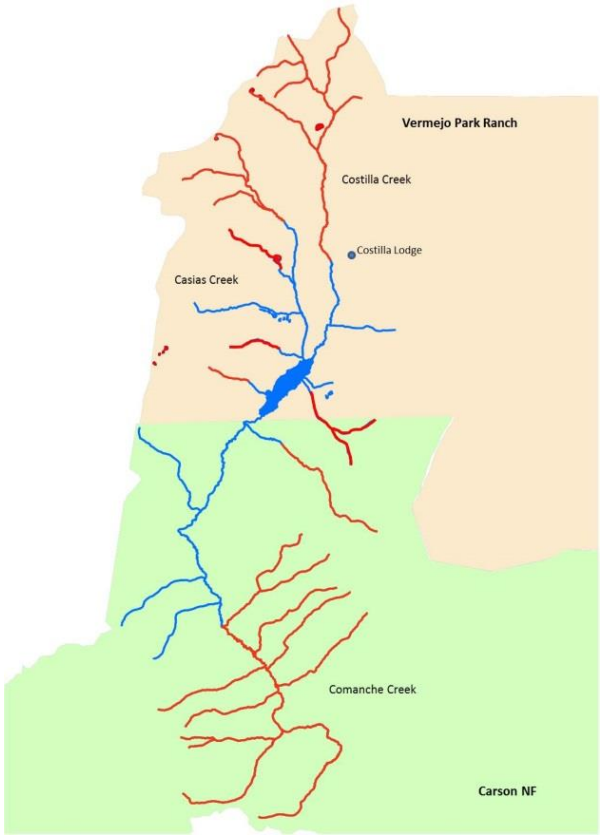


Figure 3.1. Costilla Cr. project area. Red lines indicate stream segments that have been renovated for RGCT reintroduction.

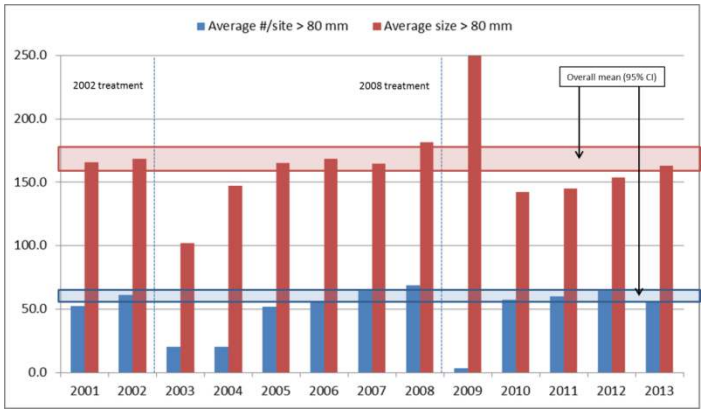


Figure 3.2. Number of trout > 80 mm per 100 m of stream (blue bars) and their average size (mm; red bars) in upper Costilla Creek before and after renovation. Piscicide treatment and restocking of RGCT occurred after the 2002 sample and again (to remove hybrids) after the 2008 sample.

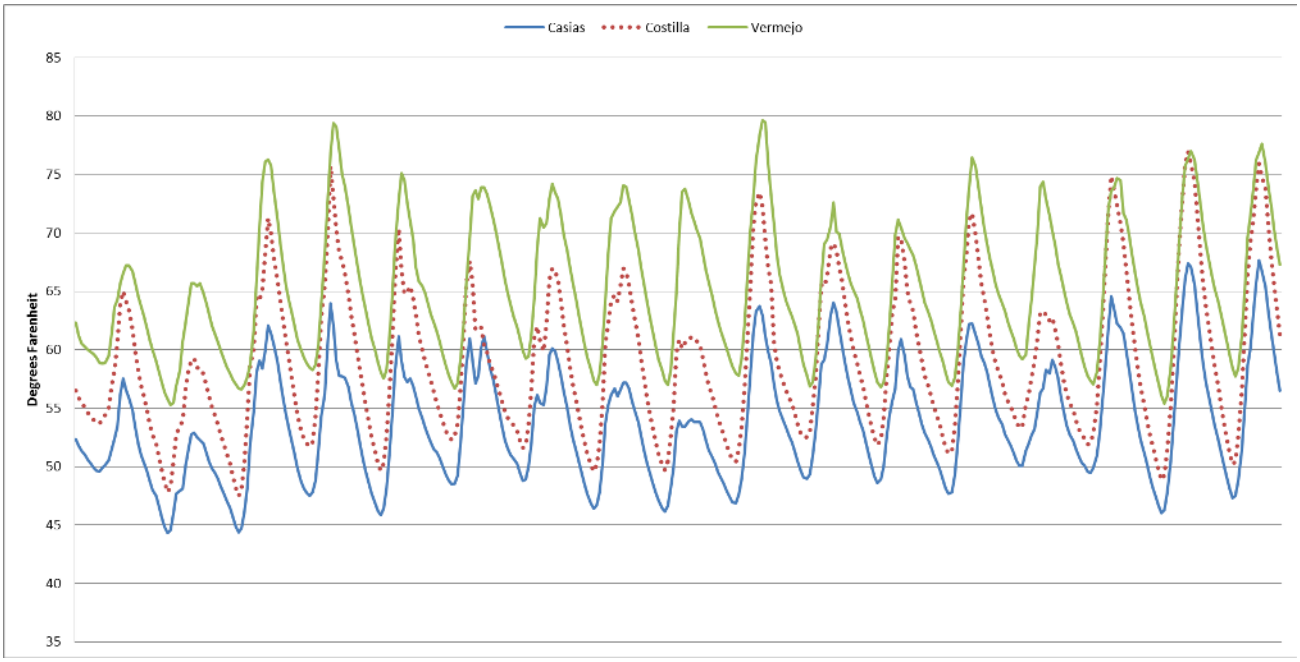


Figure 3.3. Daily stream temperatures for the period July 15-31, 2013 showing the difference in water temperature between Casias (blue solid) and Costilla (red dotted) creeks, which both flow into Costilla Reservoir in the Costilla Creek project area. The difference in this one habitat variable demonstrates the importance of larger restoration areas; if Costilla Creek temperatures warm to levels intolerable for RGCT they will still be able to persist in Casias Creek, which is significantly cooler. A smaller project, which included only upper Costilla Creek (as the original project plan called for), might have proven unsustainable under a warming climate scenario. Vermejo River temperatures (solid green) demonstrate the impact of lower elevation and riparian condition on stream temperatures, which often exceed upper limits for trout at this location, in part due to lack of streamside shade.

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 habitat suitable for cutthroat trout (Figure 3.4), and is the largest piscicide renovation project ever completed for the purpose of cutthroat trout conservation. The project began with establishment of a collaborative working group, feasibility analyses, and environmental planning in 1997. Opposition to the use of piscicides and nonnative fish removal, through a series of legal and administrative challenges, delayed initial piscicide application until 2003. Piscicide applications were completed in 2010. In 2006, WCT introductions began via remote stream-side egg incubators and were completed by stocking young of year fish in 2012. Approximately 37,000 eyed eggs and 8,500 young of year fish from multiple wild populations and a hatchery conservation broodstock were introduced to the project area. WCT are now found throughout the project area and successful reproduction is occurring – two important benchmarks of success. The Cherry Creek project is a significant conservation achievement for WCT on the east side of the continental divide. This project increases the extent of stream occupied by WCT in the Madison River basin from 7 km to over 100 km or from 0.3% of historical occupancy to almost 5%. Perhaps more importantly the success of the Cherry Creek project, and lessons learned from, has catalyzed several other cutthroat trout re-introduction projects in southwestern MT. The scope of this project has allowed innovative research on relative survival, growth and dispersal of cutthroat trout source stocks; the impacts of piscicides on non-target organisms; movement and colonization of fish in renovated habitats; and the genetic fitness of multiple source stocks.

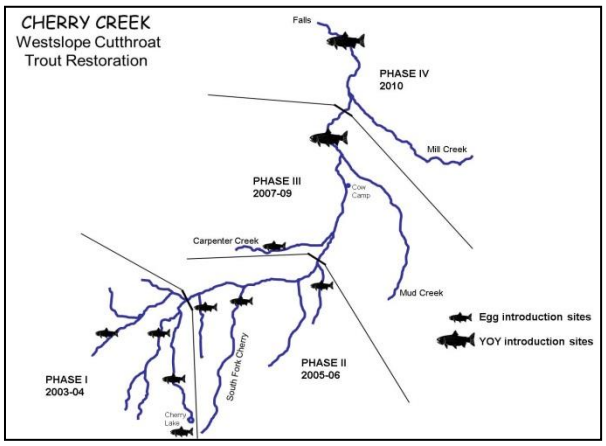


Figure 3.4. Cherry Creek project area.

To date, five graduate students have used different aspects of the project to receive doctoral and master's degrees. This research and resulting publications in peer reviewed scientific journals will be invaluable to guide and improve future aquatic conservation efforts. TBD assisted MT FWP and USFWS with the development of a Candidate Conservation Agreement with Assurances (CCAA) for westslope cutthroat trout in MT, and Cherry Creek was one of the first conservation areas to be included under the CCAA.

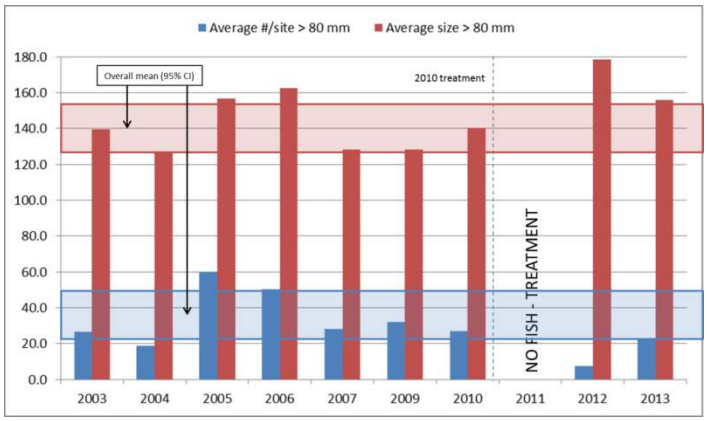


Figure 3.6. The number of trout > 80 mm per 100 m of stream (blue bars) and their average size (mm; red bars) in upper Casias Creek before and after renovation. Piscicide treatment and restocking of RGCT occurred after the 2011 treatment. Prior to the 2010 treatment the population was primarily brook trout.

Project Activities in 2013:

Costilla Creek – In 2013 TBD installed a temporary fish migration barrier (sixth of seven that will be needed for the overall project) on Beaver Creek (Figure 3.5) and chemically treated 3.7 km of creek and Beaver Lake above the barrier for the first time.

Figure 3.5. Beaver Creek temporary fish migration barrier.

An additional 6.0 km of stream were treated above barriers for the second time in Allen and Dominquez creeks. No fish were seen during these second treatments, suggesting renovation was successful. In late summer, 1,250 young of year and age-one RGCT were stocked into Allen Creek. Dominquez Creek will not be immediately stocked, but held as a reserve site for emergencies (population salvage due to forest fire for example). A final stocking of 1,000 young of year RGCT was put into Casias Creek above the temporary fish migration barrier. Monitoring of restored RGCT populations in Casias and Costilla creeks with electrofishing continued in 2013. Populations are recovering as expected and the upper Costilla Creek population is similar in number and average size to the pre-treatment salmonid population (Figures 3.2 & 3.6). To support the recreational angling program at Vermejo Park Ranch RGCT were stocked into Glacier Lakes #2 and #3. A CCAA for Rio Grande cutthroat trout in the Costilla Basin was signed by VPR and the USFWS in June. This document recognizes the RGCT conservation actions implemented by VPR and provides operational assurances to the ranch should the species become listed under ESA.

Vermejo River – TBD completed the fourth and final year of an intensive hybrid removal effort in the upper (above headquarters bridge) 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). The project had three objectives: reduce or eliminate rainbow trout hybrids in the upper Vermejo River watershed to maintain or reduce the current level of introgression; reduce BKT numbers in the upper Vermejo River watershed to maintain and perhaps enhance RGCT populations; and determine current sources of rainbow trout invasion in the drainage. To accomplish the first two objectives over 30 km of the upper Vermejo River drainage was electrofished multiple times to remove non-native fish. Approximately 2,735 BKT were removed from the watershed in 2013, bringing the four year removal total to 17,842 BKT (Table 3.2). Most importantly, 20 confirmed rainbow x cutthroat trout hybrids were removed from the watershed over the four year period, including two in 2013, helping to keep the genetic status of Vermejo River RGCT at least 99% pure.

Table 3.2. Number of brook trout removed by electrofishing over four 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

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 has destabilized banks and impacted water quality to the detriment of native fishes (Figure 3.7). In 2013, Turner Biodiversity applied for and received a $25,000 Partners for Fish and Wildlife Grant from the US Fish and Wildlife Service to construct exclosure fencing along sections of the upper Vermejo. That money will be matched by Turner Biodiversity and Vermejo Park Ranch to construct three, ½ mi, 8 ft. high ungulate exclosures in 2014 in attempt to improve riparian conditions over the next decade. Ultimately, the goal is to enhance riparian conditions and restore beaver (*Castor canadensis*) to promote long-term riparian health, RGCT persistence, and natural water storage in the upper Vermejo system.

Figure 3.7. The upper Vermejo River showing limited riparian habitat due to drought and over browsing.

Las Animas Creek **–** This project was initiated in 1998 and 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. This effort has languished since 2003 due to other priorities among partners, social resistance, and the presence of the threatened Chiricahua leopard frog. However, in 2013 a draft environmental assessment (EA) that analyzed re-implementation of the project was completed, and is currently under final review in anticipation of a 2014 piscicide application to remove non-native longfin dace (*Agosia chrysogaster*) and hybridized rainbow x cutthroat trout from the project area. In June 2013, the Silver Fire burned the entire National Forest portion of the watershed resulting in significant flood and ash flows during the following summer monsoon season (Figure 3.8). It is probable that these flows killed most of the fish in the project area. Stream sampling in August indicated that fish survived only in off channel refugia such as small springs and tributaries not impacted by the fire – potentially simplifying the planned piscicide treatment.

Figure 3.8. Ash and sediment flow in Las Animas Creek during August 2013 after the Silver Fire. Note the sediment deposition along banks from previous higher flows.

Cherry Creek **–** TBD continued to monitor the recovery of WCT in the Cherry Creek project area on the Flying D Ranch. Electrofishing sampling in 2013 showed *a*) the WCT population is rapidly expanding and approaching pre-treatment densities (Figure 3.9); *b*) essentially the entire extent of stream that contained trout prior to treatment is now occupied by cutthroat trout; *c*) no non-natives remain in the project area; and *d*) natural reproduction is occurring throughout the watershed, including the Butler Reach where wild young of year WCT were documented for the first time. Over 3,480 WCT in the project area (600 individuals in 2013) have been individually marked with PIT tags and, through regular sampling and remote antennas, these fish have been "recaptured" times, providing us with a better understanding of survival, movement, growth, and genetic fitness of the introduced population.

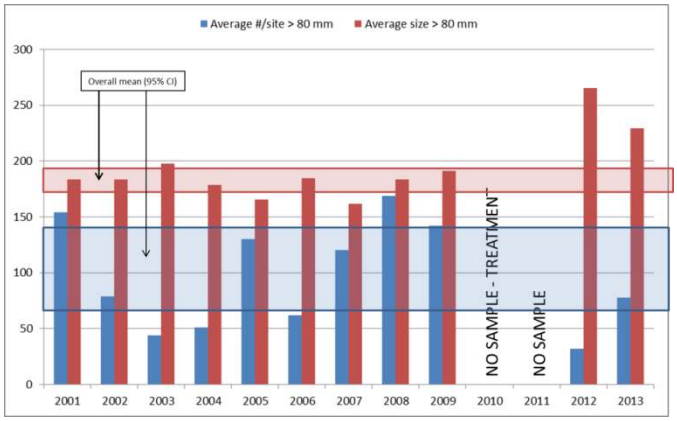


Figure 3.9. The number of trout > 80 mm per 100 m of stream (blue bars) and their average size (mm; red bars) in the Butler Reach of Cherry Creek before and after renovation. Restocking of WCT began in 2011. Prior to the 2010 treatment the population was comprised of brook and rainbow trout.

