REPORT
ON
THE STATUS AND CONSERVATION
OF
THE BOREAL TOAD
Bufo boreas boreas
IN
THE SOUTHERN ROCKY MOUNTAINS

2006 - 2007

Prepared By The Colorado Division of Wildlife

Tina Jackson, Coordinator

REPORT
ON
THE STATUS AND CONSERVATION
OF
THE BOREAL TOAD
Bufo boreas boreas
IN
THE SOUTHERN ROCKY MOUNTAINS

2006- 2007

Colorado Division of Wildlife

Tina Jackson, Herptile Coordinator

6060 Broadway

Denver, CO 80216

December 2008

Table of Contents

Introduction

This is the eighth in a series of reports updating information provided in the Boreal Toad Recovery Plan (Colorado Division of Wildlife 1994, 1997) and the Boreal Toad Conservation Plan and Agreement (Loeffler 1998, 2001). The purpose of this document is to provide a summary and progress report of boreal toad conservation work in the Southern Rocky Mountains for the 2006 and 2007 field seasons.

The boreal toad (*Bufo boreas boreas*) was once considered common in the Southern Rocky Mountains of Wyoming, Colorado, and New Mexico but, by the early 1980's, dramatic declines were becoming apparent. The current understanding within the conservation community is that these declines are due to *Batrachochytrium dendrobatitis* (Bd) infection (Carey, 1993). Other factors, including water quality and habitat changes, may also be responsible for some losses (Loeffler, 2001).

Recovery actions in 2006 and 2007 included continued monitoring of over 65 breeding sites each year, discovery of 7 new breeding sites, maintenance and breeding of a captive broodstock population, and continued research into disease dynamics, population modeling, genetic relationships, and translocation methodologies.

Current legal status

As of November 2008, the boreal toad remains a state listed endangered species in Colorado and New Mexico, as well as a protected species in Wyoming. During 2006, the New Mexico Department of Game and Fish implemented a recovery plan for the toad within that state (New Mexico Department of Game and Fish, 2006).

Federal status of the Southern Rocky Mountain Population (SRMP) of boreal toads has not changed since the "not warranted" decision announced by the US Fish & Wildlife Service on September 29th, 2005.

Taxonomy & genetics

Research into the genetics of the SRMP continues at both Florida Gulf Coast University with Dr. Anna Goebel and the US Geological Service with Dr. John Switzer. It is hoped that this work will both enlighten the taxonomic discussions and ensure that management within the SRMP, such as reintroductions, will maintain remaining the natural diversity.

Recovery team & recovery efforts

In late 1994, the Colorado Division of Wildlife worked with other agencies to form the Boreal Toad Recovery Team. This team has been instrumental in the on-going management and recovery activities for boreal toads in the Southern Rocky Mountain region. The team consists of representatives from those agencies and organizations that have signed the Conservation Agreement, members of the Technical Advisory Group, and other interested individuals. The current team members are listed below.

Recovery Team Agency Representatives

Colorado Division of Wildlife, Tina Jackson, Colorado Springs, CO

New Mexico Game & Fish Department, Charlie Painter, Santa Fe, NM

Wyoming Game & Fish Department, Zack Walker, Laramie, WY

US Fish & Wildlife Service, Terry Ireland, Grand Junction, CO

USGS/Biological Resources Division, Erin Muths, Fort Collins, CO

US Forest Service, Region 2, Doreen Sumerlin, Granby, CO

US Forest Service, Region 3, Donna Storch, Taos, NM

National Park Service, Rocky Mountain National Park, Mary Kay Watry, Estes Park, CO

Bureau of Land Management, Jay Thompson, Lakewood, CO

Environmental Protection Agency, Ed Stearns, Denver, CO

Technical Advisory Group

Paul Bartelt, Waldorf College, Forest City, IA

Ron Beiswenger, University of Wyoming, Laramie, WY

Cynthia Carey, University of Colorado, Boulder, CO

Steve Corn, USGS/Biological Resources Division, Missoula, MT

Anna Goebel, Florida Gulf Coast University, Fort Myers, FL

Mary Jennings, US Fish & Wildlife Service, Cheyenne, WY

Don Kennedy, Denver Water Board, Denver, CO

Brad Lambert, Colorado Natural History Program, Fort Collins, CO

Lauren Livo, University of Colorado, Boulder, CO

Kevin Thompson, Colorado Division of Wildlife, Montrose, CO

Breeding Site Monitoring

The majority of known breeding sites are monitored each year for the presence of boreal toads, including all age classes, breeding activity and any other factors that may impact the future success of the toad populations in the area. These activities are performed by numerous individuals from many different agencies.

In 2006, 77 breeding sites (41 populations) were known to exist, 65 of those sites were monitored. There are numerous reasons for not monitoring the other 12 sites, including the inability to access sites located on private land, the failure to enlist personnel to cover the monitoring, and previous inactivity of the sites. The number of active sites fell slightly in 2006 with the total reaching 40. The change in number of active sites is often misunderstood; the total number of active sites must be compared with the previous year but also take into consideration the number of new sites that were located. In 2006, 5 new sites were located. The 2006 results maintain the designation of 1 population as viable (Cottonwood Creek, Chaffee County, Colorado). The White Rock Mountain population is no longer viable with the positive disease findings of one site within that population in 2006.

In 2007, 80 breeding sites (44 populations) were known to exist, 69 of those sites were monitored. The total number of active sites remained steady at 40 in 2007. Three new sites were located in 2007. The 2007 numbers maintain the designation of 1 population as viable (Cottonwood Creek, Chaffee County, Colorado).

During breeding site monitoring, swabs are taken, when possible, to test for Bd presence at each site. To date 22 sites have tested positive, 35 sites have tested negative, and 22 sites have not been tested. Research is still on-going to develop an environmental test for Bd, which will help determine disease presence without the need to locate and capture one-year old and older animals.

A table summarizing the population and site numbers can be found in Appendix I. The monitoring and disease testing history of each site can be found in Appendix II.

Surveys

Each summer, agency personnel and private individuals survey areas of potential boreal toad habitat and follow-up on reports of boreal toads. It has been difficult to quantify this effort on a yearly basis as many of these surveys go unreported. The one number that can be reported

as an indication of the amount of effort and success these surveys produce is how many new sightings and breeding locations are recorded each year.

In 2006, over 70 site surveys were reported and 5 new breeding sites were located:

- Campground Lift Pond, PI05, Pitkin County
- Buzzard Creek, ME01, Mesa County
- Rough and Tumbling West, PA02, Park County
- Grizzly Reservoir, PI04, Pitkin County
- Homestake Reservoir, PI06, Pitkin County

In 2007, 2 new breeding sites were located:

- South Fork, GR07, Grand County
- Cow Creek, GU06, Gunnison County

Future plans include the continued surveying of new and potential sites as well as follow up on any reports of boreal toads from around the state. It is requested that individuals participating in these efforts report their activities so more accurate information can be provided to the Recovery Team and in these updates.

Research

In 2006 and 2007, research focused on a number of different questions vital to the recovery and management of boreal toads in Southern Rocky Mountain region. Some highlights of the work that occurred include continued mark/recapture work in the largest known population in the state, follow up on the largest translocation effort to be studied, and development of a technique to non-invasively identify individual animals in captivity. Updates on many of the specific research projects can be found in Appendix VI.

Future research plans include the continuation of on-going disease and field studies, as well as developing a further understanding of the possibility of disease resistance developing in wild populations, development of a habitat model to identify areas of potential unknown populations, and further refinement of translocation and breeding protocols and procedures.