In a novel effort, TBD began testing the ability of scent dogs to detect fish in water as a way to be more efficient at detecting rare or hard to find aquatic species (Figure 3.10). For example, rather than spending 100's of man hours looking for remaining fish after a piscicide treatment (or newly invading or nuisance species), dogs might be able to survey a drainage faster. Initial results were encouraging in that dogs can smell fish in water, but additional work needs to be completed to determine if they can find fish at low densities.

Figure 3.10. Scent dogs conducting trials to locate fish in water.

NF Spanish Creek – Since the majority of this project is on public land, Montana Fish Wildlife and Parks is the lead agency and began public scoping for the environmental assessment in 2013; but preparation for this proposed project, partially on the Flying D Ranch, continues to move slowly. TBD assisted with continuing to gather pre-treatment information – population monitoring was conducted at standard sites in September and fish distributions throughout the watershed continue to be mapped. In October, 80 genetically pure WCT were captured in Bostwick Creek on the west side of the Bridger Mountains and transplanted to Placer Creek, a fishless tributary in the NF Spanish Creek watershed. The Bostwick population of WCT is declining due to competition with BKT and hybridization with rainbow trout, thus all fish that visually appeared to be cutthroat trout were captured, genetically tested, and, if pure, moved to Placer Creek. Upper Placer Creek was fishless due to a natural barrier falls in the drainage. The Bostwick fish could serve as a founding source for a restored NF Spanish Creek WCT population.

Greenhorn Creek – Final planning and environmental documents were completed for the Greenhorn Creek WCT restoration project on the Snowcrest Ranch. Pre-treatment fish population monitoring was conducted for the final time at six 100-m electrofishing sampling sites in July to document the density and size-range of the existing salmonid population. In late July, a few remaining aboriginal WCT in the NF Greenhorn Creek were captured and held in live cars immediately prior to piscicide application. The 32 km project area, including the NF and SF of Greenhorn Creek, was successfully treated with rotenone for the first time during the last week of July. Salvaged WCT were released back into the creek. When completed in 2014, this project will represent a significant conservation gain for WCT in the Ruby River drainage.

Green Hollow Creek – Since 2003, in an effort to reduce disease and competitive pressures on the Green Hollow II arctic grayling (*Thymallus arcticus*) conservation broodstock, TBD has mechanically (i.e., electrofishing) removed brook trout from upper Green Hollow Creek to reduce BKT numbers. In 2010 the focus of the removal program shifted from reduction to elimination in anticipation of reintroducing WCT to upper Green Hollow Creek (above Green Hollow Reservoir #2). Removal activities are conducted opportunistically as scheduling allows. In 2013 approximately 590 BKT were removed from upper Green Hollow Creek, bringing the 11 year total number of fish removed to 14,453 (Figure 3.11). Few adult or spawning fish were captured in 2013, suggesting that BKT extirpation above the fish barrier could occur with additional effort in 2014. The Green Hollow fish migration barrier was

modified in 2013 to prevent BKT passage during high waters (as was observed in 2011). Montana Fish Wildlife and Parks is exploring upper Green Hollow as a potential refugia site for Gallatin Drainage WCT stocks, which are nearly extinct.

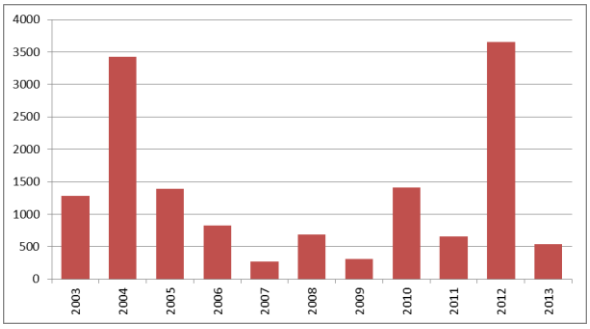


Figure 3.11. Number of non-native BKT removed from Green Hollow Creek. Note that high spring flows in 2011 allowed a few adult BKT to pass the fish barrier and spawn in the creek, resulting in large numbers of young BKT to be captured in 2012. Barrier was modified in 2013 to prevent a recurrence. Otherwise, variability in catch is partially due to differential effort on an annual basis.

Proposed Future Activities and Considerations:

Over the past decade, TBD has developed both capable partnerships and considerable field expertise that, with a little luck, should drive the *Cutthroat Trout Initiative* to a successful conclusion. 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.

Dr. Carter Kruse stocking Cherry Creek with westslope cutthroat trout.

4. BLACK-FOOTED FERRET

Mustela nigripes
– ESA listing: ENDANGERED

PROJECT STATUS: *Ongoing*

Principal biologist:
- *Dustin Long*

Conservation Problem: The near extinction of black-footed ferrets was a direct result of the range-wide decline of their primary prey item — prairie dogs (*Cynomys spp*.). Prairie dog conservation remains the primary challenge in black-footed ferret recovery. The range-wide loss of prairie dogs, and by extension the black-footed ferret, is attributable to:

- Non-native disease—sylvatic plague (*Yersinia pestis*)
- Loss of habitat and habitat fragmentation
- Human persecution

Conservation Status (additional information):
- The black-footed ferret was first listed as endangered throughout its historical range in 1967 under the Endangered Species Preservation Act—the predecessor to the more robust Endangered Species Act (ESA). Once the ESA was passed in 1973 the species was moved to that list where it remains today.
- The black-footed ferret was listed as an endangered species under the New Mexico Wildlife Conservation Act in 1975 but was removed from this list in 1988 after surveys indicated that the species was likely extirpated in the state. Today the species is categorized as a protected furbearer, although no legal harvest has been allowed since the 1960's.
- In South Dakota the black-footed ferret is a Species of Greatest Conservation Need and is designated as a state listed endangered species.

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

Project Partners (integral to success):
- U.S. Fish and Wildlife Service
- New Mexico Department of Game and Fish
- South Dakota Game, Fish and Parks
- Cheyenne Mountain Zoo, CO

Project Funding:
- TESF

Project Goals and Objectives: Our longstanding goal has been to work with state and federal agencies and other partners in meeting downlisting criteria for the species. The most recent (2013) black-footed ferret recovery plan which includes downlisting and delisting criteria can be found at: (http://ecos.fws.gov/docs/recovery_plan/20131108%20BFF%202nd%20Rev.%20Final%20Recovery%20Plan.pdf).

In order to achieve downlisting or delisting goals the very specific habitat requirements of ferrets must be met: develop and protect large disease-free prairie dog complexes.

Project Background:

Extant black-footed ferret populations, both captive and wild, can all be traced to seven distinct 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.

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, NM (Figure 4.1). Naïve, cage reared ferrets (Figure 4.2) 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.

Figure 4.1. Pre-conditioning pens at Vermejo Park Ranch. Ferrets with pen experience have significantly higher survival rates than those without when released into the wild.

From 2005-2007 at Vermejo and 2009-2011 at Bad River, TESF took the next step in pre-conditioning ferrets and initiated wild pre-conditioning projects at those ranches. At Vermejo, female ferrets and their kits were added to an enclosure that incorporated 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 (Figure 4.3). At Bad River the same procedures were followed without the use of electric netting. After a 1-3 month wild pre-conditioning period the ferrets were captured and transported to permanent release sites. Of the ferrets used in this wild pre-conditioning strategy, 48% and 45% of those released were recaptured at Vermejo and Bad River respectively, and were subsequently sent for permanent release elsewhere.

Figure 4.2. The USFWS and other partners produce several hundred ferret kits every year in captivity. Prior to release into the wild, cage born ferrets are provided pre-conditioning experience in outdoor pens. Credit: USFWS.

Figure 4.3. TESF's "wild pre-conditioning" at Vermejo Park Ranch, NM. Electric netting was erected around the prairie dog colony prior to adding ferrets. This program was commonly referred to "ferret boot camp".

In 2008, TESF began permanent ferret releases on black-tailed prairie dog colonies at Vermejo (Figure 4.4). In 2009 TESF documented the first wild reproduction of ferrets in NM in over 75 years. Over a 5-year period of annual releases the ferret population at Vermejo fluctuated in response to variable annual spring precipitation and the effects that had on prairie dog populations. The ferret population on black-tailed prairie dogs at Vermejo fluctuated from a high of >20 ferrets in 2011 to a low of 2 ferrets (both males) in 2013.

Figure 4.4. Black-footed ferret release onto a black-tailed prairie dog colony at Vermejo Park Ranch, NM. Long-term ferret survival on black-tails at Vermejo has been poor and appears to be a direct result of the ongoing severe drought.

2012 marked the first year TESF began ferret releases on the Gunnison's prairie dogs which occupy the high elevation mountain meadows of Vermejo (Figure 4.5). Historical records and preliminary data suggest ferrets should survive better on this species of prairie dog than on black-tails provided sylvatic plague can be managed.

Figure 4.5. Black-footed ferret release on the Gunnison's prairie dogs at Vermejo Park Ranch. Credit D. Garelle.

Project Activities in 2013:

2013 represented a pivotal year for TESF's ferret recovery efforts on the black-tailed prairie dogs which occupy both the shortgrass prairie at Vermejo Park Ranch, NM and the mixed-grass prairie at Bad River Ranches, SD.

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 and declining ecological conditions on some colonies, that it is unlikely a stable ferret population can be established on this species of prairie dogs at Vermejo. In general, ferrets did very well 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 crashed. During these drought years we documented the loss of all kits and females, although male ferrets appeared to be largely unaffected by the drought. It is because of the failure of ferrets to reproduce and survive during drought years and the likelihood that droughts will become more frequent and severe in the southwest that TESF has decided to withdraw from any future ferret releases on colonies of black-tailed prairie dogs at Vermejo.

The planned ferret release at Bad River in 2013 was derailed by a plague epizootic in late 2012 which decimated the prairie dog population rendering the site unsuitable for a ferret population.

A bright spot for TESF's ferret recovery effort is on the Gunnison's prairie dog colonies at Vermejo. Historical records suggest Gunnison's in New Mexico provide better habitat for ferrets than do black-tails. In New Mexico ferret collections on Gunnison's colonies represent 89% of the confirmed historical records. Five of 20 ferrets released in the fall of 2012 were located in the spring of 2013 (Table 4.1). One of those ferrets, a female, had moved from the Castle Rock release site 6.25 miles east to a colony outside the Vermejo headquarters where she was discovered and moved back to Castle Rock in February. Twenty-six additional ferrets were released onto the Castle Rock complex in September 2013. Despite difficult fall surveying conditions, post-release monitoring suggested good 2-week post release survival and it seems likely wild reproduction occurred in 2013 although we were unable to capture those kits (Table 4.1). Conditions in the late winter/early spring are generally more conducive to ferret monitoring on Gunnison's colonies at Vermejo.

Table 4.1. Ferret releases and survey results on the Gunnison's prairie dog colonies at Castle Rock and Bremmer Park. Population estimate is determined using the following criteria: % of habitat surveyed (approximately 2/3), available high-quality habitat, recapture rates for individual ferrets, previous survey results and intuition. Please use observed ferret number only for any official correspondence or reports.

Year	Colony acreage	Release N/ (♂:♀)	Detected* N/(♂:♀)/$\hat{N}$	Notes
Spring 2012	~ 1,526			
Fall 2012		20/(11:9)	11/(6:5)/?	First release on VPR Gunnison's
Spring 2013	~2,563		5/(3:2)/8-10	1 female moved from HQ to BP in February
Fall 2013		26/(13:13)	8/(3:2:2)/?	2 unknowns probably wild born
Spring 2014			8/(1:7)/10-15	3 wild born (1:2)
Fall 2014				

KEY:
N = Total number released or observed*
BP = Bremmer Park
$\hat{N}$ = Estimated number
* = Observed during surveys

Proposed Future Activities and Considerations:

Ferret recovery on Turner properties is inextricably linked to prairie dog conservation which in turn requires active plague management. Currently the only viable plague management option is to dust prairie dog burrows with an insecticide which kills fleas which serve as the vector for the disease. As colonies have expanded on Turner properties dusting those colonies has become increasingly more demanding and has reached a point where TESF is unable to support what is necessary to maintain a ferret population in both New Mexico and South Dakota. Because of this limitation, ferret releases and ferret habitat management on Turner properties over the next several years will focus solely on the existing ferret population living on the Gunnison's colonies at Vermejo.

Fortunately, there is optimism that a cost-effective and efficacious oral plague vaccine will be available in 2017. At that time TESF expects to once again manage for black-tailed prairie dog colony growth at Bad River and soon thereafter begin permanent ferret releases there.

5. PRAIRIE DOGS

Black-tailed prairie dog (*Cynomys ludovicianus*)

Gunnison's prairie dog (*Cynomys gunnisoni*)
– ESA listing (both species): NOT LISTED

PROJECT STATUS: *Ongoing*

Principal biologist:
- *Dustin Long*

Figure 5.1. Black-tailed prairie dog.

Conservation Problem: The range-wide decline of all prairie dog species is attributable to:

- Non-native disease—sylvatic plague (*Yersinia pestis*)
- Loss of habitat and habitat fragmentation
- Human persecution (e.g. poisoning and shooting)

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

Project Partners
- None

Project Funding
- TESF

Conservation Status (additional information): Both the black-tailed (Figure 5.1.) and Gunnison's prairie dogs have been candidate species for listing under the Endangered Species Act. Neither species is currently listed nor afforded any significant state protection in NM, SD or KS.

Project Goals and Objectives: Prairie dogs are a keystone species whose presence on the landscape has a profound positive effect on biodiversity. The primary goal of TESF's prairie dog restoration project is to provide sufficient habitat to support a stable population of black-footed ferrets (see Section 4). Black-footed ferrets are an endangered obligate predator of prairie dogs that require large, disease-free prairie dog complexes in order to survive.

Project Background:

Few species engender as much controversy in the American west as prairie dogs do. Many agricultural producers view prairie dogs as competitors for a limited grass resource whose presence represents an immediate threat to their livelihood; conservationists view prairie dogs as a keystone species whose presence on the landscape meets the very specific habitat requirements of numerous imperiled species. The TESF seeks to find that balance where prairie dogs and associated ecological processes and species assemblages can exist in harmony with for-profit endeavors (e.g., bison ranching and big game hunting).

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

Prairie dog restoration on Turner properties began in 1997 with the development of a reliable prairie dog soft-release technique. Using this method, TESF expanded black-tailed prairie dog acreage on the Vermejo Park Ranch from 500 acres to 10,000 acres (Figure 5.2); the Ash Creek Restoration Area (ACRA) of Bad Rivers Ranches from 125 acres to 1,650 acres; and the Z-Bar from 75 acres to 590 acres. Using the same translocation technique, the Gunnison's prairie dog population at Vermejo has increased from 23 acres to 3,900 acres. In total, prairie dog acreage on Turner properties which TESF has had oversight over the past 15 years grew from 725 acres to a maximum of 16,140 acres.

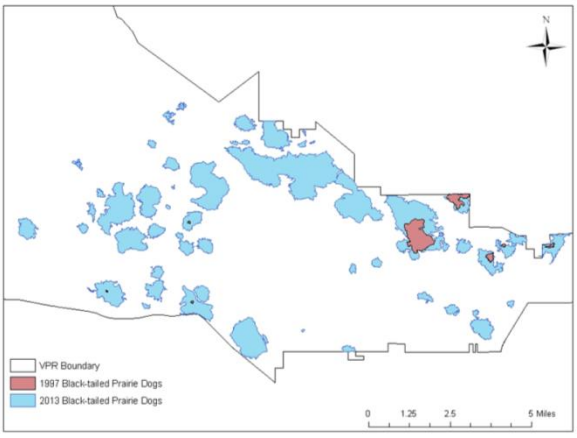


Figure 5.2. When Ted Turner purchased Vermejo Park Ranch, NM black-tailed prairie dogs occupied ~500 acres. By 2013 that acreage had increased to ~10,000 acres.