Habitat Management

As in the recovery of any wildlife species, the Boreal Toad Conservation Plan and Agreement (Loeffler, 2001) calls for the protection, management, and improvement of habitat for boreal toads. The main focus of this work is on boreal toad breeding habitat, including shallow ponds and wetlands. Upland habitat and movement corridors have also been addressed in some portions of the species range. The majority of boreal toad habitat occurs on public lands, mainly the US Forest Service and Rocky Mountain National Park.

In 2006 and 2007, specific habitat management projects included the continuation of the Crooked/Pole Project in Grand County and the initiation of a project to develop a breeding site at Grizzly Reservoir in Pitkin County. The Crooked/Pole Project has created 34 breeding ponds since 2000 in cooperation with private landowners and the local municipalities. (Horstman, 2007) The population using these ponds has tested positive for Bd but continues to maintain stable numbers (as well as show increases in some years). The Grizzly Reservoir Project is attempting to recreate a breeding site that had been lost in the development of the Grizzly Reservoir. Tadpoles were found in a small drainage ditch at the site in August of 2006. It was determined that the drainage ditch was not meeting the habitat requirements of these animals and a more appropriate location needed to be built to ensure the continued use of this location. CDOW and USFS cooperated on the design and construction of the site in 2007. The formal project is expected to be completed in 2008.

Future plans for habitat management and improvement include determining the extent habitat may be playing a role in the continued declines of this species, developing a model to determine areas of appropriate habitat that should receive additional survey effort, and continuing to make habitat improvements in areas that present the opportunities.

Translocations

Translocations into historic and created habitats are currently seen as an important aspect of boreal toad recovery in the Southern Rocky Mountain Population. In 2006, planning continued for future translocation projects and 2 small tadpole releases occurred. A small number of tadpoles were released at the Grand Mesa site, following up on the previous 3 years of releases at this location. The Zimmerman Lake translocation site also received 2,500 tadpoles in 2006 to determine the disease status of the site. Attempts will be made to recapture these animals in 2007 for disease testing. Plans were finalized for the Rocky Mountain National Park

release that was expected to begin in 2007. Plans also continued to move forward for the future release of animals into appropriate habitat in New Mexico.

In 2007, 53 animals were observed from the 2006 release at the Zimmerman Lake site, which represents a minimum recruitment of 2.1%, which is significantly higher than the minimum recruitment seen at the Grand Mesa release site. All Bd swabs tested negative for disease presence, providing encouragement for the future success of this translocation project. Translocations were also planned to begin at a location in Rocky Mountain National Park in 2007. Tadpoles were not released at the site due to issues with captive broodstock animals, including the loss of some adults during their hibernation period and the inability to produce eggs from remain adults. This was a disappointment for all personnel involved but provided an additional year of surveying and preparation at the release site.

Future plans include releasing animals at the Rocky Mountain National Park site, the Zimmerman Lake site, and identified locations in historical boreal toad range in New Mexico. Additional release sites need to be identified and surveyed in the near future to continue moving the translocation aspect of toad recovery forward.

Captive Information

The Native Aquatic Species Restoration Facility (NASRF) maintains a large captive population of boreal toads for reintroduction and research purposes. As of January 2008, 677 individual toads were housed at NASRF. These animals represent 63 separate lots (egg masses) from 21 breeding sites. In 2006 and 2007, toads were also housed at various zoos and research facilities, including the Cheyenne Mountain Zoo (Colorado Springs, CO), the Denver Zoo (Denver, CO), the Mississippi River Museum and Aquarium (Debuque, IA), and the University of Colorado at Boulder (Boulder, CO).

Conclusion

The recovery of boreal toads in Colorado and the Southern Rocky Mountains continues to be a slow process due to the nature of the threats they face. The discovery of an additional 7 breeding sites and the continued viable status of 2 populations are important results from the 2006 and 2007 field seasons. But the future of the boreal toad recovery program rests on the ability of the involved management agencies to successful establish new breeding sites in

currently unoccupied areas and to determine the possibility of toads to persist in light of the significant disease threats they face in the wild.

Appendix I – Viability Summary Table

Year	Total Population (Sites)	Breeding Populations (Sites)	Recruitment Populations (Sites)	Populations (Sites) with 20+ adults & 4+ egg masses	Populations (Sites) Positive for Bd	Viable Populations
1993	*	* (6)	* (2)	*	**	*
1994	*	5 (10)	2+ (3)	2	**	*
1995	*	12 (20)	2+ (3)	4	**	*
1996	*	20 (28)	11 (12)	5	**	*
1997	* (37)	19 (30)	9+ (10)	5 (9)	**	3
1998	26 (40)	16 (24)	5+ (9)	6 (11)	**	5
1999	29 (50)	18 (35)	10 (14)	4 (8)	**	6
2000	30 (56)	18 (33)	13 (13)	6 (8)	**	1
2001	32 (59)	22 (38)	15 (24)	5 (9)	**	1
2002	32 (60)	24 (38)	13 (19)	7 (10)	6 (9)	1
2003	32 (63)	22 (38)	15 (19)	4 (9)	8 (10)	1
2004	37 (69)	24 (37)	16 (22)	5 (10)	11 (13)	1
2005	39 (71)	24 (41)	18 (24)	5 (10)	13 (16)	2
2006	41 (77)	26 (40)	14 (19)	3 (6)	14 (17)	1
2007	44 (80)	25 (40)	***	2 (9)	19 (22)	1

* Pre-1997 data is unavailable for some fields.
** Bd testing did not begin until 2001.
*** 2007 recruitment cannot be determined until 2008.

Appendix II - Breeding Site Reports

BO01 - Lost Lake

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	0/1/0	No	2(M,A)	Toadlets introduced
1997	0/1/1	No	3(M,1,A)	Toadlets introduced**
1998	0/2/0	No	3(1,2,A)	No breeding observed
1999	0/0/0	No	None seen	Minimal surveys done
2000	0/0/0	No	None seen	Monitoring adequate
2001	0/0/0	No	None seen	Monitoring adequate
2002	0/0/0	Unk	None seen	Monitoring adequate
2003	0/0/0	Unk	None seen	Site visited 3 times
2004	0/0/0	Unk	None seen	Site visited 2 times
2005	0/0/0	Unk	None seen	Site visited 2 times
2006	0/0/0	Unk	None Seen	Site visited once
2007	0/0/0	Unk	None Seen	

*PCR test results were chytrid negative for samples from 5 groups of sentinel tadpoles placed at Lost Lake in 2001.

**Tadpoles observed, possibly from mating of a resident female and a translocated male toad.

Bd Testing

Site not tested

Comments

This is an experimental reintroduction site. This site no longer receives priority monitoring as it appears the 1996/1997 reintroduction has failed.

CC01 - Vintage

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	?/?/?	Unk	Multiple	Little data available
1995	3/2/2	Unk	2(M,A)	Prob. few metamorphs
1996	1/1/1	No	1(A)	No production
1997	1/1/1	No	1(A)	Eggs froze
1998	3/0/0	No	1(A)	No breeding observed
1999	3/0/0	No	1(A)	No breeding observed
2000	0/0/0	No	None seen	Minimal monitoring
2001	0/0/0	Unk	None seen	Minimal early monitoring
2002				Not monitored
2003	0/0/0	Unk	None seen	No evidence of breeding
2004				Not monitored
2005	0/0/0	Unk	None seen	No evidence of breeding
2006	0/0/0	Unk	None seen	Site is drying
2007	0/0/0	Unk	None seen	Site is dry

Bd Testing

Site not tested

Comments

This site appears to have failed due to a loss of appropriate habitat.