Project Activities in 2013:

Severe drought in New Mexico and Kansas and plague in South Dakota resulted in a significant black-tailed prairie dog population loss on Turner properties in 2013. The Gunnison's prairie dogs at Vermejo, which appear to be more resilient to drought than black-tailed prairie dogs, experienced significant growth in 2013.

Range and forage conditions at Vermejo in 2013 further deteriorated due to the ongoing severe drought which recently surpassed the Dust Bowl and the droughts of the 1950's. These conditions resulted in another year of poor black-tailed prairie dog pup production and survival (Figure 5.3). Maximum population densities on black-tail colonies at Vermejo in June 2013 were ~ 4/acre; juveniles represented 14% of the population. The population, particularly the juvenile cohort, declined further through the summer as the drought intensified and deepened. Total black-tailed prairie dog coverage at Vermejo declined slightly from 2012 to cover 9,740 acres.

Figure 5.3. Black-tailed prairie dog pup survival is tied to spring and early summer precipitation. During drought years very few pups survive through the summer.

Since 1997, TESF has managed black-tailed prairie dog colonies at Vermejo in a manner necessary to support a self-sustaining black-footed ferret population. Unfortunately, based on nine years of release data, we have determined that ferrets are unlikely to persist on black-tailed prairie dogs at Vermejo. Consequently, we have relinquished direct management of black-tailed prairie dogs at that location to Turner Enterprises Inc (TEI). Due to an expected increase in aridity (because of rising atmospheric concentrations of CO_2) and the currently degraded condition of Vermejo's shortgrass prairie, TEI will manage black-tailed prairie dogs to permanently reduce the size of the population.

Black-tailed prairie dogs in the ACRA at Bad River were devastated likely by a plague epizootic in 2012. This occurred despite a comprehensive dusting effort in early 2012, although heavy precipitation in the month following application may have washed away the insecticide. As expected with a plague epizootic, densities and coverage were greatly reduced throughout the entire ACRA. Several small, low density pockets of surviving prairie dogs totaling 239 acres were dusted in the summer of 2013 (Figure 5.4). To discourage prairie dog colony growth onto a neighboring property, 300ft of snow fence and 4 raptor poles were erected along the vegetative barrier on the south bench in ACRA.

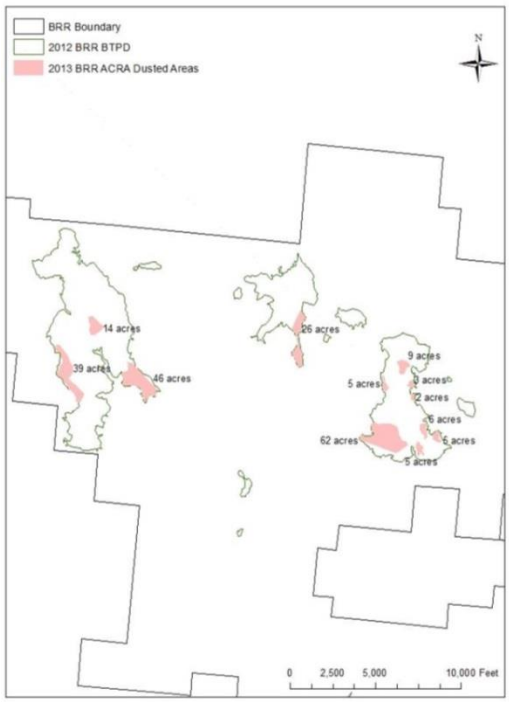


Figure 5.4. Black-tailed prairie dog coverage in Ash Creek Restoration Area prior to the plague epizootic in late 2012 (green) and the areas dusted (pink) in the summer of 2013.

Acreage occupied by black-tailed prairie dogs at the Z-Bar Ranch declined 40% in 2013 from 592 acres to 356 acres. Densities dropped to ~5/acre. The cause of the decline is probably due to drought, although plague has not been ruled out.

Gunnison's at Vermejo expanded 70% to cover 3,900 acres; maximum densities were down from 2012 but were still robust at ~17/acre. Approximately 2,000 acres of Gunnison's at Castle Rock and Bremmer Park were dusted to prevent sylvatic plague (Figure 5.5).

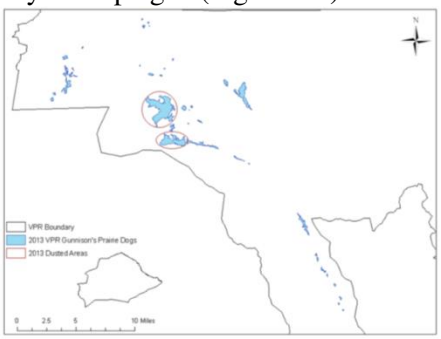
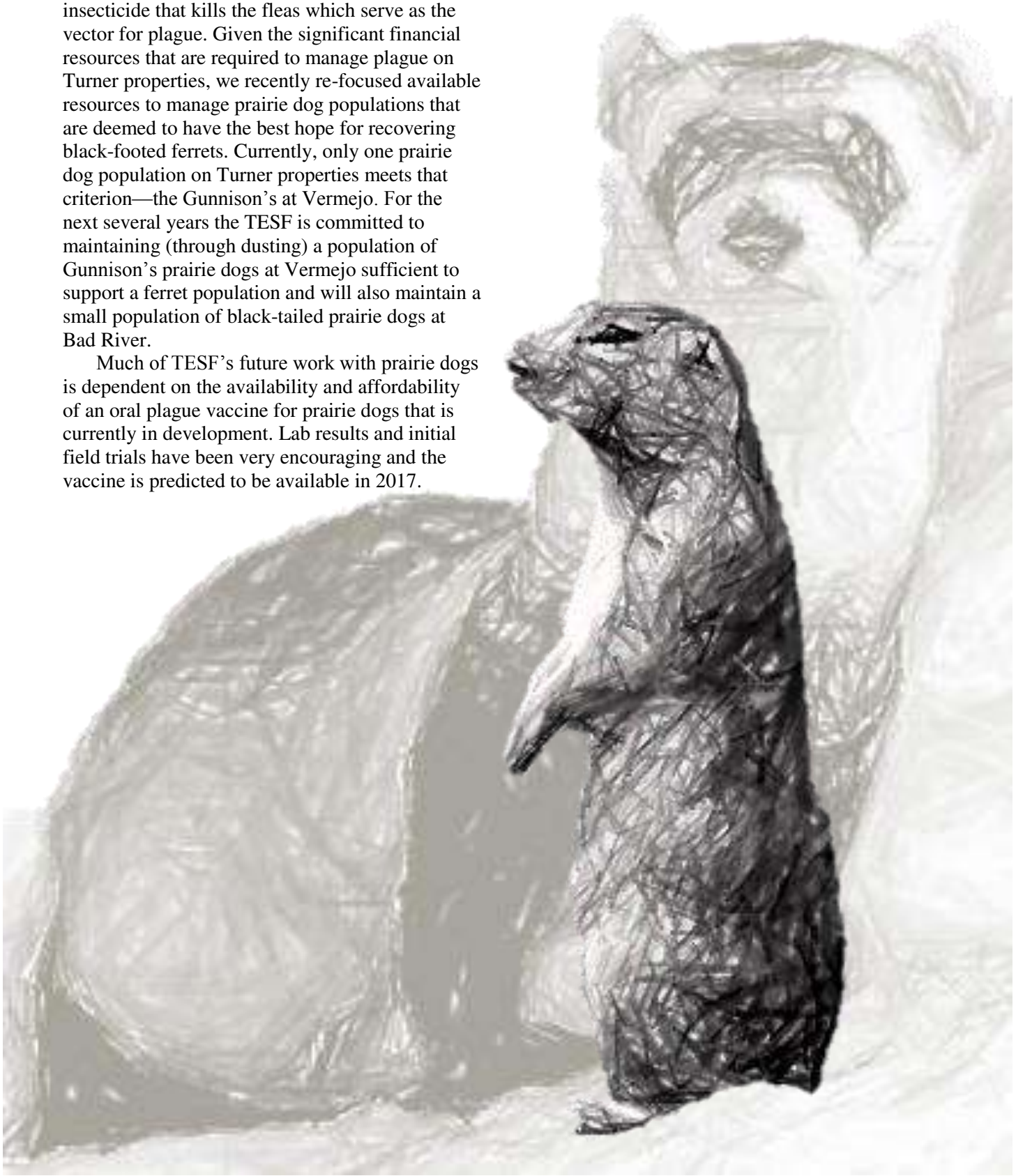


Figure 5.5. Gunnison's prairie dog colonies on Vermejo Park Ranch. ~ 2,000 acres were dusted in 2013 to inhibit the spread of sylvatic plague.

Proposed Future Activities and Considerations:

Managing prairie dogs on Turner properties in the future will require chronic plague management. Currently the only viable option for this is to dust prairie dog burrows with an insecticide that kills the fleas which serve as the vector for plague. Given the significant financial resources that are required to manage plague on Turner properties, we recently re-focused available resources to manage prairie dog populations that are deemed to have the best hope for recovering black-footed ferrets. Currently, only one prairie dog population on Turner properties meets that criterion—the Gunnison's at Vermejo. For the next several years the TESF is committed to maintaining (through dusting) a population of Gunnison's prairie dogs at Vermejo sufficient to support a ferret population and will also maintain a small population of black-tailed prairie dogs at Bad River.

Much of TESF's future work with prairie dogs is dependent on the availability and affordability of an oral plague vaccine for prairie dogs that is currently in development. Lab results and initial field trials have been very encouraging and the vaccine is predicted to be available in 2017.



6. 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:
- 1970 listed as endangered under the federal ESA

Project Location: Avalon Plantation is located in Jefferson County, Florida approximately 35 km east of Tallahassee (Figure 6.1). It is the southern-most plantation in the Red Hills physiographic region of north Florida and South Georgia. The plantation represents an excellent opportunity to restore red-cockaded woodpecker population

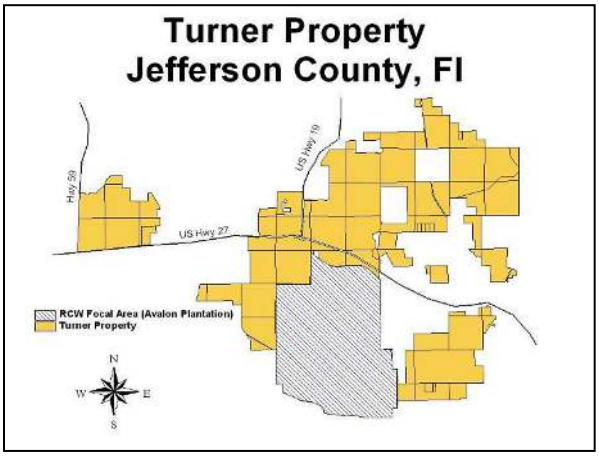


Figure 6.1. Avalon Plantation showing focal RCW project area.

Project Partners (integral to success):
- 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 and 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 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. About 1 percent of their original range remains.

RCWs are a cooperatively breeding species, living in family groups consisting of a breeding pair, which may also include one or two male helpers (females can also become helpers, but do so at a lower rate than males). The critical resource for RCWs is the availability of tree cavities, which the birds excavate in live pine trees, 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 this is the metric of population size for RCWs

In March 1998, TESF in cooperation with the U.S. Fish and Wildlife Service initiated an effort 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 red-cockaded 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 have 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 December 2013 the population has expanded to 15 active groups.

Project Activities in 2013:

Artificial cavity construction

Due to the extremely large diameter of trees on Avalon Plantation and their relatively young age (60 -70 years old) we exclusively use inserts. Per Appendix 4 of the Red-cockaded Woodpecker Recovery Plan, a minimum of four artificial cavities (inserts) are established in each abandoned cluster and for each 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). Each recruitment cluster is normally located within 0.4 – 1 km of an existing cluster.

Four previously abandoned clusters were restored in 2013 (Figure 6.2). As of December 2013, two of these abandoned clusters had become active (Clusters 10 & 19). No recruitment clusters were established during 2013 as all activities were focused on restoring abandoned clusters.

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. A Timber Ax attached to a New Holland TV145 tractor was used for mowing. This combination worked perfectly – reduced fire fuel loads with minimal soil disturbance compaction. There was enough fine fuels (pine needles, grass, etc.) remaining post mowing to allow prescribed fire to safely burn 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.

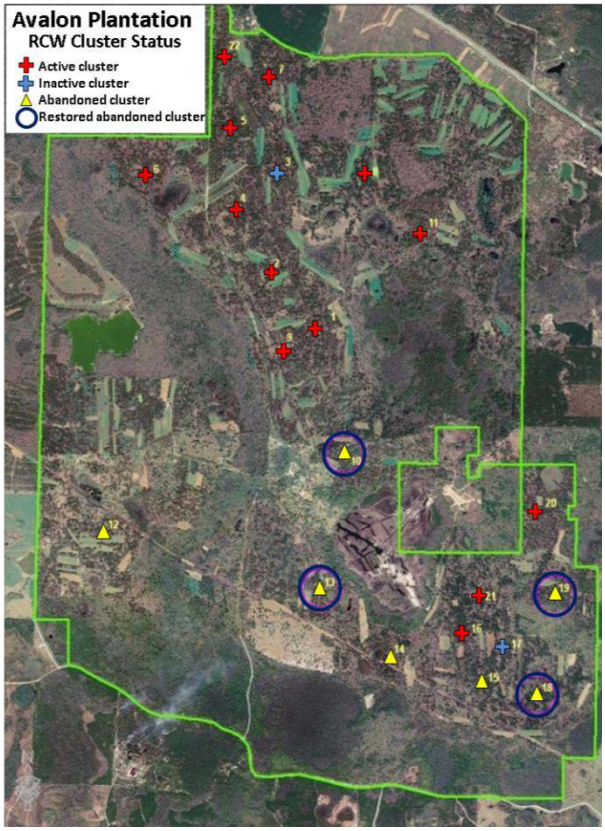


Figure 6.2. Abandoned cluster restoration and cluster status.

All clusters (active, inactive and abandoned) were mowed in late February – early March 2013 in advance of the burning season. A total of approximately 45 acres was 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 with pink flagging throughout the entire property. As a final precaution prior to any activity within or near cluster sites, vehicle operators were reminded of the location of cavity trees.

Prescribed fire

Approximately 70% of the property was burned during March 2013.

Cluster monitoring

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

7. MEXICAN GRAY WOLF

Canis lupus baileyi
– ESA listing: ENDANGERED

PROJECT STATUS: *Ongoing*

Principal biologists:
- *Chris Wiese*
- *Mike Phillips*

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

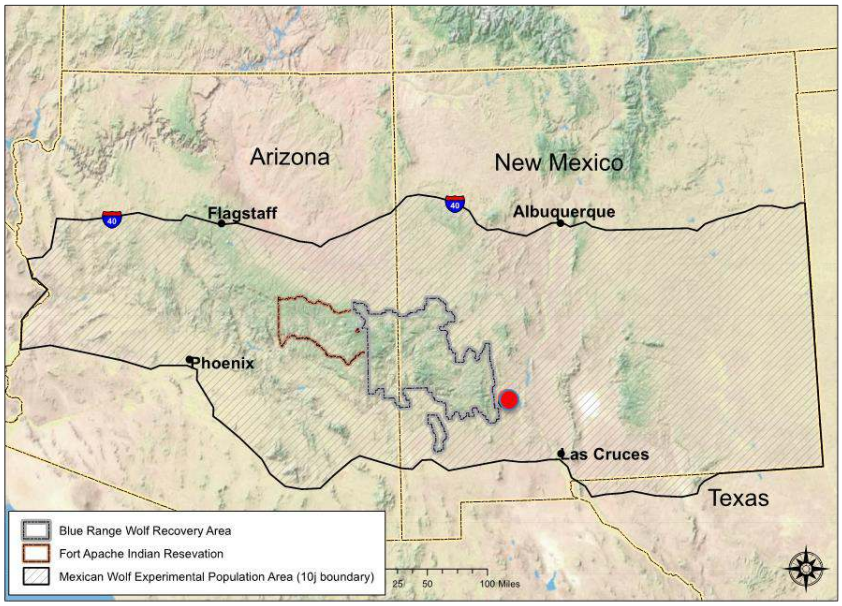


Figure 7.1. The location of the Blue Range Wolf Recovery Area (BRWMA). The red dot indicates the approximate location of the Ladder Ranch. (Source: http://www.fws.gov/southwest/es/mexicanwolf/BRWRP_home.cfm)

Conservation Status:
- 1976 listed as endangered under the federal ESA

Project Location: Ladder Ranch, New Mexico

Project Partners:
- U.S. Fish and Wildlife Service

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

Project Goals and Objectives: The overarching goal of the Mexican wolf Recovery Program is to rebuild healthy ecosystems by recovering top predators like the Mexican gray wolf in the wild. Towards this goal, TESF provides support to the USFWS led Mexican wolf recovery efforts by operating a pre-release facility for Mexican gray wolves. In this capacity, we have bred wolves in captivity and we provide transitional housing and acclimation care for captive wolves that are chosen for release to the wild as well as for wild wolves that have to be (temporarily or permanently) removed from the wild.

Project background:

Mexican gray wolves (MGW) are a distinct subspecies of gray wolves that roamed most of the southwestern US and portions of Mexico until, due to aggressive government-sponsored predator control measures, they were functionally eradicated in the wild by the mid-20th century. By the time the government reversed its policy, and in 1976 listed the Mexican gray wolf as endangered, the MGW was on the verge of extinction. Wildlife biologists captured the last five MGWs remaining in the wild and began a captive breeding program. As a result, the subspecies is secure in captivity.

Reintroductions of MGWs into the Blue Range Wolf Management Area (BRWMA) that spans portions of eastern Arizona and western New Mexico (Figure 7.1) began in 1998. About 100 wolves were free-ranging at the end of 2013.

The Ladder Ranch has been actively involved in Mexican Gray Wolf recovery since 1997, beginning with construction of the Ladder Ranch wolf management facility (LRWMF). As one of only three pre-release facilities nationwide, the LRWMF plays an important role in the USFWS's implementation of wolf reintroductions to the wild by providing pre-release care and acclimatization for animals eligible for release to the wild. The LRWMF also assists with specific management

needs associated with reintroductions in the Blue Range Wolf Recovery Area by serving as a "halfway house" between the wild and traditional holding facilities (zoos and wildlife sanctuaries) for wolves that are removed from the wild for depredating livestock. The LRWMF is managed collaboratively by TESF and the USFWS. Since we began housing wolves in 1998, over 100 wolves have passed through the LRWMF facility.

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

Project Activities in 2013

Wolves held at LRWMF in 2013

The LRWMF maintains wolves that are valuable to the recovery program, as most wolves housed at the facility are eligible for release in the US or Mexico. We made a big push in 2013 to move non-releasable wolves out of the pre-release facilities on the Ladder and the Sevilleta and stock both facilities primarily with release candidates (or removals from the wild). This required an unusually large number of transfers into and out of both facilities in 2013, but between the LRWMF and the Sevilleta Wolf Management Facility (SWMF), we successfully reached our goal of positioning ourselves for potential releases in 2014.

Our "wolf shuffle" in 2013 also included setting up breeding pairs. Current best practices include two ways to increase the chances of success for wolves released to the wild: (1) subject wolves to conditioned taste aversion (CTA) treatment to deter them from feeding on cattle, and (2) pairing and breeding of wolves to "anchor" released animals to the release area for improved monitoring and managing to avoid conflicts with livestock. Although we welcome the possibility of resurrecting an active wolf breeding program at the LRWMF (the last Ladder litter of wolf pups was born in 2004), the USFWS's decided to consolidate all four breeding pairs at the SWMF to accommodate pen space and personnel availability as well as allow us to subject all release candidates to CTA (which takes place exclusively at the SWMF).

A total of 12 wolves were held at the LRWMF in 2013, with a maximum of seven wolves at the facility at any one time (Table 7.1). Five wolves (F1033, M1052, M1215, M919, and M921) entered the LRWMF in January 2013 following several months of facility renovations in 2012. Two wolves, M1051 and F1126 (named the "Coronado Pack"), were returned to captivity from their acclimation pen in Arizona due to concerns over their safety and were placed at the Ladder

Table 7.1. Management of wolves at the LRWMP in 2013.

SSP to LD	LD to SSP	LD to SV	SV to LD	Removals from wild
M921				
M919			F1033	
			M1215	
			M1052	
	M919			
	M921			
			F1202	
			F1218	
				F1126
				M1051
		M1052		
		F1033	F858	
			M1133	M795
		M1215		
		F1202		
		F1218		
	M795			

KEY:
Green shading = wolves at LRWMF at the beginning of 2014
SSP = Species Survival Plan facility
LD = Ladder Ranch
SV = Sevilleta

Ranch in June 2013. Paradise pack AM795 was temporarily placed at the LRWMF in late October 2013 after being removed from the wild due to livestock depredations. He was transferred to the NY Wolf Conservation Center in December 2013 so he can be on the semen collection route for 2014. His sister, spayed female F858, arrived at the LRWMF in September to serve as a companion to M1215, who showed signs of distress when alone in a pen. Following M1215's transfer out of the facility (M1215 was chosen to be released in the wild in Mexico with his mate, F1033), M1133 joined F858 in late December for companionship. This pair (M1133 and F858) will be transferred to another SSP holding facility in the spring once space becomes available following the breeding season (bonded pairs that are not scheduled to reproduce in a given year have to be physically separated during the breeding season, which requires extra pen space).

No wolves were born or died at the LRWMF in 2013. Three wolves arrived at the Ladder from the wild (the Coronado pack's F1126 and M1051 (Figure 7.2) arrived from a temporary acclimation pen, the Paradise pack alpha male M795 arrived from the wild), and no wolves were directly released from the Ladder (although several wolves were chosen for future release after a brief stay at the SWMF).

Figure 7.2. The alpha male of the Coronado pack, M1051, was returned to captivity with his mate (F1126) when the field crew discovered that the territory chosen for their release was occupied by another wolf pack.

Food & feeding

Mexican gray wolves held at the LRWMF are fed a combination of foods recommended by the SSP. These are: Mazuri® Exotic Canine Diet (aka "kibble"), Central Nebraska classic canine diet (aka "carnivore logs"), and native prey species. Mazuri® Exotic Canine Diet is a meat-based kibble diet preferred by most zoos that meets the nutrient requirements of all wolf life stages. Carnivore logs are composed predominantly of horsemeat and fortified meat byproducts that are frozen into 5 pound logs (Figure 7.3). These are protein-rich and also suitable for all life stages. Native prey animals (mule deer, oryx, elk, and bison) are mainly provided as meat scraps and/or bones salvaged from hunts on the Armendaris and Ladder Ranches and are sporadically fed as supplemental food.

Figure 7.3. F1202 (in her shaggy summer coat) enjoys a meal of carnivore logs.

Observations

We observed LRWMF animals on a regular basis to ensure their health and wellbeing. Informal observations took place during scheduled feedings, where we obtained a visual of each animal in the facility and checked for signs of injury or illness. Our ability to examine wolves up close was enhanced by installing trail cameras near the wolf pens.

Formal observations were made every 4 – 6 weeks (but more frequently if newly arrived animals or new pairings needed to be monitored) from a blind positioned near the facility. No medical problems were documented for the 12 wolves held at the facility in 2013. We did observe M1215 displaying aberrant behavior whereby he spent a lot of time pacing along the fence in his pen. After consulting with the USFWS wolf biologists Dr. Susan Dicks and Melissa Kreutzian, we provided some distraction for M1215 by placing him in a pen with F1033. This strategy worked very well: M1215 stopped pacing the fence.

A combination of informal, formal, and trail camera observations revealed the M795, a 12-year old wild-born wolf that had recently been removed from the wild because of livestock depredations, was having some difficulties adjusting to captivity. Although he quickly learned to respect the chain-link fence surrounding his pen as a barrier to his

movement, he began to dismantle, bit-by-bit, one of the den boxes in his pen. Because of this behavior, we recommended that M795 be transported in a special, sturdy crate for his scheduled transfer to NY.

Health assessments & medical care

All wolves received thorough health checks, vaccinations, and anti-parasite medication before arriving at the LRWMF in 2013. Similarly, all wolves removed from the LRWMF in 2013 received deworming and anti-parasite medication (ivermectin and revolution) before leaving the facility and received vaccinations as warranted. The goal is to perform health checks and update vaccinations for each wolf once a year (usually done during the cooler months). All wolves in the facility at the end of December 2013 are current on their vaccinations and treatments.

All male wolves present at the LRWMF in February 2013 (M1215, M919, M921, and M1052) were captured on February 14, 2013, and again on February 17, 2013, for semen collection and sperm banking. The semen was collected by Dr. Cheri Asa, a canine reproductive specialist from St. Louis (Figure 7.4). Unfortunately, as in 2012, most of the semen was of poor quality and was therefore not successfully banked. The second semen collection performed three days after the first collection resulted in equally poor samples (Table 3). Poor quality semen is most likely a result of the stress imposed on the wolves by capturing them.

Figure 7.4. USFWS wildlife veterinarian Dr. Susan Dicks examines an anesthetized wolf with assistance from Karen Bauman (pink shirt), while Dr. Cheri Asa (wearing a green shirt in the center of the picture) and Kim Scott (blue shirt) prepare for the semen collection and former US Senator and President of the United Nations Foundation and Better World Fund Tim Wirth (red shirt) and staff from the offices of US Senators Martin Heinrich and Tom Udall look on.

LRWMF maintenance

Our facility underwent major renovations in the fall and winter of 2012 to implement erosion control and make necessary repairs. To minimize stress to the animals, all captive wolves were removed from the facility prior to starting the work. Work on the facility began in mid-October 2012 and was mostly completed by January 2013.

This work was accomplished in large part because of the help we received from the many volunteers, including the USFWS volunteer field team from Alpine, AZ, Melissa Kreutzian, local high school students, and students from the NMSU Wildlife Society, the UNM Wilderness Alliance, the UNM SEEDS organization, the Albuquerque Wildlife Federation, and Kirtland AFB. Volunteers hailed from places as far away as Alaska, California, Nevada, and New York. A total of 956 volunteer hours were devoted to the wolf pen renovation project.

We succeeded in finishing all the repairs in time to allow repopulating the LRWMF by early January 2013 (i.e., before the next breeding season) to help relieve the pressure placed on other facilities (most notably, SWMF) by emptying out our facility.

Off-site Activities and Outreach

We participated in several off-site activities in 2013 that included helping with wolf captures and health checks at the SWMF, transferring wolves to Mexico (April 11, 2013) or from the BRWMA to captivity, participating in the Drug Immobilization workshop in Alpine, AZ (August 16 and 17, 2013), and serving as part of the ground crew during helicopter surveys (January 22-24 and November 19-21, 2013). Outreach activities included a visit to a 5th grade classroom in San Bruno, CA as part of a Rocket21 program (February 6, 2013), a lecture about the Mexican Gray wolf program presented to students in the Furman University "Wild Semester" program (October 27, 2013), and informal presentations to the UNM Mammology class and wolf capture volunteers from UNM, NMSU, and Truth or Consequences High School (various times throughout the year). We also participated in the filming of a USFWS-sanctioned documentary about the Mexican Gray Wolf produced by Christopher Miller (November 12, 2013).

Proposed Future Activities and Considerations:

As one of three pre-release facilities in the country, and the only pre-release facility adjacent to the BRWMA and close to the SWMF and Mexico, the LRWMF plays an important role as a transitional facility for wolves that are being transferred between captivity and the wild. We plan on continuing our strong support of the USFWS-led efforts to recover the Mexican gray wolf in the Southwest. In this capacity, we will continue to serve as caretakers of important wolves, participate in hands-on activities (captures, health checks, transfers, surveys, etc.) and mandatory training sessions, and participate in SSP-related management activities (for example, annual meetings and semen collections etc.). Moreover, the LRWMF is well situated to serve as potential host for hands-on wolf handling sessions. In principle, the LRWMF could also serve as a Mexican wolf breeding facility, although no wolf breeding has taken place at the Ladder in over 5 years.

The USFWS recently proposed a number of changes to the rules, status, and recovery area of the Mexican gray wolf. These changes, if accepted, are likely to increase the number of wolf releases in Arizona and New Mexico, a move that may be critical for improving the genetic health of the wild population. These changes are likely to increase the number of wolves transitioning through our facility and thus concomitantly further increase the importance of the LRWMF to the Mexican gray wolf recovery efforts.

Frequently asked questions about Mexican gray wolves:

QUESTION 1: *How big is the LRWMF, and how many wolves can it accommodate?*

ANSWER: The LRWMF consists of 5 separate pens, each of which is between 0.3 and 0.5 acres in size. We can accommodate up to 5 wolf packs. In the wild, Mexican gray wolves live in family groups ("packs") consisting of the alpha male and female and some of their offspring. Wolf packs range in size from 2 to ~8 animals. At the LRWMF, we often place only 1 or 2 wolves in a pen. Historically, the LRWMF houses between 5 and 10 wolves at any one time, but in 2006 as many as 20 wolves (including several pups) occupied the facility concurrently.

QUESTION 2**:** *How often do Mexican gray wolves breed?*

ANSWER**:** Breeding season for Mexican gray wolves occurs once a year, usually between mid-January to mid-March. Females give birth in April or May following a 63-day gestational period. A typical litter consists of 2-6 pups.

QUESTION 3**:** *Do you breed MGWs on the Ladder?*

ANSWER**:** Because of space limitations in the approved Mexican gray wolf holding facilities that constitute the Special Survival Plan (SSP), wolf breeding is restricted each year to certain pairs that are "matched" based mainly on their genetics. The last wolf pups were born at the LRWMF in 2004. One reason for this is that we serve as a sister facility to the USFWS-run wolf management facility at the Sevilleta Wildlife Refuge (SWMF; which is located about 100 miles northeast of the Ladder Ranch) and in the last few years, all breeding of pairs destined for release has taken place at the SWMF. The LRWMF serves an important support role by housing wolves that are not allowed to breed and thus need to be separated during the breeding season (which greatly increases the number of holding pens required to house wolves).

QUESTION 4**:** *Will there be free-roaming wolves on the New Mexico Turner Ranches?*

ANSWER**:** The portion of Arizona and New Mexico designated as the Blue Range Wolf Recovery Area (BRWRA) currently comprises the area where wolves are allowed to roam freely. Current law states that wolves that wander outside of the BRWRA must be captured and returned to the BRWRA. The BRWRA abuts the Ladder Ranch to the west, but does not actually encompass the Ladder (or any other of the Turner New Mexico ranch properties). However, since the Ladder Ranch has been officially enrolled in the recovery program for many years, Mexican wolves can occupy the ranch. While no wolf has established permanent residency, over the years we have documented wild wolves travelling across the ranch, and this occurred most recently during fall 2013.

8. ROCKY MOUNTAIN GRAY WOLF

Canis lupus
– ESA listing: DELISTED

PROJECT STATUS: *Ongoing*

Principal biologists:
- *Val Asher*
- *Mike Phillips*

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

Conservation Status:
- Delisted under ESA in April of 2011
- Listed as "species in need of management" in Montana

Project Location: Flying D Ranch, MT

Project Partners:
- None

Project Funding
- TESF
- TBD

Project Goals and Objectives: Our goal is to promote the persistence of wolves on the Flying D Ranch, and understand their relationship with bison and elk.

Project Background:

Gray wolves of the Beartrap pack first established residency on the Flying D Ranch in 2002. At its peak in 2011, this pack comprised 24 wolves making it a notably large pack.

Due to a successful recovery program gray wolves are now widely distributed in the northern Rocky Mountains, including the Greater Yellowstone ecosystem. Wolves were delisted from the ESA in April of 2011. In Montana, wolves were reclassified statewide as a "species in need of management." This designation allows for flexibility in managing wolves and addressing wolf-livestock conflicts.

In 2009, Montana Fish, wildlife and Parks (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 5 per hunter with no wolf management area quotas set, except for areas around Yellowstone and Glacier National Parks. As of January 10, 2014, 150 wolves had been harvested statewide.