CC02 - Urad/Henderson

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	131/19/19	Yes	4(M,1,S,A)	
1996	142/18/18	Yes	4(M,1,S,A)	Few metamorphs
1997	167/33/23	Yes	4+(M,1,S,A)	
1998	203/107/55	Yes	4(M,1,S,A)	Many metamorphs
1999	141/60/60	Unk	4(M,1,S,A)	Bd mortality
2000	34/34/34	Yes	2(M,A)	
2001	14/14/14	Unk	3(M,1,A)	Some egg mortality*
2002	25/22/22	Unk	2(M,A)	Several sites dry**
2003	15/15/15	Yes	1(A)	
2004	10/16/16	Yes	3(M,1,A)	Several sites dried up
2005	2/12/12	Yes	2(M,A)	Poor hatching success
2006	2/1/4	Yes	4 (M,1,S,A)	Some water level issues
2007	2/2/6	Unk	3(M,1,A)	Some Sandpiper predation

*Egg mass mortality due to a water fungus observed at the Hesbo site; other sites had good egg mass survival.

Bd Testing

Year	Number	Results (# Positive)	Comments
2007	17	Positive	

Comments

This site is on private property and includes numerous ponds in the Urad Valley. Monitoring of the site is very intense and includes radio tracking and water testing.

CC03 - Herman Gulch

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	?/?/?	Unk	2(M,A)	Breeding observed
1994	11/11/11	Unk	2(M,A)	
1995	52/12/12	Unk	3(M,S,A)	Good production
1996	20/12/12	No	1(A)	Poor larvae survival
1997	19/10/10	Unk	3(M,S,A)	Many metamorphs
1998	10/10/10	Unk	2(M,A)	Few metamorphs seen
1999	11/11/11	Yes	1(A)	High egg mortality
2000	9/5/5	Unk	3(1,S,A)	No metamorphs seen
2001	2/2/4	Unk	3(M,S,A)	<50 metamorphs
2002	0/1/0	Unk	1(A)	No evidence of breeding
2003	1/1/1	Yes	1(M)	<50 metamorphs
2004	4/4/4	Unk	2(1,A)	
2005	0/0/0	Unk	None seen	
2006	0/0/0	Unk	None seen	Site visited once
2007	0/0/0	Unk	None seen	Surveyed all ponds at site

Bd Testing

Site not tested

Comments

No site specific comments.

CC04 - Mount Bethel

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	Yes	Unk	2(M,A)	Many metamorphs
1994	Yes	Unk	2(M,A)	
1995	4/1/1	No	2(S,A)	Few, if any, metamorphs
1996	3/3/3	Unk	2(M,A)	Few metamorphs
1997	9/1/1	Unk	2(M,A)	
1998	11/3/3	Unk	2(M,A)	36+ metamorphs seen
1999	23/1/1	Yes	2(M,A)	500+ metamorphs seen
2000	29/3/3	Yes	4(M,1,S,A)	Many metamorphs seen
2001	28/6/5	Yes	4(M,1,S,A)	500+ metamorphs seen
2002	16/4/4	Yes	3(M,1,A)	Metamorphosis early
2003	7/7/7	Unk	3(M,1,A)	<50 metamorphs
2004	68/8/8	Unk	3(M,S,A)	<50 metamorphs
2005	33/6/6	Unk	2(M,A)	Tested Bd positive
2006	5/0/7	Unk	2(M,A)	Early breeding
2007	1/1/1	Unk	2(M,A)	Dytiscid beetles present

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	20	Positive (5 or 25%)	
2006	5	Positive (5 or 100%)	All results triple positive

Comments

No site specific comments.

CC05 - Bakerville

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	1/1/1	Unk	2(M,A)	Limited data
1995	Unk	Unk	Unk	Site not monitored
1996	0/0/0	No	None seen	
1997	Unk	Unk	Unk	Site not monitored
1998	0/0/0	Unk	None seen	Inadequate monitoring
1999	0/1/0	Unk	1(A)	Inadequate monitoring
2000	0/0/0	Unk	None seen	Monitoring adequate
2001	3/0/0	Unk	1(A)	Inadequate monitoring
2002				Site not monitored
2003	1/1/1	Unk	1(A)	Few tadpoles found
2004	0/0/0	Unk	None seen	
2005	0/0/0	Unk	None seen	
2006	0/0/0	Unk	None seen	Site visited once
2007	0/0/0	Unk	None seen	Habitat looks good

Bd Testing

Site not tested

Comments

Only breeding observed at site was in 1994 and 2003.

CC06 - Silverdale

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	?/?/0	Unk	Multiple	First survey of site
1994	?/?/0	Unk	Multiple	No metamorphs
1995	2/0/0	Unk	2(S,A)	No breeding observed
1996	5/0/0	No	1(A)	No breeding observed
1997	0/0/0	No	None seen	Inadequate monitoring
1998	1/1/0	Unk	2(S,A)	Monitoring marginal
1999	0/0/0	Yes	1(S)	41 sub-adults seen
2000	0/0/0	Unk	2(1,S)	Many sub-adults seen
2001	0/0/0	Unk	2(S,A)	65 sub-adults, 7 adults
2002				Site not monitored
2003				Site not monitored
2004	0/0/0	Unk	None seen	
2005	0/0/0	Unk	1(A)	9 un-sexed adults seen
2006	0/0/0	Unk	None seen	Site visited twice
2007	0/0/0	Unk	None seen	Poor visibility during visit

Bd Testing

Site not tested

Comments

Breeding site used in the 1990's apparently not being used at present, and location of current breeding site unknown.

CC07 - Otter Mountain

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2003	1/1/1	Unk		200 tadpoles seen
2004	2/2/2	Unk	1(A)	50 tadpoles seen
2005	0/0/0	Unk	1(A)	1 adult seen
2006	2/2/2	Unk	1(A)	5 adults seen
2007	0/0/0	Unk	None seen	Road construction in area

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2006	4	Negative	

Comments

Population may be moving between multiple breeding localities as this location was found while looking for animals from previous known site nearby.

CF01 - Collegiate Peaks Campground

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	1/1/1	Yes	1(A)	Reproduction presumed
1994	1/1/1	Unk	4(1,2,3,A)	Larvae observed
1995	11/5/5	Unk	3+(M,S,A)	Sub-adults not aged
1996	13/5/5	Unk	3(M,S,A)	Few metamorphs
1997	10/8/6	Unk	2(M,A)	Numerous metamorphs
1998	38/7/7	Yes	2(M,A)	1st year of PIT tagging
1999	24/3/3	Yes	4(M,1,S,A)	4 one-year olds seen
2000	6/6/3	Unk	3(M,1,A)	1 one-year old seen
2001	12/6/6	Yes	3(M,S,A)	Numerous metamorphs
2002	21/4/3	Yes	4(M,1,S,A)	About 200 metamorphs
2003	23/5/5	Yes	4(M,1,S,A)	~3000 eggs removed
2004	18/9/9	Yes	4(M,1,S,A)	~7000 eggs removed
2005	41/5/5	Yes	3(1,S,A)	4 egg masses desiccated
2006	39/4/4	Yes	4(M,1,S,A)	Early breeding season
2007	57/6/6	Unk	3(M,1,A)	Early breeding season

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	8	Negative	
2005	20	Negative	
2006	20	Negative	
2007	20	Negative	

Comments

Site receives some disturbance from area recreation. Colorado Natural Heritage Program personnel have conducted a mark recapture study in this population since 1998. Adult numbers are based on these study results.

CF02 - Denny Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	5/5/5	Unk	2(S,A)	Probably metamorphs
1995	16/10/3	Unk	3(M,S,A)	Sub-adults not aged
1996	4/4/4	Yes	3(M,S,A)	Metamorphs present
1997	10/4/4	Yes	3(1,S,A)	Few, if any, metamorphs
1998	55/22/22	Yes	4(M,1,S,A)	1st year of PIT tagging
1999	63/18/16	Yes	4(M,1,S,A)	Good production
2000	58/23/23	Yes	4(M,1,S,A)	Good production
2001	52/22/22	Yes	4(M,1,S,A)	Numerous metamorphs
2002	27/13/13	Unk	4(M,1,S,A)	Only 1 metamorph seen
2003	33/22/14	Yes	3(M,S,A)	Slow to develop
2004	21/12/12	Yes	3(M,S,A)	~8000 eggs removed
2005	41/19/14	Yes	4(M,1,S,A)	~4000 eggs removed
2006	50/16/9	Yes	4(M,1,S,A)	Good production
2007	45/12/8	Unk	4(M,1,S,A)	Productive year

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	20	Negative	
2006	20	Negative	
2007	21	Negative	

Comments

Colorado Natural Heritage Program personnel have conducted a mark recapture study in this population since 1998. Adult numbers are based on these study results.

CF03 - Hartenstein Lake

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	5/?/?	Unk	1(A)	Limited data
1995	29/6/6	Unk	1(M,A)	Few metamorphs seen
1996	10/2/2	Yes	2(M,A)	Metamorphs presumed
1997	12/5/5	Unk	2(M,1,A)	Many metamorphs
1998	31/7/5	Yes	3+(M,S,A)	1st year of PIT tagging
1999	64/10/9	Unk	2(1,A)	Predation by mallards
2000	57/14/14	Yes	2(M,A)	Few metamorphs
2001	69/5/5	Yes	3(1,S,A)	Four yearlings seen
2002	21/4/4	Yes	4(M,1,S,A)	Metamorphosis early
2003	11/7/7	Yes	2(S,A)	No metamorphs seen
2004	24/3/3	Yes	3(1,S,A)	Metamorphs presumed
2005	24/7/7	Yes	3(M,S,A)	Poor hatching
2006	28/6/6	Unk	3(M,S,A)	Good survival at Outlet pond
2007	29/20/20	Unk	3(M,S,A)	Terrific year

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	10	Negative	
2005	20	Negative	
2006	20	Negative	
2007	20	Negative	

Comments

Colorado Natural Heritage Program personnel have conducted a mark recapture study in this population since 1998. Adult numbers are based on these study results.

CF04 - South Cottonwood Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	24/3/3	Unk	3(M,S,A)	Numerous metamorphs
1996	12/4/4	Yes	2(M,A)	Good production
1997	26/3/3	Yes	4(M,1,2,A)	Numerous metamorphs
1998	35/7/7	Yes	4(M,1,S,A)	1st year of PIT tagging
1999	45/11/11	Yes	3(M,1,A)	Numerous metamorphs
2000	54/10/10	Yes	4(M,1,S,A)	Numerous metamorphs
2001	51/5/5	Yes	4(M,1,S,A)	Numerous metamorphs
2002	26/5/5	Yes	4(M,1,S,A)	Low water levels*
2003	62/4/4	Unk	4(M,1,S,A)	>500 metamorphs
2004	35/3/3	Yes	1(A)	Metamorphs presumed
2005	79/5/4	Yes	3(M,1,A)	
2006	76/3/3	Yes	3(M,1,A)	Early breeding season
2007	117/3/4	Unk	3(M,1,A)	Highest adult male count recorded

*In 2002, in addition to adults caught and gender determined, approximately 15 additional adults seen but not captured; few metamorphs observed.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	11	Negative	
2005	15	Negative	
2006	20	Negative	
2007	20	Negative	

Comments

Colorado Natural Heritage Program personnel have conducted a mark recapture study in this population since 1998. Adult numbers are based on these study results.

CF05 - Brown's Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	2/3/1	Yes	2(S,A)	Metamorphs unlikely
1996	4/4/4	Unk	3(M,S,A)	Few metamorphs
1997	2/2/2	Unk	3(M,2,A)	Fair metamorphosis
1998	0/1/0	Unk	1(A)	No breeding observed
1999	3/2/2	Unk	2(M,A)	Snake predation
2000	0/0/0	Unk	None seen	Monitoring adequate
2001	1/2/1	Unk	2(M,A)	5 metamorphs seen
2002	2/3/1	Unk	1(A)	Tadpoles disappeared
2003	1/1/0	Unk	1(A)	No evidence of breeding
2004	0/0/0	Unk	None seen	No evidence of breeding
2005	1/1/1	Unk	1(A)	Possible predation loss
2006	1/0/0	Unk	1(A)	No evidence of breeding
2007	2/2/2	Unk	2(M,A)	Poor tadpole survival

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	3	Negative	
2006	1	Negative	
2007	5	Negative	

Comments

No site specific comments.

CF06 - Kroenke Lake

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	3/2/2	Unk	1(A)	Metamorphs unlikely
1996	2/2/2	Unk	2(M,A)	Fair metamorphosis
1997	9/2/2	Unk	1(A)	Metamorphs unlikely
1998	3/3/3	Unk	1(A)	Metamorphs unlikely
1999	6/3/3	Unk	1(A)	No night surveys
2000	3/2/2	Unk	2(S,A)	One sub-adult seen
2001	9/1/1	Unk	3(M,S,A)	4 metamorphs
2002	2/2/2	Yes	2(M,A)	15 metamorphs seen
2003	16/3/3	Unk	3(M,1,A)	Likely many metamorphs
2004	2/2/2	Unk	2(M,A)	
2005	5/3/3	Unk	2(M,A)	Likely many metamorphs
2006	8/3/3	Unk	2(M,A)	Good hatching and survival
2007	3/3/3	Unk	2(M,A)	Late breeding season

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	2	Negative	
2005	5	Negative	
2006	10	Negative	
2007	2	Negative	

Comments

No site specific comments.

CF07 - Fourmile Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	3/1/0	No	1(A)	No breeding observed
1996	2/2/2	Yes	2(M,A)	Numerous metamorphs
1997	3/3/3	Yes	4(M,1,2,A)	Good production
1998	1/1/1	Unk	4(M,1,S,A)	Late egg clutch
1999	6/3/2	Unk	2(S,A)	Eggs lost to desiccation
2000	1/0/0	Unk	1(A)	Monitoring adequate
2001	10/4/4	Yes	2(M,A)	Ca. 100 metamorphs
2002	1/2/1	Unk	2(1,A)	Tadpoles disappeared
2003	10/3/3	Unk	3(M,S,A)	Likely many metamorphs
2004	5/1/1	Yes	1(A)	Likely metamorphs
2005	9/5/5	Yes	3(M,1,A)	1000+ metamorphs
2006	6/6/6	Yes	3(M,1,A)	Very successful year
2007	5/5/5	Unk	2(1,A)	2 egg masses lost to desiccation

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	6	Negative	
2005	11	Negative	
2006	7	Negative	
2007	20	Negative	

Comments

No site specific comments.

CF08 - Morgan's Gulch

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1997	19/6/6	Yes	2(M,A)	Many metamorphs
1998	24/1/1	Yes	4(M,1,S,A)	Eggs late season
1999	40/3/3	Unk	4(M,1,S,A)	One egg mass not viable
2000	17/5/5	Unk	2(S,A)	Few or no metamorphs
2001	12/5/5	Yes	3(M,S,A)	30 metamorphs seen
2002	10/0/0	Yes	2(S,A)	No breeding observed, Pond dried
2003	21/7/7	Yes	2(S,A)	Likely desiccation loss
2004	7/2/2	Yes	1(A)	Likely desiccation loss
2005	36/1/1	Unk	2(S,A)	Likely desiccation loss
2006	37/2/2	Unk	3(M,S,A)	Poor hatching success
2007	42/5/5	Unk	2(M,A)	4 egg masses lost to desiccation

*Pond dried by mid-June in 2002.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	9	Negative	
2005	20	Negative	
2006	20	Negative	
2007	20	Negative	

Comments

Site experiences early season drying and water level issues. Colorado Natural Heritage Program personnel have conducted a mark recapture study in this population since 1998. Adult numbers are based on these study results.