In 2000, TESF hired a biologist to assist the U.S. Fish and Wildlife Service (USFWS) and later MTFWP, with wolf recovery in southwest Montana. TESF is 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, in 2010 our efforts shifted to the Flying D Ranch, with a focus on promoting wolf use of the ranch and understanding how they affect the bison ranching and elk hunting operations.

Project Activities in 2013

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 3 wolves in 2004 after a control action took place near Ennis Lake in response to livestock depredations. A total of 22 wolves occupied the ranch in 2013 with an official pack split. The Beartrap pack consists of 15 individuals and the Tanner Pass pack, a total of 7 individuals (Figure 8.1). Both packs occupy the ranch, although the smaller Tanner Pass pack seems to spend most of their time on the south and west sides of the ranch and adjacent forest.

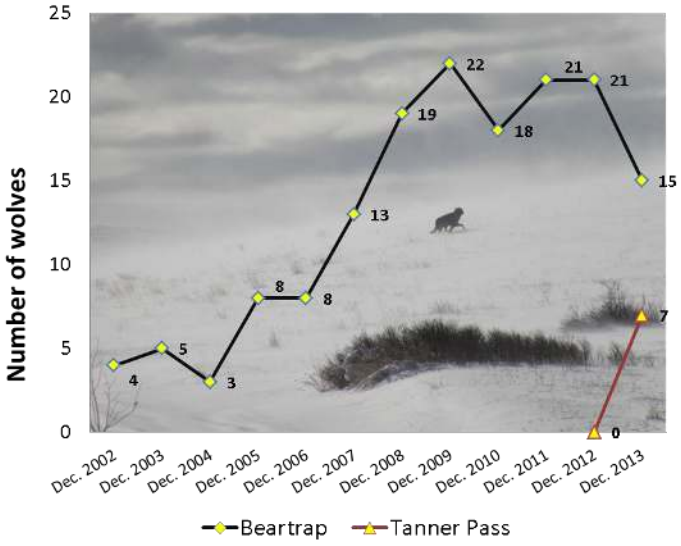


Figure 8.1. Annual counts of the Beartrap pack and Tanner Pass pack.

A total of 805 carcasses were investigated on the Flying D from 2010-2013. 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 haemorrhaging under the skin, bite marks and feeding pattern. Categories used to define predator killed prey were "confirmed", "suspected", and "unknown". Due to a small sample size confirmed and suspected were combined to look at prey composition.

A total of 239 predator kills were documented during this 4-year period (2010-2013), with 181 attributed to wolves. The remainder comprised 31 coyote kills, 8 mountain lion kills, 2 bobcat kills, 5 bear kills and 12 due to unknown predators. A breakdown of the number of confirmed and suspected wolf kills during this time period reveals that wolves were likely responsible for killing 122 elk, 47 bison, 8 white-tailed deer (WTD), 1 moose calf and 3 coyotes (Figure 8.2).

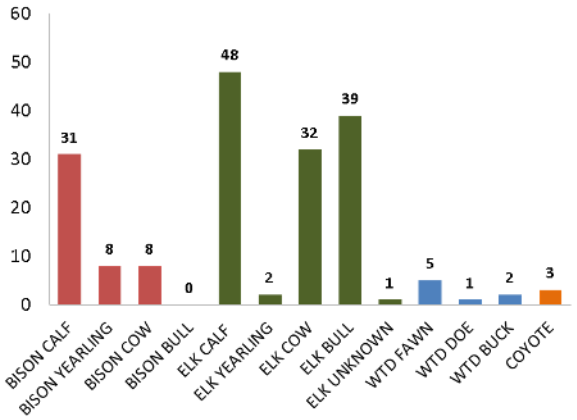


Figure 8.2. Confirmed/suspected wolf kills by prey type.

For bison, calves (66%) were most often preyed upon followed by yearlings (17%), and cows (17%). We have not detected wolves preying on bull bison. Considering elk, wolves killed bulls (32%), cows (28%) and calves (40%). More deer fawns (62%) were killed than adult deer (38%).

Elk population estimates have ranged from 1100-2400 individuals since wolves established themselves on the Flying D. Elk numbers on the ranch have remained relatively stable over the last few years. Small groups of elk have always spent part of the winter on neighboring ranches but there has become a noticeable trend of larger groups of elk leaving the ranch during the winter months, influencing our annual counts, especially in 2013 (Figure 8.3). These larger group movements began in 2010, alternating years until 2013 where the majority of the Flying D's resident cow herd moved north across highway 84. Though it took eight years, we suspect that wolves played a role in initiating this trend along with factors such as herd knowledge, extreme fluctuations in 2013 winter conditions, and increased logging activity.

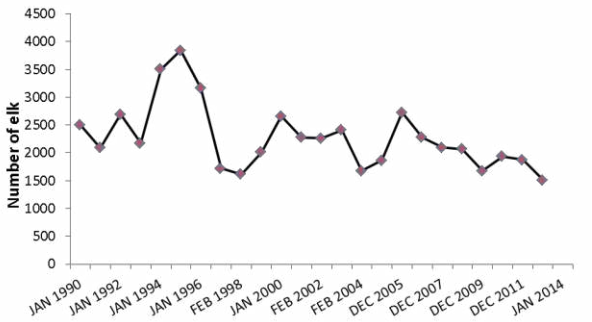


Figure 8.3. Elk abundance estimates on the Flying D provided by the Flying D and Montana Hunting Corporation.

Though not documented to date, it will be interesting to determine if any of the wolves occupying the Flying D change their movement patterns and home range to coincide with seasonal elk movements. Research suggests that wolves can influence the size of elk herds and their use of habitats, leading MTFWP to consider wolf activity as 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 with when wolves were absent. Other studies have concluded no effect of wolf presence on herd size. On the Flying D, we see both large and small herds, but preliminary data analysis suggests that these differences in group size tend to correlate better with seasonal changes rather than the presence of wolves.

A study conducted on the Flying D from 2003-2005 revealed that as wolves settled onto the ranch, elk increased their use of the more complex habitats (juniper canyons and steep slopes) that are typically preferred by mule deer. This led to an increase in cougar predation on elk and a decrease of cougar predation on mule deer. Interestingly, it appeared as though cougars killed elk irrespective of the elk's nutritional status, whereas wolves appear to select for elk that were in poor body condition. This is perhaps due to differences in hunting strategies between the two predators. A mountain lion is an ambush predator whose success depends on the element of surprise. A wolf, by contrast, is a coursing predator whose success relies on locating a prey item that is predisposed to predation.

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 the young, the old, the sick or injured, or weak individuals. Age, health, environmental traps, maternal behavior and injuries would apply in determining why an animal is subject to predation.

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". Of the 130 elk and deer kills, marrow was collected from 111 carcasses. We visually classed marrow into three categories, white/waxy, red/soft, red/gelatinous (Figure 8.4). Of the 75 samples (68%) of deer and elk were in marginal to poor health condition.

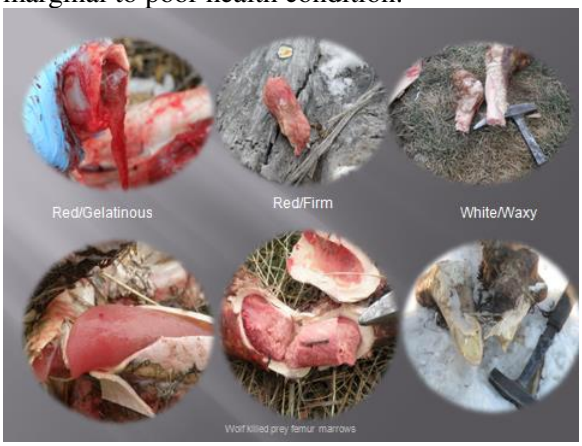


Figure 8.4. Femur marrow helps determine the condition of the prey species.

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

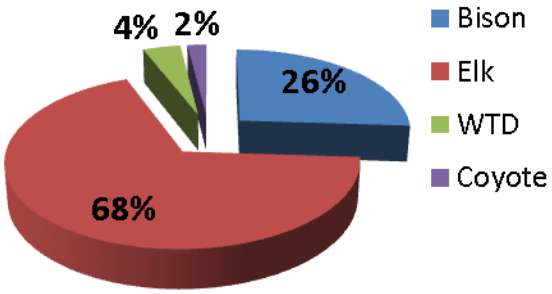


Figure 8.5. Percentage of wolf kills by prey species.

to date, wolves appear to be more successful at killing elk, or are actively selecting elk to prey upon (Figure 8.5.). 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 present, cow bison tend to stand still with a head/tail up posture, or initiate a group defense strategy 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 move from the area. Bison are usually aware of when wolves are in their vicinity, often observing the wolf as it passes through the herd, without exhibiting defensive or escape behaviors (Figure 8.6).


Figure 8.6. Encounters between wolves and bison are numerous, though not always leading 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 2011-2013 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. Notably, in 2013 the ranch recorded an unusually high production of bison calves even though two packs of wolves occupied the ranch throughout the year.

Off-site Activities and Outreach

TESF and Rocket21™ (an online social network where kids explore amazing possibilities for their lives and futures) joined forces in 2012 to run a video competition themed ***HOWL-o-ween: Dream Big in the Wild***. This was intended to increase kids' awareness of wildlife conservation, and introduce them to wildlife science careers.

Middle and high school student members of Rocket21 shared videos featuring their most inspired, passionate, creative, and individual brand of wolf howl to compete for one of two family trips to Montana. In 2013, winning howlers participated in a wolf conservation and recovery activity dubbed a "howling party", along with biologists at Ted Turner's Flying D Ranch in Montana. Winners also toured Yellowstone National Park.

In a separate category, teachers entered their classes to compete for one of three school-based "Classroom Howling Parties." Winning classrooms received a visit from TESF wildlife experts.

Individual competition winners

Under-13 age category: Joshua Kilgore.
~ Joshua took his two 10 year old brothers on his trip to Montana. ~ (Figure 8.6.)

Over-13 age category: Zane Carey.

Class competition winners

~ Kathleen Talbot's 5th grade class at Portola Elementary, San Bruno, CA.

~ Michele Burke's engineering class at Woodland Park High School, Woodland Park, CO.

Additional classroom visit

~ Fairfield Country Day School, Fairfield, CT

Proposed Future Activities and Considerations

To assist in understanding food habits of wolves. Four years of scat data is being analyzed and should be completed spring of 2014. We are also in contact with a grad student in the United Kingdom who has built wolf vocalization software to identify animals at the individual level. This collaborative 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 continue to be active with the anthrax/brucella project on the ranch. Attempts to fit cow elk with GPS collars will start January of 2014.

Figure 8.6. Competition winner, Joshua Kilgore, and his two brothers join Mike Phillips for a howling party on the Flying D Ranch.

9. SOUTHERN ROCKY MOUNTAINS GRAY WOLF

Canis lupus
– ESA listing: ENDANGERED

PROJECT STATUS: *Ongoing*

Principal biologist:
- *Mike Phillips*

Conservation Problem: Wolf recovery continues to be a controversial and divisive issue in the western US which limits the species' distribution to about 15% of its 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 and Objectives: Our goal is to advance gray wolf restoration to the western Colorado portion of the SRE.

Project Background:

Despite the improved conservation status of the gray wolf (*Canis lupus*) in the Great Lakes states (Minnesota, Michigan, and Wisconsin) and the northern Rocky Mountains (Montana, Wyoming, and Idaho), the job of recovering the species is not complete. No convincing argument concerning the conclusion of recovery efforts can be put forth until there has been a serious discussion about restoring the gray wolf to the SRE. Why? Because of widespread and persistent public support for the notion, because no other region in the U.S. offers the same potential to support a population of wolves on a vast expanse of highly suitable public land that is currently unoccupied by the species, and because of the sweeping recovery mandate of the ESA.

The tremendous success with wolf restoration in the northern Rocky Mountains and Great Lake states underscores the practicality of accomplishing the same in the SRE. This notion is bolstered by recent studies that revealed tremendous potential for gray wolves to occupy the ecoregion in numbers and with a distribution that would satisfy the spirit and intent of both the federal and Colorado state endangered species acts.

The SRE represents the best remaining area for gray wolves in the US. The ecoregion stretches from north central Wyoming, through western Colorado, into north central New Mexico (Figure 9.1). The ecoregion is defined by nearly 25 million acres of public land that supports unnaturally large populations of native prey. This amount of public land 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 Mexican wolves being reintroduced in the southwest. 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.

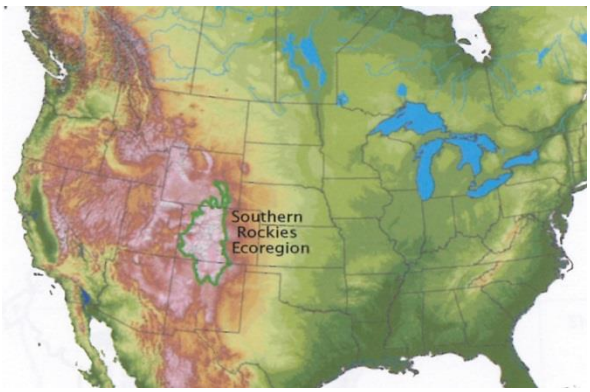


Figure 9.1. Southern Rockies Ecoregion is mostly located in western Colorado and represents a vast refugia of high quality habitat for gray wolves.

Two studies have estimated the carrying capacity of the SRE for wolves. The first was done in 1994 and concluded that the Colorado portion of the area alone could support over 1,000 wolves. The second study concluded, after application of sophisticated modeling of variables of importance to wolf survival (e.g., distribution/abundance of native prey), that the SRE could support 2,000 wolves.

Fortunately, the public is broadly supportive of restoring wolves to the SRE (Figure 9.2). A public opinion poll conducted in 2001 revealed that 71% of Coloradoans supported wolf restoration. Majority support was widespread among various demographic groups.

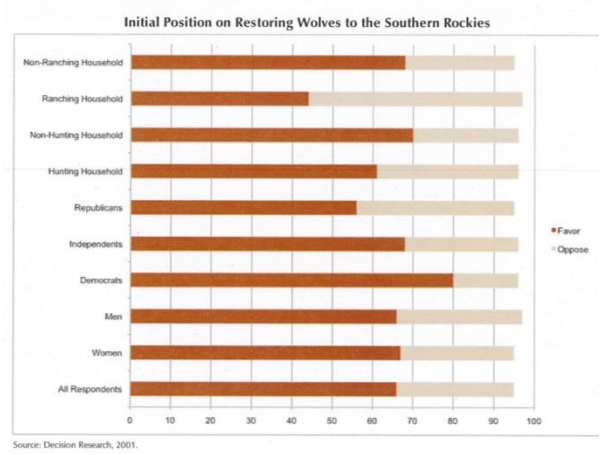


Figure 9.2. Results of a 2001 public opinion survey revealed widespread, bi-partisan support for restoring wolves to the Southern Rockies.

The SRE is a vast refugia of high quality and highly 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 re-create 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.

Project Activities in 2013

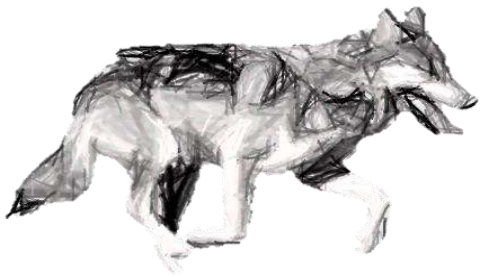
By 2013 it was clear that the US Fish and Wildlife Service did not intend to advance wolf restoration to the SRE based on the agency's only authority to do so – the federal ESA mandate. Indeed, the Service seems intent to redouble efforts to do just the opposite. Consequently, a non-federal approach is needed to restore the gray wolf to the ecoregion.

To that end 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 will be conducted in early 2014.

The principal aim of the survey is to determine baseline support for a 2016 ballot initiative to amend the state's constitution to mandate that Colorado Parks and Wildlife restore the gray wolf to Colorado. The results of survey will provide cardinal instruction to conservationists considering advancing such an initiative.