CF09 - Sayre's Gulch

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1997	9/1/1	Unk	1(A)	Site found late in season
1998	34/2/2	Unk	2(S,A)	Metamorphs few, if any
1999	4/4/2	Unk	2(S,A)	Larvae lost to mallards
2000	8/5/5	Unk	2(S,A)	No early-season survey
2001	13/5/5	Yes	2(S,A)	Larvae apparently lost*
2002	21/6/6	Yes	4(M,1,S,A)	
2003	9/4/4	Yes	4(M,1,S,A)	Likely many metamorphs
2004	13/6/6	Yes	2(1,A)	Likely desiccation loss
2005	23/5/5	Unk	4(M,1,S,A)	Late breeding
2006	41/6/6	Yes	3(M,S,A)	Tadpole loss in lower pond
2007	7/7/7	Unk	3(M,1,A)	Tadpole survival poor

*Observation of 1 one year old toadlet in 2002 indicates at least some survival of tadpoles from 2001.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	12	Negative	
2004	6	Negative	
2005	20	Negative	
2006	20	Negative	
2007	7	Negative	

Comments

Most larvae apparently lost to mallard and/or dytiscid predation in 1999 and 2000; the same may have occurred in 2001.

CF10 - South Cottonwood Cr. West

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	2/2/2	Yes	2(M,A)	Excellent production
1999	9/9/9	Yes	3(M,1,A)	Good production
2000	19/9/9	Yes	3(M,1,A)	Good production
2001	26/7/7	Yes	4(M,1,S,A)	Numerous metamorphs
2002	14/5/5	Yes	4(M,1,S,A)	Numerous metamorphs
2003	6/6/6	Yes	4(M,1,S,A)	Numerous metamorphs
2004	9/5/5	Yes	3(M,1,A)	Numerous metamorphs
2005	5/5/5	Yes	4(M,1,S,A)	Very productive year
2006	12/4/4	Yes	4(M,1,S,A)	Very productive year
2007	12/12/12	Unk	3(M,1,A)	Very productive year

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	11	Negative	
2006	14	Negative	
2007	18	Negative	

Comments

Colorado Natural Heritage Program personnel have conducted a mark recapture study in this population since 1998. Adult numbers are based on these study results.

CF11 - Rainbow Lake

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	4/3/3	Unk	1(A)	Larvae lost to mallards
2000	1/1/1	Unk	2(S,A)	One sub-adult seen
2001	2/1/1	Yes	1(A)	Tadpoles disappeared*
2002	3/2/2	Unk	2(1,A)	Tadpoles disappeared
2003	1/1/1	Unk	1(A)	Few tadpoles found
2004	1/0/0	Unk	1(A)	No evidence of breeding
2005	0/0/0	Unk	None seen	No evidence of breeding
2006	0/0/0	Unk	None seen	No evidence of breeding
2007	0/0/0	Unk	None seen	No evidence of breeding

*Larvae may have been preyed on by mallards and gartersnakes, but at least one from 2001 survived as a one year old toadlet in 2002.

Bd Testing

Site not tested

Comments

Colorado Natural Heritage Program personnel have conducted a mark recapture study in this population since 1998. Adult numbers are based on these study results. This site is on private property and subject to considerable recreational use. Site also does not appear to be very good boreal toad habitat and may only receive breeding adults sporadically.

CF12 - Middle Cottonwood

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	13/1/1	Unk	4(M,1,S,A)	8 one-year olds seen
2000	9/1/1	Unk	3(M,S,A)	Few metamorphs seen
2001	11/4/4	Yes	3(M,S,A)	100 metamorphs seen
2002	14/3/3	Yes	4(M,1,S,A)	15 metamorphs seen
2003	53/5/3	Yes	3(1,S,A)	Likely many metamorphs
2004	30/3/3	Yes	3(M,1,A)	~1000 eggs removed
2005	33/6/6	Yes	3(1,S,A)	Likely some metamorphs
2006	44/4/4	Unk	3(1,S,A)	Poor hatching success & survival
2007	39/6/6	Unk	3(M,S,A)	Poor hatching success & survival

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	4	Negative	
2005	16	Negative	
2006	20	Negative	
2007	21	Negative	

Comments

Colorado Natural Heritage Program personnel have conducted a mark recapture study in this population since 1998. Adult numbers are based on these study results.

CF13 - Denny Creek West

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	5/2/2	Unk	1(M,1,A)	5 metamorphs seen
2000	1/0/0	Unk	1(A)	Minimal monitoring
2001	3/0/0	No	1(A)	Adequate monitoring
2002	3/3/3	Unk	3(1,S,A)	Metamorphosis possible*
2003	2/2/2	Yes	2(M,A)	Adequate monitoring
2004	2/3/1	Yes	2(1,A)	Likely desiccation loss
2005	3/1/1	Unk	2(M,A)	High water levels
2006	2/2/1	Unk	3(M,S,A)	Good hatching & tadpole survival
2007	11/2/2	Unk	2(M,A)	Poor hatching and tadpole survival

*Five one year olds were observed in 2002 despite no breeding observed at this site in 2001; successful breeding in 2001 may have been overlooked or it is possible that the toadlets were from the Hartenstein or Denny Creek sites. No metamorphs were observed in 2002, but it is possible some were produced.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	4	Negative	
2005	4	Negative	
2006	6	Negative	
2007	12	Negative	

Comments

Colorado Natural Heritage Program personnel have conducted a mark recapture study in this population since 1998. Adult numbers are based on these study results.

CF14 - Denny Creek South

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Unk	3(M,S,A)	4 sub-adults seen
2000	1/0/0	Unk	1(A)	Dried up mid-summer
2001	2/2/2	No	1(A)	Egg masses desiccated
2002	0/0/0	No	None seen	Site dry
2003	0/1/0	Unk	1(A)	Site dry
2004	0/0/0	Unk	None seen	Site dry most of season
2005	0/0/0	Unk	None seen	Site dry
2006	0/0/0	Unk	None seen	Site dry
2007	0/0/0	Unk	None seen	No evidence of breeding

Bd Testing

Site not tested

Comments

This site is marginal habitat and subject to desiccation.

CF15 - Holywater Beaver Ponds

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2002	?/?/?	Yes	1(M)	About 50 metamorphs
2003	5/1/1	Yes	2(1,A)	Some apparent egg loss
2004	1/0/0	Yes	3(1,S,A)	No evidence of breeding
2005	1/0/0	Unk	3(1,S,A)	No evidence of breeding
2006	3/0/0	Unk	1(A)	No evidence of breeding
2007	2/0/0	Unk	1(A)	No evidence of breeding

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	1	Negative	
2005	4	Negative	
2006	3	Negative	

Comments

Site was discovered on July 3, 2002, when metamorphs were found. Colorado Natural Heritage Program personnel have conducted a mark recapture study in this population since 1998. Adult numbers are based on these study results.

CF16 - Sayres West

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2006	4/0/1	Unk	1(A)	Discovered 8/2/2006
2007	5/1/1	Unk	1(A)	Site dried mid-season

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2006	4	Negative	
2007	13	Negative	

Comments

Site is located at 12,050 feet in elevation, well above timberline.

EA01 - Holy Cross City

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Unk	1(A)	Predation & late season
1997	1/1/1	Unk	1(A)	Recruitment unlikely
1998	2/2/2	Unk	1(A)	Inadequate monitoring
1999	2/0/0	Unk	1(A)	Inadequate monitoring
2000	1/0/0	Unk	1(A)	Inadequate monitoring
2001	1/1/1	Unk	None seen	5 visits to site
2002	2/1/1	Unk	1(A)	Breeding pond dried
2003	2/1/1	Unk	1(A)	5 visits to site
2004	1/0/0	Unk	1(A)	No evidence of breeding
2005	1/0/0	Unk	1(A)	No evidence of breeding
2006	0/0/0	Unk	None seen	No evidence of breeding
2007	1/0/0	Unk	1(A)	No evidence of breeding

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	2	Negative	

Comments

No site specific comments.

EA02 - East Lake Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Unk	3(M,S,A)	Site found 8/13/96
1997	Unk	Yes	Unk	Site not monitored
1998	3/0/0	Yes	2(1,A)	Inadequate monitoring
1999	4/4/4	Yes	3(M,1,A)	No night survey done
2000	2/2/2	Unk	3(1,S,A)	Minimal monitoring
2001	1/0/0	Yes	1(A)	Only one adult male seen*
2002	2/2/2	Yes	3(1,S,A)	14 adults seen (not sexed)
2003	2/2/2	Yes	3(M,S,A)	Likely many metamorphs
2004	2/2/2	Yes	4(M,1,S,A)	
2005	16/1/1	Yes	4(M,1,S,A)	
2006	5/0/1	Yes	4(M,1,S,A)	Tadpoles on first visit
2007	8/1/1	Unk	3(1,S,A)	Tadpoles on first visit

*Successful breeding in 2001 assumed due to 2 one year olds observed in 2002.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	3	Negative	
2005	20	Negative	
2006	20	Negative	
2007	19	Negative	

Comments

There are two closely associated breeding ponds at this site.

EA03 - East Vail

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	3/1/1	Yes	3(M,S,A)	Site found late July.
2000	8/2/1	Unk	3(M,1,A)	Many metamorphs.
2001	32/4/3	Yes	3(M,S,A)	15 metamorphs seen
2002	7/1/1	Yes	4(M,1,S,A)	Many sub-adults
2003	4/1/1	Yes	4(M,1,S,A)	50-100 metamorphs seen
2004	5/1/1	Yes	4(M,1,S,A)	300+ metamorphs seen
2005	8/2/2	Yes	4(M,1,S,A)	500+ metamorphs seen
2006	6/1/1	Yes	4(M,1,S,A)	High water levels
2007	2/2/2	Unk	4(M,1,S,A)	High water levels

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	8	Negative	
2005	9	Positive (1 of 9)	
2007	11	Negative	

Comments

This site is near a bike path and surrounded by development.

EA04 - Strawberry Lakes

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2003	1/1/1	Unk	1(A)	100-500 tadpoles
2004	1/1/1	Unk	3(M,S,A)	100-500 tadpoles
2005	0/2/0	Unk	1(A)	Likely metamorphs
2006		Yes		Monitoring report not received
2007	3/1/2	Unk	2(1,A)	

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2006	14	Negative	

Comments

No site specific comments.

GR01 - Jim Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	5/1/?	Unk	3+(S,A)	Substantial population
1996	?/?/0	Unk	3+(S,A)	Substantial population
1997	0/0/0	Unk	None observed	Monitoring inadequate
1998	0/0/0	Unk	None observed	Monitoring inadequate
1999	0/0/0	Unk	None observed	No night survey done
2000	0/0/0	Unk	None observed	Monitoring adequate
2001	0/0/0	Unk	None observed	No night survey done
2002				Not monitored
2003	0/0/0	Unk	None observed	Site visited 7 times
2004	0/0/0	Unk	None observed	
2005				Not monitored
2006				Monitoring report not received
2007	0/0/0	Unk	None seen	Possible water temperature issue

Bd Testing

Site not tested

Comments

Population indicates breeding pre-1996, but no actual breeding site found.

GR02 - Pole Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	5/3/3	Unk	2(M,A)	Numerous metamorphs
1996	3/3/3	Yes	2(M,A)	Few metamorphs
1997	10/4/2	No	2(1,A)	Few, if any, metamorphs
1998	5/2/2	Yes*	2(M,A)	Monitoring marginal
1999	5/5/5	Unk	2(M,A)	Metamorphs at #4
2000	6/2/2	Yes	3(M,S,A)	One clutch desiccated
2001	9/7/7	Yes	4(M,1,S,A)	>500 metamorphs
2002	14/6/6	Yes	4(M,1,S,A)	Metamorphs present**
2003	7/2/2	Yes	4(M,1,S,A)	>500 metamorphs
2004	2/2/2	Yes	3(M,S,A)	>150 metamorphs
2005	34/8/8	Yes	4(M,1,S,A)	>3000 metamorphs
2006	5/5/5	Yes	3(M,1,A)	35 adults seen total
2007	12/4/3	Unk	3(1,S,A)	>3000 metamorphs

* Recruitment from 1998 production based on observation of sub-adult toads in 2000.
**Metamorphs sampled on 9/23/02 were chytrid-positive.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	7	Positive (7 of 7)	
2007	9	Positive	

Comments

This locality is on Pole Creek Golf Course, near holes #4 and #15. As of 2007, 34 boreal toad ponds have been built in this area (Horstman, 2007). Egg masses were deposited in 2 ponds in 2007.

GR03 - Vasquez Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Yes*	1(A)	Found late in season
2000	0/0/0	Unk	None seen	Monitoring adequate
2001	0/0/0	Unk	1(S)	One sub-adult seen*
2002	0/0/0	Unk	None seen	One site visit
2003				Site not monitored
2004	0/0/0	Unk	None seen	
2005	0/0/0	Unk	1(A)	1 adult seen
2006	0/0/0	Unk	None seen	Investigating habitat improvements
2007	0/0/0	Unk	None seen	Area around traditional site surveyed

* 16 toadlets from 1999 clutch were captive reared and released in Vasquez Creek drainage in 2000; the sub-adult observed in 2001 was observed at the release site. No toads were observed at the 1999 breeding site.

Bd Testing

Site not tested

Comments

No site specific comments.

GR04 - McQueary Lake

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2001	2/3/3	Yes	2(1,A)	No metamorphs observed
2002	8/6/6	Unk	2(M,A)	<50 metamorphs seen
2003	2/2/2	Unk	2(S,A)	Desiccation & predation
2004	0/0/0	Unk	None seen	
2005	0/0/0	Unk	None seen	
2006	0/0/0	Unk	None seen	Possible adult sighting
2007	0/0/0	Unk	None seen	One site visit

Bd Testing

Site not tested

Comments

Site is difficult to access and thus receives minimal monitoring.

GR05 - Upper Williams Fork

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2001	2/2/2	Yes	3(M,1,A)	Metamorphs observed
2002	1/1/1	Yes	3(1,S,A)	No metamorphs seen
2003	1/2/1	Yes	4(M,1,S,A)	<50 metamorphs
2004	2/2/2	Yes	4(M,1,S,A)	Cold water temps
2005	2/1/1	Unk	2(1,S,A)	Metamorphs possible
2006	2/0/1	Yes	2(M,A)	
2007	2/1/1	Unk	3(M,1,A)	3 site visits

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2006	11	Positive (2 of 11)	

Comments

No site specific comments.

GR06 - Big Meadow

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2004	1/1/0	Yes	3(M, 1,A)	
2005	2/2/2	Yes	2(1,A)	
2006	0/0/2	Unk	1(S)	Pond dried
2007	1/1/2	Unk	2(S,A)	Large numbers of tadpoles

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	1	Positive (1 of 1)	

Comments

No site specific comments.

GR07 – South Fork

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2007	0/0/0	Unk	1(A)	Site found 9/11/2007

Bd Testing

Site not tested

Comments

No site specific comments.