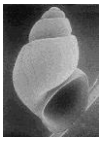
Due to the US Fish and Wildlife Service's chronic insistence that there is no mandate per the ESA to restore wolves to the SRE, a state led effort now represents the most viable option for advancing the idea. Given the favorable biological and socio-political attributes of Colorado for large carnivores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

A successful state led effort would also have great value by reminding the conservation community that approaches besides those based on federal legislation can be useful for advancing progress on important wildlife conservation matters (e.g., plains bison restoration in Montana).



10. CHUPADERA SPRINGSNAIL

Pyrgulopsis chupaderae
– ESA listing: ENDANGERED



PROJECT STATUS: *Under development*

Principal biologist:
- *Magnus McCaffery*

Conservation Problem: Endangered by habitat loss and degradation of aquatic resources, particularly decreases in spring flow due to drought and ongoing and future groundwater pumping in the surrounding area, habitat degradation from livestock grazing, and springhead modification.

Conservation Status (additional information): The USFWS designated the snail as a candidate for protection under the ESA in 1984, and listed it as endangered in 2012. Critical habitat was designated at Willow Spring and a nearby unnamed spring in 2012, although it is unlikely that snails currently exist at the unnamed spring. The species is categorized as a *Species of Greatest Conservation Need (SGCN)* in the Rio Grande watershed in *New Mexico's Comprehensive Wildlife Conservation Strategy*.

Project Location: Willow Spring on Highland Springs Ranch owned by Ben Brooks New Mexico, LLC. This site is approximately a mile north of the Armendaris Ranch boundary in Socorro County, NM. (Figure 10.1)

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

Project Goals and Objectives: Our goal is to implement a comprehensive conservation and recovery program for this species. An important component of this project will be for us to work at the interface between the private landowner and the USFWS to achieve conservation benefits for this species. Initially, we aim to:
- Formalize a Memorandum of Understanding (MOU) between TESF and Ben Brooks New Mexico, LLC. that will grant TESF access to Willow Spring.
- Conduct comprehensive biotic and abiotic surveys at Willow Spring.
- Organize a Chupadera springsnail Recovery Planning Meeting at the Ladder Ranch, bringing key partners and stakeholders together to synthesize a conservation strategy for the species and to begin developing a species recovery plan.
- Work in partnership with New Mexico Department of Fish and Game and the U.S. Fish and Wildlife Service to assemble a captive breeding and holding facility for Chupadera springsnails on the Ladder Ranch. Population of this facility with springsnails will not take place under this Share with Wildlife grant.
- Attempt to identify spring sites on the Ladder and Armendaris ranches with habitat characteristics capable of supporting Chupadera springsnail (this will be informed by data gathered from survey work at Willow Spring described above).
- Potentially translocate Chupadera springsnails to new sites if deemed warranted by the Recovery Team.

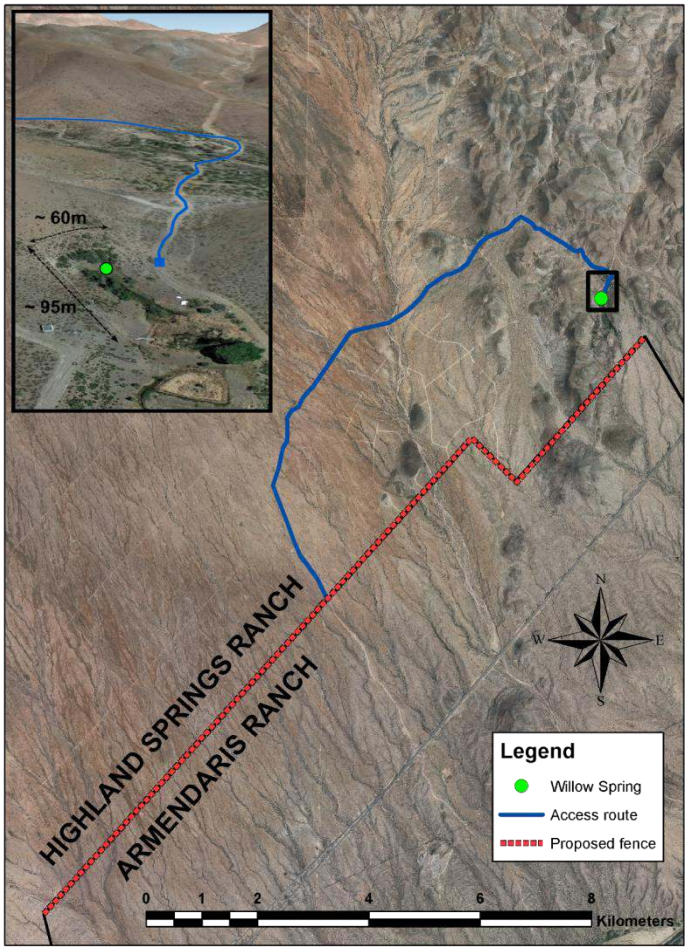


Figure 10.1. Location of Willow Spring to the north of the Armendaris Ranch.

Project Background:

The Chupadera springsnail (CSS, *Pyrgulopsis chupaderae*) is a small (2 – 3 mm tall) freshwater snail (Figure 10.2.) that is endemic to Willow Spring and a nearby unnamed spring. The CSS is highly endemic and is considered imperiled given the limited extent of (0.5 to 2 m wide x 38 m long) and potential threats to occupied habitat.

Habitat, water quality, and CSS abundance data were collected at Willow Spring in 1997-98 by NMDGF biologists (B. Lang, personal communication, 2013). These data suggest that the species survives only on rhyolitic gravels within a relatively stable range of water quality parameters, which were summarized in the Determination of Endangered Status for the Chupadera Springsnail and Designation of Critical Habitat prepared by the US Fish and Wildlife Service (77 FR 41088). However, an updated, regular, and long-term habitat monitoring program would better define the habitat conditions required for CSS persistence.

Access to Willow Spring for the purpose of CSS monitoring has been restricted since the current owners purchased the property in 1998. TESF is in the process of negotiating an access agreement to conduct conservation work on behalf of CSS at Willow Spring. In its current form (subject to revision prior to official signature), the agreement will allow TESF long-term access to the Willow Spring site for the purpose of CSS conservation.

Project Activities in 2013:

- Through a collaborative effort involving Russ Miller, Josh Marks, Tom Waddell, Carter Kruse, Mike Phillips, and Magnus McCaffery, we produced a MOU to facilitate access for TESF to conduct conservation work on behalf of the Chupadera springsnail. The MOU is currently under review by Ben Brooks New Mexico, LLC.
- We applied for and received grant funding from the NMDGF Share with Wildlife program.

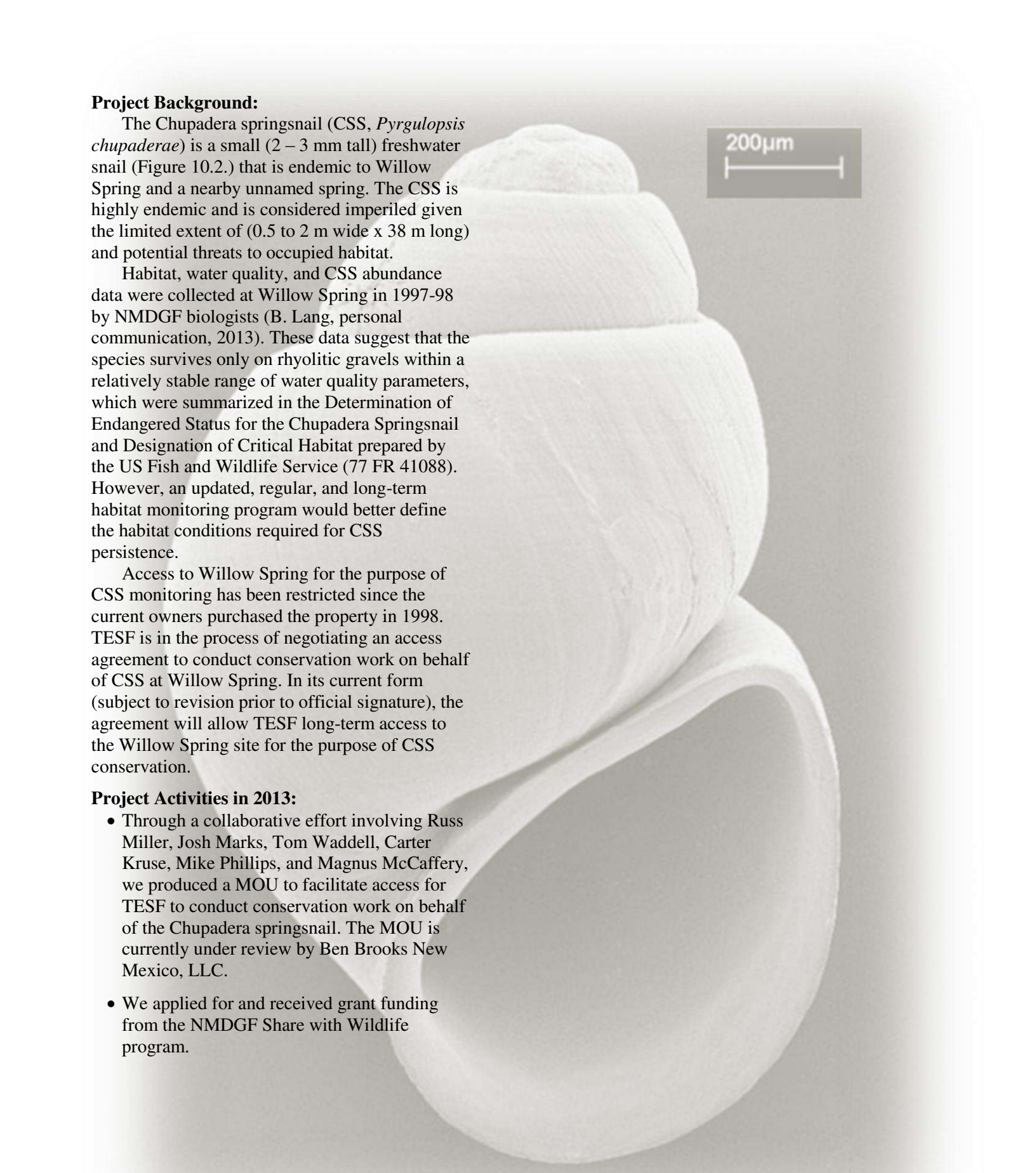


Figure 10.2. Chupadera springsnail (*Pyrgulopsis chupaderae*)

11. 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. Populations have also been severely depleted by human predation.

Conservation Status (additional information): The gopher tortoise is currently state listed as Threatened in Georgia and Florida, and is a Candidate species for listing under the ESA. In the western portion of its range, the species is listed as threatened under the ESA (Figure 11.1).

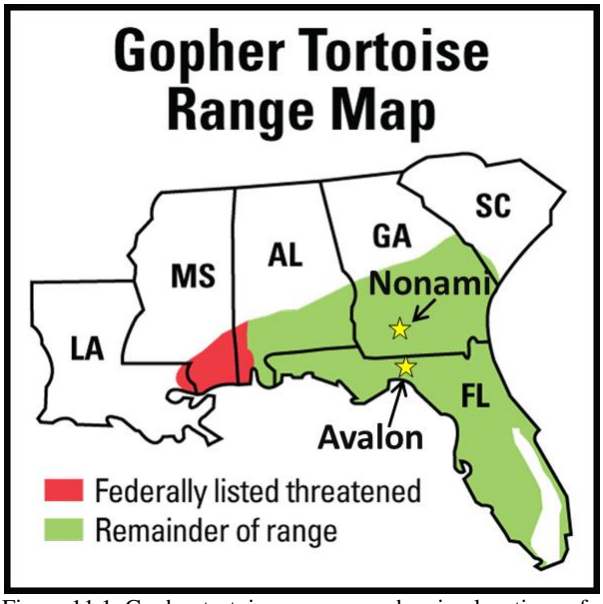


Figure 11.1. Gopher tortoise range map showing locations of Nonami and Avalon Plantations.

Project Location: Nonami Plantation, GA; Avalon Plantation, FL (Figure 11.1)

Project Partners:
- Georgia Department of Natural Resources
- Florida Fish and Wildlife Conservation Commission

Project Funding:
- TESF

Project Goals and Objectives: Our overarching goal is to restore robust and viable gopher tortoise populations to suitable habitat at the Nonami and Avalon Plantations.

Associated with this goal, our major objectives include:
- determining the current gopher tortoise population size and density on each property,
- determining the health and disease status of the extant populations,
- working with state and federal agencies to augment the extant populations using translocations,
- establishing minimum densities of 0.4 tortoises/hectare in focal conservation areas at each property,
- ultimately establishing densities of 1 to 2 tortoises/hectare in focal conservation areas at each property,
- recording recruitment of juveniles into the populations over time,
- conducting regular population monitoring, and
- conducting research on gopher tortoises and their commensal species.

Project Background:

The Nonami Plantation (3,578 ha) in Dougherty County, GA, and the Avalon Plantation (12,584 ha) in Jefferson County, FL are principally managed for northern bobwhite quail recreational hunting as well as for ecological conservation. Both properties comprise 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 tortoise 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 practices.

The importance of restoring robust gopher tortoise populations to Nonami and Avalon is supported by ecological and conservation

considerations. For instance, the gopher tortoise is a keystone species in Sandhill, longleaf pine, and shrub ecosystems. Their excavation of deep burrows provides habitat for approximately 60 vertebrate and 300 invertebrate commensal species, many of which are legally protected. Therefore, increasing gopher tortoise densities is expected to enhance local biodiversity, and improve the recovery prospects for other imperiled species that rely on tortoise burrows to meet their ecological requirements. Furthermore, gopher tortoise is state listed as threatened in Georgia and Florida, and is a candidate species for listing under the ESA. We aim to contribute to producing a level of benefit to the species that could preclude or remove any need to list the gopher tortoise under the ESA in Georgia and Florida.

Project Activities in 2013:

In 2013, we conducted soil analyses to evaluate the suitability of the Nonami (Figure 11.2) and Avalon (Figure 11.3) for gopher tortoises. To obtain site-specific soil information, we used the Natural Resources Conservation Service (NRCS) Web Soil Survey (www.soils.usda.gov) and ArcGIS boundary layers for the properties. We classified soil as being acceptable for gopher tortoises per the gopher tortoise management plan:

- moderately well-drained to excessively well-drained, and
- depth to water table value of 45 cm or greater.
- soils that did not conform to the above criteria, but were known to support gopher tortoises were included as suitable habitat.

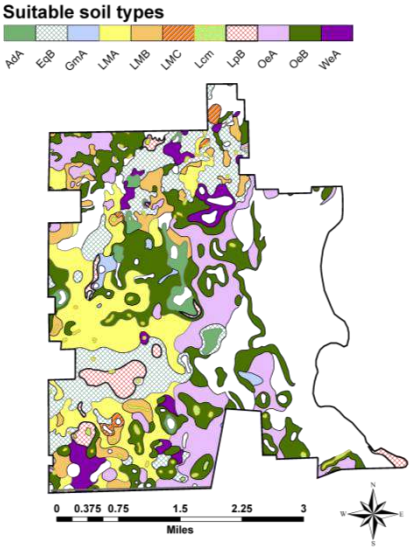


Figure 11.2. Soil types on the Nonami Plantation suitable for gopher tortoise occupancy.

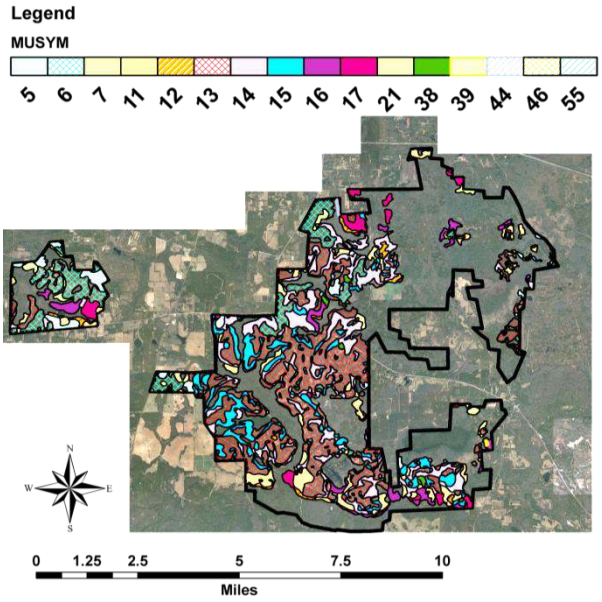


Figure 11.3. Soil types on the Avalon Plantation that suitable for gopher tortoise occupancy.