GU01 - Triangle Pass

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	3/3/3	Unk	1(A)	Metamorphs unlikely
1994	Unk	Unk	Unk	No data
1995	1/1/1	Unk	2(S,A)	Metamorphs unlikely
1996	Unk	Yes	Unk	No monitoring
1997	2/2/2	Yes	4(M,1,S,A)	Many metamorphs
1998	17/5/5+	Unk	4(M,1,2,A)	Many metamorphs
1999	19/5/4	Unk	2(M,A)	No night survey done
2000	13/13/13	Unk	3(M,S,A)	One sub-adult seen
2001	18/14/11	Yes	2(M,A)	No night survey done
2002	16/17/16	Yes	3(1,S,A)	No visits after 7/25/02
2003	32/14/14	Unk	4(M,1,S,A)	Numerous metamorphs
2004	33/10/10	Unk	2(M,A)	Diving beetle predation
2005	8/1/1	Yes	1(A)	Locality snowed in
2006	8/2/13	Unk	3(M,S,A)	Snow on first visit
2007	40/8/17	Unk	1(A)	Early season snow at site

This locality has also been referred to as "White Rock Basin".

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	4	Negative	
2006	19	Negative	
2007	20	Negative	

Comments

This locality has also been referred to as “White Rock Basin”.

GU02 - West Brush Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Unk	2(M,A)	<50 metamorphs seen
2000	0/0/0	Unk	None seen	Inadequate monitoring
2001	0/1/0	Unk	1(A)	Inadequate monitoring
2002	0/0/0	Unk	None seen	One site visit
2003	1/1/0	Unk	1(A)	One site visit
2004	0/0/0	Unk	None seen	
2005	0/0/0	Unk	None seen	
2006	0/0/0	Unk	None seen	
2007	0/0/0	Unk	None seen	

Bd Testing

Site not tested

Comments

No site specific comments.

GU03 - Magdalene Gulch

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Unk	2(M,A)	Site found late in season
2000	2/1/0	Unk	1(A)	Adequate monitoring
2001	0/0/0	Unk	None seen	Inadequate monitoring
2002	0/0/0	Unk	None seen	One site visit
2003	0/0/0	Yes	None seen	Inadequate monitoring
2004	7/7/7	Yes	2(M,1)	Numerous metamorphs
2005	7/7/7	Unk	2(1,A)	Late snow at site
2006	1/0/1	Yes	1(A)	Numerous tadpoles
2007	6/2/5	Unk	3(M,1,A)	Some egg masses lost to cold weather

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	2	Negative	
2006	1	Negative	
2007	7	Negative	

Comments

No site specific comments.

GU04 - Brush Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	3/3/3	Yes	4(1,2,S,A)	Minimal monitoring
2001	6/1/1	Unk	3(1,S,A)	Minimal monitoring
2002	23/5/1	Yes	2(S,A)	Minimal monitoring
2003	7/2/1	Yes	1(A)	Minimal monitoring
2004	27/11/11	Yes	3(1,S,A)	Possible predation loss
2005	10/10/10	Yes	2(M,A)	New breeding pond found
2006	9/4/8	Yes	4(M,1,S,A)	Breeding in 5 ponds
2007	3/1/6	Unk	4(M,1,S,A)	Breeding in 2 ponds

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	8	Negative	
2005	22	Negative	
2006	20	Positive (16 of 20)	
2007	15	Positive	

Comments

No site specific comments.

GU05 - Upper Taylor River

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2004	2/0/0	Yes	4(M,1,S,A)	Site found post egg hatch
2005	1/1/1	Unk	3(1,S,A)	Significant snow at site
2006	4/2/0	Unk	2(S,A)	No evidence of breeding
2007	8/1/0	Unk	1(A)	No evidence of breeding

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	5	Negative	
2006	16	Negative	
2007	16	Negative	

Comments

No site specific comments.

GU06 – Cow Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2007	2/1/4	Unk	2(M,A)	Site found 7/20/2007

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2007	4	Positive (4 of 4)	

Comments

This site is on the Gunnison County side of Cottonwood Pass. There is much concern about the positive disease result from this site due the proximity to the Cottonwood Creek population.

HI01 - West Trout Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	2/2/2	Unk	2(M,A)	Site found mid-season
2001	4/4/4	Yes	4(M,1,S,A)	Minimal monitoring
2002	1/1/1	Yes	2(1,A)	1 visit, 6 1-yr-olds seen
2003	5/5/5	Yes	3(1,M,A)	100-200 metamorphs
2004	9/4/4	Yes	3(M,S,A)	Good reproduction
2005	0/0/0	Yes	3(M,1,S)	Excellent reproduction
2006	0/0/10	Unk	3(M,S,A)	25 adults seen, none sexed
2007	4/1/0	Unk	2(S,A)	Larvae seen

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2006	7	Negative	

Comments

No site specific comments.

JA01 - Spike Lake

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2001	?/?/?	Unk	1(M)	Two visits after discovery
2002	?/?/?	Unk	?	Site info not provided
2003	0/0/0	Unk	none seen	
2004				Not monitored
2005	2/2/2	Unk	1(A)	Access difficult
2006				Monitoring report not received
2007				Monitoring report not received

Bd Testing

Site not tested

Comments

This breeding locality was discovered in 2001 comments. In 2002 tadpoles were collected for broodstock at NASRF.

JA02 - Twisty Park

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2004				Site discovered, not monitored

Bd Testing

Site not tested

Comments

Site is located on private land and will not be monitored.

JA03 - Muddy Pass Lake

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2005	2/2/2	Yes	2(M,A)	Site discovered 6/20/05
2006	0/0/0	Unk	2(1,S)	No breeding observed
2007	0/0/0	Unk	None seen	No breeding observed

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	16	Positive (2 of 16)	
2005	15	Positive (12 of 15)	

Comments

No site specific comments.

LR01 - Lost Lake

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1990	?/?/22	Unk	1(A)	Incomplete data
1991	206/28/15	Unk	1(A)	No data on sub-adults
1992	143/23/23	Unk	1(A)	No data on sub-adults
1993	77/10/?	Unk	1(A)	Incomplete data
1994	110/35/35	Unk	1(A)	No data on sub-adults
1995	122/32/32	Yes*	1(A)	No data on sub-adults
1996	43/15/15	No	1(A)	No data on sub-adults
1997	112/15/15+	No	3(M,2*,A)	15 to 20 egg masses
1998	106/12/12	Unk	2(M,A)	150+ Metamorphs seen
1999	10/10/10	Unk	1(A)	Metamorphs possible
2000	3/3/3	Unk	1(A)	Positive for chytrid
2001	0/3/0	Unk	1(A)	Only females observed
2002	0/1/0	Unk	1(A)	One female observed
2003	0/0/0	Unk	None seen	Surveys adequate
2004	0/0/0	Unk	None seen	Juvenile toads found
2005	3/3/3	Unk	1(A)	Larvae seen
2006	0/0/0	Unk		Larvae seen
2007	2/0/0	Unk	2(S,A)	No breeding observed

* Recruitment in 1995 based on observation of 2 year old toads in 1997.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2000	?	Positive	
2005	2	Positive (2 of 2)	

Comments

No site specific comments.