In October 2013, we collaborated with Georgia Department of Natural Resources (DNR) biologists, Matt Elliott (Program Manager) and Jess Gonyor McGuire (Wildlife Biologist), to conduct preliminary surveys of the Nonami Plantation's gopher tortoise population. We focused surveys in areas identified as suitable for gopher tortoise occupation by our soil analysis in conjunction with vegetation information derived from aerial imagery and field reconnaissance. Under the guidance of DNR biologists, we searched suitable gopher tortoise habitat for burrows and we were trained in the use of burrow cameras to determine burrow occupancy. We located 42 burrows (occupied = 12; unoccupied = 15; unknown = 15), and importantly, we identified focal areas with active burrow aggregations.

Following our training at Nonami Plantation with Georgia DNR, we strategically searched for gopher tortoise burrows in suitable areas of the Avalon Plantation property. We located a total of 129 burrows (both active and inactive), and identified three previously unknown remnant colonies on the Avalon Proper part of the property. These initial surveys then allowed us to map active burrow aggregations and to delineate focal "conservation areas" on which to focus our future recovery work (Figure 11.4). The next step will be to build upon this preliminary information by conducting rigorous survey work to ascertain the size of the extant Avalon Plantation population.

This will lay the foundation for enhancing gopher tortoise densities to > 0.4 tortoises/ha, which is considered to be the lower threshold needed to achieve a viable population.

Our long-term objective of attaining tortoise densities of 1 to 2 tortoises/ha follows the recommendations of J. W. Jones Ecological Research Center Associate Scientist, Dr. Lora Smith.

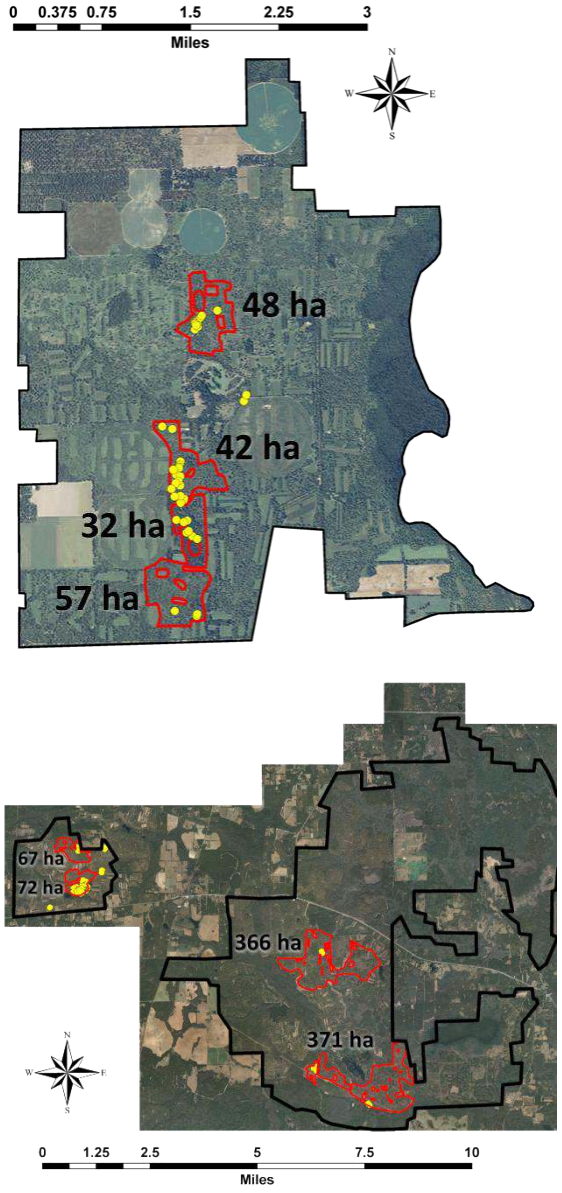


Figure 11.4. Nonami (top) and Avalon (bottom) Plantations showing locations of gopher tortoise burrows (yellow dots) located in 2013. Red polygons delineate proposed "gopher tortoise conservation areas" which represent sizeable areas of contiguous gopher tortoise habitat that incorporate extant gopher tortoise colonies at relatively low densities. The area in hectares (ha) of these conservation areas is shown adjacent to the corresponding polygon.

Proposed Future Activities and Considerations:

Burrow occupancy surveys in 2014

In spring 2014, we plan to conduct a systematic burrow search to map the extent of existing gopher tortoise colonies on the Nonami and Avalon Plantations, and to refine the sampling frame to be used in line transect distance (LTDS) sampling. The coordinates of each burrow observed will be recorded using a GPS unit, and all burrows will be scoped with a burrow camera to determine whether a tortoise is present (Figure 11.5). Camera equipment will be disinfected using sanitizing wipes after examining each burrow to minimize the risk of disease transmission. We will categorize burrows as either 'occupied' or 'empty', only if the operator is certain of tortoise presence or absence in the burrow. Otherwise, a burrow will be classified as 'undetermined' if the operator is unable to maneuver the camera to the end of the burrow due to burrow architecture or obstructions (e.g., dramatic turns, tunnel size, and roots).

Population estimation – line transect distance sampling (LTDS)

Pilot study

We will conduct pilot surveys to determine the tortoise encounter rate at each site and to refine the extent of the sampling frame prior to implementing full LTDS. We will use transects distributed and orientated randomly throughout the sampling frame, and attempt to detect 5 to 15 tortoises along these transects. Pilot surveys will involve three observers; one person will search for burrows on or near the transect center line, while two people will search on either side of center line. All burrows observed will be scoped with a burrow camera to determine whether a tortoise is present. We will then calculate the tortoise encounter rate (number of tortoises observed per meter of transect surveyed) for each site.

The encounter rate derived from the pilot study will be used to determine the total length of transect required for the full LTDS survey to generate tortoise abundance and density estimates with a CV < 20%. The full LTDS surveys will be designed using systematic random sampling in Distance 5.0 software.

Full LTDS survey

Three observers will walk along transects identified by the pilot study. The central observer will search the transect centerline, while the lateral observers search on either side weaving back and

forth to detect burrows from the centerline outward. When a burrow is observed, the following measurements will be recorded:

- The perpendicular distance from the transect line to the burrow will be measured. Perpendicular distance will be measured from the transect line to either the burrow's mouth or the beginning of the burrow apron, whichever is closest to the transect line.
- GPS coordinates for each burrow.
- Burrow width 50 cm inside the burrow.
- Each burrow will be classified according to width: juvenile (< 14 cm wide), sub-adult (14 – 23 cm wide), and adult (> 23 cm).
- Each burrow will be visually classified into one of two burrow status categories: active and inactive. Active burrows are those with burrow aprons and entrances with little or no debris, and have evidence of tortoise occupation (e.g. tracks, scat, etc.). Inactive burrows often have debris and leaf litter on the apron, at the mouth, and in the burrow tunnel, and are judged unlikely to be occupied by a gopher tortoise. Inactive burrow mouths may also be degraded so that they do not exhibit the classic, half-moon tortoise shape.
- We will scope all burrows identified and categorize them as occupied, empty, or undetermined.

Figure 11.5. Scoping a gopher tortoise burrow (top) to determine gopher tortoise occupancy (bottom).

12. WESTERN PEARLSHELL MUSSEL

Margaritifera falcata
– ESA listing: NOT LISTED

PROJECT STATUS: *Under development*

Principal biologist:
- *Carter Kruse*

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 (e.g., native salmonids).

Conservation Status: Historically found across the northwestern US, the species remains widespread in geographic area, but regional and localized declines are concerning. Documented, localized, watershed level extirpations are common. 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
- Montana Natural Heritage Program

Project Funding:
- TBD

Project Goals and 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 experiment and research necessary to establish accepted protocols for translocation and restoration of WPM in Montana.
- 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 12.1). Population persistence requires suitable habitat and water quality, males and females in close proximity, and presence of a host fish species.

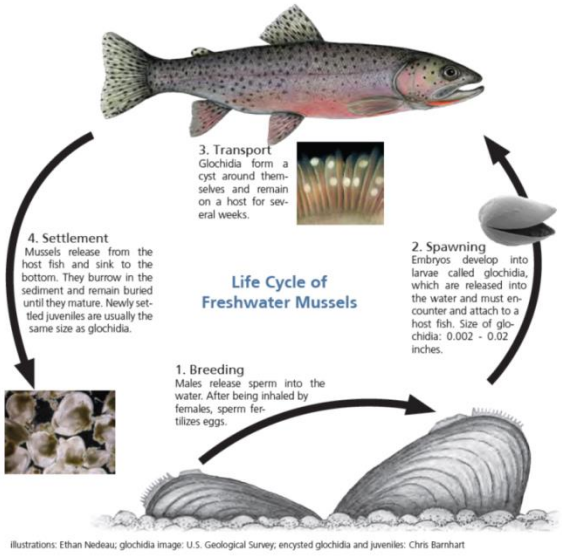


Figure 12.1. Cartoon of the complicated life cycle of western pearlshell mussel.

In Montana, the native westslope cutthroat trout is the preferred host fish, but WPMs have been documented to use bull, brook and rainbow trout. Thus, as westslope cutthroat trout populations have declined (see Section 3: cutthroat trout project) and habitat has been fragmented (preventing (re)colonization of barren habitat), among other things, WPMs have become at risk. WPMs can be relatively long-lived (50-60 years) and presence in a stream does not necessarily indicate 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 of Montana, only one (Duck Creek) had a viable WPM population; lower Cherry Creek (i.e., below the electric gate on the Flying D Ranch) contains a small, old, declining population of WPMs.

The successful establishment of westslope cutthroat trout in the upper 60 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 sections of creek might support WPMs if the species was introduced. If a suitable donor population of WPM can be found, transfer of WPM to upper Cherry Creek seems a logical action. However, as with any declining or sensitive species it is often times difficult to find a donor population that is large enough, genetically suitable, and disease free.

Project Activities in 2013:

Introduction of WPMs to Cherry Creek will not occur until the cutthroat trout population fills the renovated habitat and demonstrates stable population numbers with consistent reproduction. However, much discussion occurred with project partners in 2013 regarding the most appropriate way to translocate WPMs to Cherry Creek, or other reintroduction sites. Most translocations done to date in MT have been within watershed, where disease and genetic issues are minimalized to some extent. If WPMs are translocated between watersheds (e.g., Duck Creek to Cherry Creek) or from a disease positive to disease free site (e.g., lower Cherry to upper Cherry) certain protocols, as defined by the Montana Fish Wildlife and Parks (FWP) Fish Health Committee, must be followed. For genetic reasons it is often most desirable, but often not possible, to find a donor from a nearby watershed. To verify disease status it is often necessary to sacrifice up to 50 individuals from the donor population; however, for many species, WPM included, sacrificing 50 individuals could impact future viability of the population. In some instances, MT FWP will allow surrogate testing, or collection of individuals of other, more plentiful species that might carry the same disease. Duck Creek or lower Cherry Creek are the only two WPM populations that should be 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. The results indicated that lower Cherry Creek is positive for whirling disease, the pathogen of most interest, and Duck Creek was negative. Thus Duck Creek is a potential donor source. Additional discussion focused on quarantine and treatment of individuals to be translocated in order to clear or kill any other diseases that WPM might carry between donor and introduction sites. A quarantine period with bleach treatment has not worked well when tried during other WPM translocation events. More research is needed.

Since larval WPMs are carried for several weeks by the host fish, there was discussion that 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. It was agreed to investigate the feasibility of this type of translocation in 2014. To both encourage reproduction and prepare for such an experiment, TBD collected all visible WPMs in lower Cherry in August and grouped those 43 remaining mussels in one location (Figure 12.2).

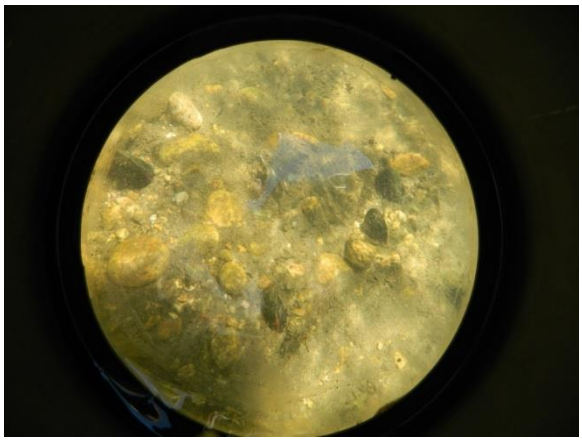
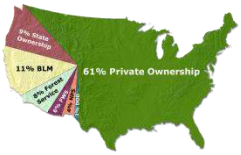


Figure 12.2. Transplanted WPMs in Lower Cherry Creek.

Reproduction by WPMs has not occurred in lower Cherry Creek for at least two decades (evidenced by lack of young WPM), likely due to the wide spatial distribution among individuals and, perhaps, a lack of suitable host fish. By grouping the remaining mussels TBD hopes 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 “exposed” to glochidia. A similar experiment is planned for Duck Creek.

13. WESTERN LANDOWNERS ALLIANCE (WLA)

Private land and imperiled species



PROJECT STATUS: *Ongoing*

Principal biologist:
- *Mike Phillips*

Conservation Problem: Relative lack of involvement by private landowners in efforts to recover imperiled species

Conservation Status: threatened and endangered species on private land

Project Location: western US

Project Partners (integral to success):
- Members of WLA

Project Goals and Objectives: Increase the number of private landowners actively supporting imperiled species conservation efforts on their land.

Project Background:
Despite our successes, the need for private land to serve as beachheads of security for imperiled species has grown more acute since TESF was founded in 1997. It is extremely unlikely that most federally listed species in the U.S will recover without the cooperation of non-federal landowners. This is because more than 60% of the U.S. is privately owned (Figure 13.1) and at least 80% of endangered or threatened species occur either partially or solely on private lands, with only about 12% of listed species found almost exclusively on public lands. Willing private landowners are essential to successful biodiversity conservation (Figure 13.2).

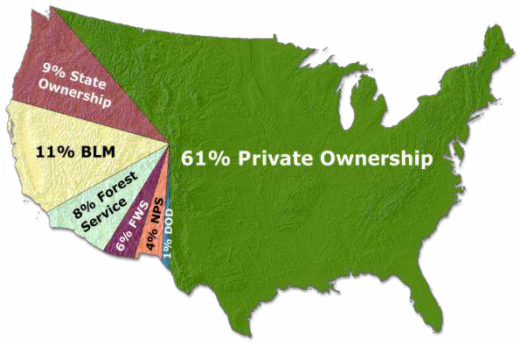


Figure 13.1. Private land is common in the continental United States and of central important to the vast majority of threatened and endangered species.

Figure 13.2. Mike Phillips, Paul Vahldiek, Michael Soulé, and Cristina Eisenberg during a meeting at the High Lonesome Ranch (Debeque, CO) to consider the role of private land in efforts to conserve biological diversity.

Many private landowners are, however, wary of the possible consequences of attracting or maintaining imperiled species on their properties. It is possible that their apprehension could be assuaged if presented with tangible examples that illustrate the capacity of private land to support imperiled species, even in the presence of active and successful land management programs. The types of examples needed are the same as the projects we have been advancing for 15 years.

It is now incumbent on us to consider new collaborations that can increase the number of private landowners motivated by an approach to land management that includes a focus on imperiled species. To that end we have worked with a few other landowners and leading conservation scientists to help found the Western Landowners Alliance (WLA; Figure 13.3).

Figure 13.3. WLA founding group at Vermejo Park Ranch.

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 to 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.

Project Activities in 2013:

During 2013, Mike Phillips accepted a position on the Board of Directors of the WLA. Throughout the year Mike provided support to ensure the growth of the organization (details at www.westernlandownersalliance.org).

14. PLAINS BISON CONSERVATION

Bison bison

– **ESA listing: NOT LISTED**

– **IUCN Red List: NEAR THREATENED**

– **State government:** some states list the species as livestock whereas others apply dual status of wildlife and livestock

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 whereas others apply a dual status as wildlife and livestock

Project Location: Historical range of plains bison with a differential 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 and Objectives: Improve the conservation status of wild plains bison without negatively impacting the bison livestock industry.

Project Background:

The plains bison (*Bison bison*) once had the widest distribution of any large herbivore in North America, ranging from the arid grasslands of Mexico to the extensive meadows of interior Alaska. By the late 19th century the species had nearly been driven to extinction. By then due to wanton destruction for myriad reasons wild bison only persisted in two locations, south of Great Slave Lake in what is now Wood Buffalo National Park (about 300 individuals) and in the remote Pelican Valley in the Absaroka Mountains deep in Yellowstone National Park (Figure 14.1).

Figure 14.1. While the American plains bison was once common throughout much of North America, wanton destruction brought the species to the precipice of extinction by the late 1800s. By 2013 wild plains bison were still absent from all but a small fraction of the species' historical range.

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.

Project Activities in 2013:

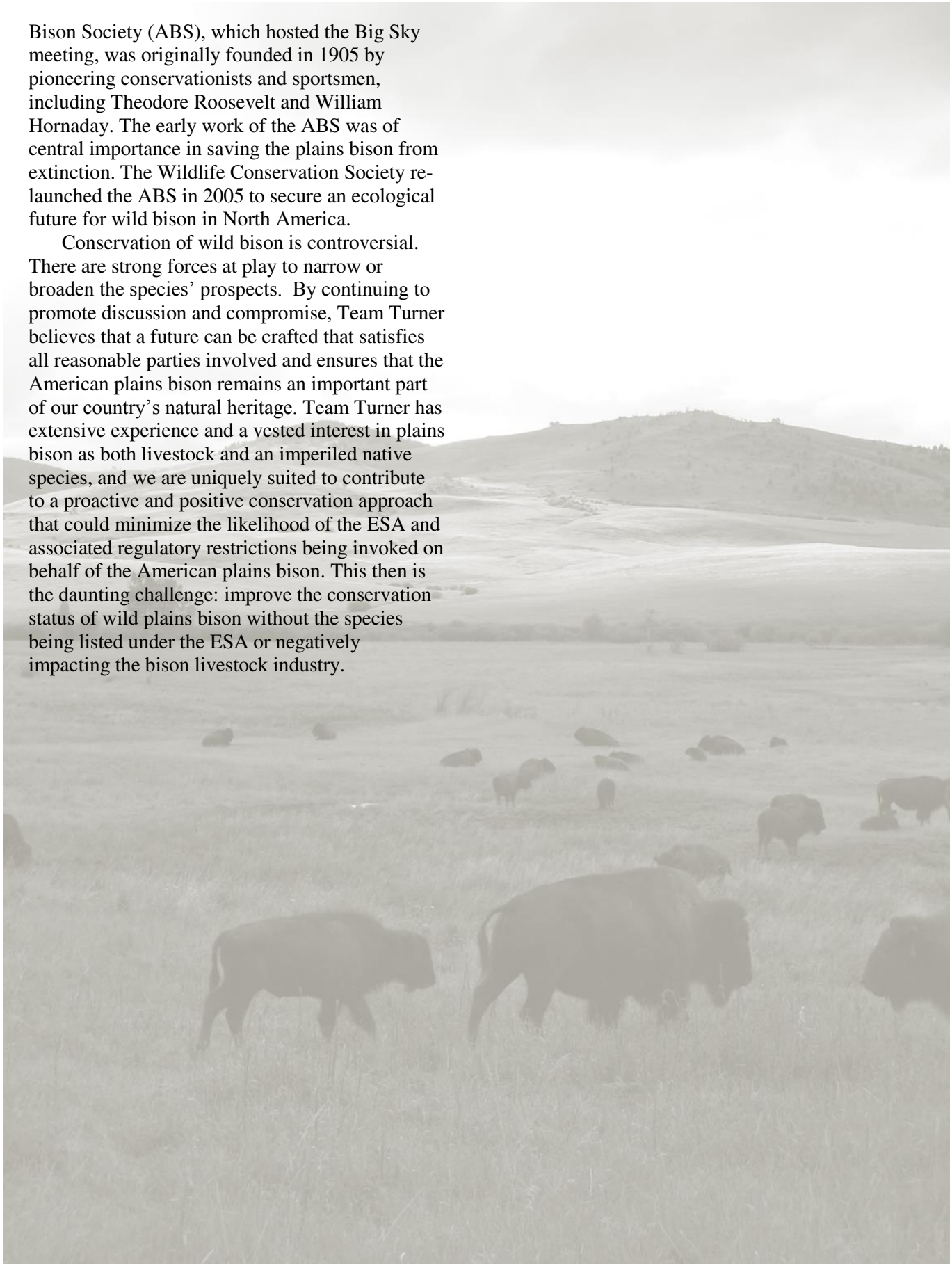
In May 2013, Mike Phillips secured support from Mr. Turner to take new steps to advance conservation of wild plains bison. Specifically, Phillips accepted an invitation to join the IUCN/SSC Bison Specialist Group. Such Groups, including several others that Phillips belongs to, are credible bodies of 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.

Phillips also accepted an invitation to lead a group of experts considering the social and cultural aspects of bison restoration. Other groups worked on related aspects of the issue, including economics, ecology, and management. The groups' work was presented during the 2013 Annual Meeting of the American Bison Society at Big Sky, MT from September 16th through 19th.

The meeting aimed to build a model for wild bison restoration that is practical but science based as reflected by the collective expertise of group members and meeting participants. The American

Bison Society (ABS), which hosted the Big Sky meeting, was originally founded in 1905 by pioneering conservationists and sportsmen, including Theodore Roosevelt and William Hornaday. The early work of the ABS was of central importance in saving the plains bison from extinction. The Wildlife Conservation Society re-launched the ABS in 2005 to secure an ecological future for wild bison in North America.

Conservation of wild bison is controversial. There are strong forces at play to narrow or broaden the species' prospects. By continuing to promote discussion and compromise, Team Turner believes that a future can be crafted that satisfies all reasonable parties involved and ensures that the American plains bison remains an important part of our country's natural heritage. Team Turner has extensive experience and a vested interest in plains bison as both livestock and an imperiled native species, and we are uniquely suited to contribute to a proactive and positive conservation approach that could minimize the likelihood of the ESA and associated regulatory restrictions being invoked on behalf of the American plains bison. This then is the daunting challenge: improve the conservation status of wild plains bison without the species being listed under the ESA or negatively impacting the bison livestock industry.



AWARDS & HONORS

2013 USFWS Recovery Champion Award

Several members of "Team Turner", including Carter Kruse, Magnus McCaffery, Hanne Small, and Steve Dobrott were part of the New Mexico Chiricahua Leopard Frog Conservation Working Group that was named as a recipient of the U.S. Fish and Wildlife Service's 2013′s National Recovery Champions. This award is in recognition of the group making significant contributions to Chiricahua leopard frog recovery in NM, changing its trajectory from extirpation from the state to the path towards recovery.

Members of the NM CLF Recovery Team accepting the National Recovery Champions award (left to right: Jack Barnitz (BLM), Hanne Small (TESF), Steve Dobrott (Ladder Ranch), Justin Schoffer (USFS), Dr. Benjamin Tuggle (USFWS), Michelle Christman (USFWS).

A stylized image of a metamorph Chiricahua leopard frog

PUBLICATIONS IN 2013

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

Carroll, C., **M. K. Phillips**, R. Frederickson, J. A. Vucetich, D. W. Smith, K. Leong, J. Servin, C. Gonzalez, and P Siminiski. In prep. Mexican wolf recovery. BioScience.

Eads, D.A. and **D.H. Long**. In prep. Effects of vegetative visual-obstructions on black-tailed prairie dogs in northeastern New Mexico.

Eads, D.A., D.E. Biggins and **D.H. Long**. In prep. Conservation implications of bottom-up ecology for prairie dogs and endangered black-footed ferrets: a case study and literature review.

Eads, D.A., D.E. Biggins, P.F. Doherty, Jr., K.L. Gage, K. Huyvaert, **D.H. Long**, M.F. Antolin. 2013. Using occupancy models to investigate the prevalence of ectoparasitic vectors on hosts: an example with fleas on prairie dogs. International Journal of Parasitology: Parasites and Wildlife 2:246-256.

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

Long, D.H. and J.N. Stuart. In Review. Black-footed Ferrets (Mustela nigripes). J.L. Cartron and J. Frey, eds. Carnivores of New Mexico.

Long, D.H. 2013. Restoration of black-tailed prairie dogs to Vermejo Park Ranch, NM, USA. Pages 210-214 in P.S. Soorae, ed. Global Re-introductions Perspectives: 2013. More case studies from around the globe. Gland, Switzerland: IUCN/SSC Re-introduction Specialist Group and Abu Dhabi, UAE: Environment Agency-Abu Dhabi- xiv +250pp.

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

Kruse, C. G., P. Clancey, S. Barndt, K. Patten, and B. Shepard. 2013. Setting the stage for conservation success: large-scale watershed renovation and re-introduction of cutthroat trout in the Rocky Mountain region of the USA. Pages 26-32 in P. S. Soorae ed. *Global Re-introduction Perspectives: 2013. Further case studies from around the globe.* Gland, Switzerland: IUCN/SSC Re-introduction Specialist Group and Abu Dhabi, UAE: Environment Agency- Abu Dhabi. xiv + 282 pp.

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. Biological Conservation.

Kruse, C. G., P. Clancey, B. Shepard, T. Lohrenz, S. Barndt, and L. Nelson. In prep. Watershed renovation and westslope cutthroat trout restoration in Cherry Creek: A case study. Conservation Biology.

Phillips, M.K. 2013. Establishment of a desert bighorn sheep population to the Fra Cristobal Mountains, New Mexico, USA. Pages 198-203 in P. S. Soorae ed. *Global Re-introduction Perspectives: 2013. Further case studies from around the globe.* Gland, Switzerland: IUCN/SSC Re-introduction Specialist Group and Abu Dhabi, UAE: Environment Agency- Abu Dhabi. xiv + 282 pp.

Phillips, M. K. 2013. 344F: a remarkable wolf. Pages 172-181 in R. P. Thiel, A. C. Thiel, and M. Strozewski, eds. Wild wolves we have known: stories of wolf biologists' favorite wolves. International Wolf Center, Minneapolis, MN. 245 pp.

Phillips, M. K., C, Carroll, J. A. Vucetich, R. Frederickson, and D. W. Smith. In prep. Assisted migration: a requisite for recovering the Mexican wolf, bolson tortoise, and Chupadera spring snail.

Sasmal, I., K. Honness, **M. McCaffery**, K. Kunkel, J. A. Jenks, and **M. Phillips**. In prep. Release methodology evaluation for swift fox reintroductions at Bad River Ranches in South Dakota.

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

Truett, J., **Long, D.**, Bly, K., Sweikert, L., Yearout, K., Yearout, E., and **M. Phillips**. In prep. Prairie Dog Colony Expansion: Rates and Controlling Factors.

PRESENTATIONS IN 2013

Burgad, A., C. Williams and **C. G. Kruse**. 2013. Recovery of a restored native cutthroat trout population after watershed renovation. Poster Presentation, 2013 Annual Meeting of the American Fisheries Society, Little Rock, AK, September 8-12.

McCaffery, M., and **M. K. Phillips**. 2013. Wolf recovery in the Northern Rockies: a unique leveraging of partnerships for conservation. 6th Annual Research Symposium for Conservation Biology. Montana Chapter Society for Conservation Biology. Bozeman, MT. November 2013.

Phillips, M. K. 2013. Mexican wolf recovery: Briefing to the Director, U.S. Fish and Wildlife Service. Washington, D.C. March 29, 2013.

Phillips, M.K. 2013. Social and cultural aspects of recovering American plains bison. 4th Biennial American Bison Society conference and workshop. Big Sky, Montana. September 17, 2013.

Phillips, M. K. 2013. What is wolf recovery? Invited Participant Plenary Debate, 2013 International Wolf Symposium, Duluth, MN, October 12, 2013.

Phillips, M. K. 2013. Mexican wolf recovery region. Oral Presentation, 2013 International Wolf Symposium, Duluth, MN, October 13, 2013.

Phillips, M. K. 2013. Prey biomass and Mexican wolf recovery. 2013 International Wolf Symposium, Duluth, MN, October 13, 2013.

Phillips, M. K. 2013. Reflections on Yellowstone. 2013 International Wolf Symposium, Duluth, MN, October 13, 2013.

Phillips, M. K. 2013. Leveraging success. Invited Plenary Lecture, Annual Meeting Montana Chapter Society for Conservation Biology, Bozeman, MT, November 6, 2013.

Wiese, C. Feb 6, 2013: Rocket21-sponsored visit with Val Asher to a 5th grade classroom in San Bruno, CA to discuss wolves (mainly) and tortoises (secondarily)

Wiese, C. March 25, 2013: gave a presentation to attendees for the "EcoGenEX" workshop on the Ladder organized by G. Roemer and Josh Donlan; toured the Ladder Headstart pen

Wiese, C. September 7, 2013: gave two presentations (one discussing wolves, one discussing tortoises) to UNM Mammalogy lab students trapping small mammals on the Ladder

Wiese, C. October 26, 2013: gave two presentations (one discussing wolves, one discussing tortoises) to Furhman University "Wild Semester" students; took the students to practice telemetry on released juveniles in the Ladder Big Pen

APPOINTMENTS

Kruse, C. G. Affiliate Faculty, Montana State University, Department of Ecology
Kruse, C. G. Affiliate Faculty, New Mexico State University, Department of Fish, Wildlife and Conservation Ecology
Kruse, C. G. Affiliate Faculty, Idaho State University, Department of Biological Sciences
Kruse, C. G. New Mexico Rio Grande Cutthroat Trout Working Group
Kruse, C. G. Montana Westslope Cutthroat Trout Technical Committee
Kruse, C. G. New Mexico Chiricahua Leopard Frog Stakeholder and Working Group
Long, D. Black-Footed Ferret Recovery and Implementation Team; Executive and Conservation Subcommittee
McCaffery, M. Affiliate Faculty, Montana State University, Department of Ecology
Phillips, M. K. USFWS Mexican Wolf Recovery Team
Phillips, M. K. IUCN/SSC Wolf Specialist Group
Phillips, M. K. IUCN/SSC Reintroduction Specialist Group
Phillips, M. K. IUCN/SSC Bison Specialist Group
Phillips, M. K. IUCN/SSC Canid Specialist Group
Phillips, M. K. Board of Directors, International Wolf Center
Phillips, M. K. Board of Directors, Western Landowners Alliance
Phillips, M. K. State Senator, Montana

Lightning storm on the Ladder Ranch in New Mexico

ACRONYMS & ABBREVIATIONS USED IN REPORT

ACRA = Ash Creek Restoration Area
AFS = American Fisheries Society
BLM = Bureau of Land Management
BRR = Bad River Ranches
CLF = Chiricahua leopard frog (*Lithobates chiricahuensis*)
DNR = Department of Natural Resources
ESA = Endangered Species Act
IUCN = International Union for the Conservation of Nature and Natural Resources
LDZG = Living Desert Zoo & Gardens State Park in Carlsbad, NM
LRWMF = Ladder Ranch Wolf Management Facility
LTDS = Line Transect Distance Sampling
MOU = Memorandum of Understanding
MT = Montana
MTFWP = Montana Fish Wildlife & Parks
NF = North Fork
NM = New Mexico
NMDGF = New Mexico Department of Game & Fish
NRCS = National Resources Conservation Service
PIT = Passive Integrated Transponder
RCW = Red-cockaded woodpecker (*Picoides borealis*)
RGCT = Rio Grande cutthroat trout
RU = Recovery Unit
SD = South Dakota
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
USFWS = U.S. Fish & Wildlife Service
VPR = Vermejo Park Ranch
WCT = Westslope cutthroat trout
WLA = Western Landowners Alliance
WPM = Western pearlshell mussel

A double rainbow over the Flying D Ranch in Montana