LR02 - Kettle Tarn

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1990	?/?/13	Unk	1(A)	Incomplete data
1991	21+/23/23	Unk	1(A)	No data on sub-adults
1992	63/18/18	Unk	1(A)	No data on sub-adults
1993	54/25/25	Unk	2(M,A)	
1994	120/21/21	Unk	2(M,A)	
1995	210/24/24	Unk	2(M,A)	
1996	29/13/8	Unk	3(M,2,A)	
1997	15/11/0	No	1(A)	
1998	18/13/10	Unk	1(A)	
1999	15/8/2	Yes*	1(A)	No metamorphs seen
2000	13/5/3	Unk	2(1,A)	One 1 year old seen*
2001	2/4/3	Yes	3(M,S,A)	Metamorphs observed*
2002	2/2/2	Yes	3(M,1,A)	See note**
2003	3/3/3	Yes	3(M,1,A)	500+ metamorphs
2004	2/2/2	Unk	3(1,S,A)	Site dry by end of July
2005	0/1/0	Unk	1(A)	Good water levels
2006	0/3/1	Unk	1(A)	Desiccation loss
2007	0/1/0	Unk	1(A)	Site dry by mid June

* Metamorphs observed, but number not estimated in monitoring form.

** Tadpoles from NASRF released at site; it is unknown whether metamorphs observed in 2002 derived from naturally produced clutches or from these released tadpoles.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	1	Positive (1 of 1)	
2006	1	Negative	

Comments

Site has experienced some water level issues.

LR03 - Spruce Lake

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	Unk	Yes	Unk	Reproduction presumed
1997	3/1/?	Unk	3(1,S,A)	Limited monitoring
1998	9/3/1	Unk	1(A)	Inadequate monitoring
1999	9/3/1	Yes	2(S,A)	Inadequate monitoring
2000	10/4/2	Unk	3(M,1,A)	Three 1 year olds seen
2001	10/2/2	Unk	2(S,A)	Larvae observed*
2002	15/3/3	Unk	1(A)	No metamorphs observed
2003	12/1/1	Unk	1(A)	No larvae observed
2004	10/2/2	Unk	1(A)	No larvae observed
2005	7/5/5	Unk	1(A)	Larvae observed
2006	7/1/3	Unk	2(M,A)	Eggs collected from site
2007	13/3/15	Unk	1(A)	Larvae observed

*Last site visit June 20, prior to time of metamorphosis.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	12	Negative	
2005	8	Negative	
2006	1	Negative	

Comments

No site specific comments.

LR04 - Glacier Basin

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	1/1/0	Unk	1(A)	
1996	1/1/1	Yes	1(A)	Transplant site
1997	0/1/0	No	2(1,A)	
1998	3/0/0	Unk	1(A)	No breeding activity seen
1999	3/0/0	Unk	1(A)	No night survey done
2000	0/0/0	Unk	None seen	Monitoring adequate
2001				Not monitored

This site will no longer be regularly monitored after 2000. Translocation appears unsuccessful (Muths et al. 2001).

Bd Testing

Site not tested

Comments

This site will no longer be regularly monitored after 2000. Translocation appears unsuccessful (Muths et al. 2001).

LR05 - Twin Lake

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	1/1/1	Unk	1(A)	Tadpoles observed
1999	0/0/0	Unk	None seen	Site disturbed*
2000	0/0/0	Yes	None seen	Low water
2001	3/2/2	Yes	3(1,S,A)	No metamorphs seen
2002	1/1/1	Unk	2(S,A)	No metamorphs seen
2003	0/0/0	Unk	0	Site disturbed
2004				Not monitored
2005				Not monitored
2006				Not monitored
2007				Not monitored

* In 1999, there was temporary disturbance at this site due to testing of reconstructed dam.

Bd Testing

Site not tested

Comments

In 1999, there was temporary disturbance at this site due to testing of reconstructed dam.

LR06 - Trout Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2004	2/2/2	Yes	1(A)	Site found 6/22/2004
2005	0/0/0	Yes	None seen	
2006	0/0/3	Unk	3(1,S,M)	Good year at site
2007				Monitoring report not received

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	1	Negative	
2006	11	Negative	
2007	12	Positive (1 of 12)	Suspicious result

Comments

No site specific comments.

LR07 - Panhandle Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2004	3/2/0	Yes	2(S,A)	Exact site not found
2005	0/0/0	Yes	None seen	
2006	5/0/1	Unk	4(M,1,S,A)	Exact site located
2007				Monitoring report not received

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2006	10	Negative	

Comments

No site specific comments.

LR08 – Fay Lakes Area

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2004	4/4/0	Yes	2(M,A)	
2005	2/2/2	Yes	2(1,A)	
2006	3/2/0	Yes	3(M,1,A)	
2007	6/2/3	Unk	3(1,S,A)	Eggs collected for NASRF

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	4	Negative	
2006	8	Negative	

Comments

This site has also been known as Ypsilon Lake.

ME01 - Buzzard Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2006	0/0/0	Yes	1(M)	Site discovered on 7/15/2006
2007	0/0/0	Unk	2(M,1)	Tadpoles and metamorphs seen

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2007	20	Positive	

Comments

Site is along route of potential extensive pipeline construction.

MI01 - Jumper Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	3/0/?	Unk	1(A)	1st toad observation
1995	Unk	Unk	Unk	Breeding likely
1996	4/2/1+	Yes	2(M,A)	Breeding observed
1997	8/3/3	Yes	3(M,1,A)	Many metamorphs
1998	7/1/2	Unk	4(M,1,S,A)	
1999	3/2/2	Unk	3(M,S,A)	<50 metamorphs seen
2000	4/2/2	Yes	1(A)	Site dessicated
2001	4/1/1	Yes	3(M,1,A)	<50 metamorphs seen
2002	0/0/0	Yes	1(1)	Site dry; 3 1-yr-olds seen
2003	1/1/1	Unk	2(1,A)	Possible desiccation loss
2004	1/1/1	Unk	1(A)	
2005	1/1/0	Unk	2(M,A)	Site filling w/vegetation
2006	0/0/1	Yes	1(M)	Low productivity
2007	0/0/0	Unk	1(1)	Site not very productive

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2007	10	Positive (8 of 10)	

Comments

Low water levels exacerbated by encroaching vegetation are degrading the habitat potential of this site.

MI02 - Trout Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1(See note)	No	None seen	Tadpoles observed
1997	0/0/0	No	None seen	
1998	0/0/0	No	None seen	
1999	0/0/0	No	None seen	Only one site visit
2000	0/0/0	Unk	None seen	Minimal monitoring
2001	0/0/0	Unk	None seen	Minimal monitoring
2002	0/0/0	Unk	None seen	Minimal monitoring
2003	0/0/0	Unk	None seen	
2004				Not monitored
2005				Not monitored
2006				Not monitored
2007				Not monitored

NOTE: This site is questionable. 1996 observations may have been result of unauthorized transplant from Jumper Creek. No eggs, tadpoles, or toads have been observed during minimal monitoring efforts associated with site visits to West Trout Creek.

Bd Testing

Site not tested

Comments

This site is questionable. The 1996 observations may have been the result of an unauthorized transplant from the Jumper Creek site. This site is along the route to the West Trout Creek site and has received minimal monitoring as crews are passing by. Site will no longer be officially monitored.

MI03 - Roaring Fork Pond

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	1/1/1	Unk	2(M,A)	Site found late season
2001	3/0/0	Unk	1(A)	Minimal monitoring
2002	1/1/1	Yes	None seen	One egg mass; 2 visits
2003	3/0/0	Unk	1(A)	No evidence of breeding
2004	1/0/0	Unk	2(S,A)	No evidence of breeding
2005				Not monitored
2006	0/0/0	Unk	None seen	
2007	0/0/0	Unk	None seen	

Previously listed as Boots Pond; renamed here to conform to a CDOW database of pond names and NASRF records.

Bd Testing

Site not tested

Comments

This site was previously listed as Boots Pond. Renamed here to conform to CDOW database of pond names and NASRF records.

PA01 - Rough and Tumbling Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2004	2/2/2	Unk	1(A)	Site discovered 7/28/04
2005	2/2/2	Unk	1(A)	Likely many metamorphs
2006	1/1/1	Unk	1(A)	Water level low throughout season
2007	1/1/1	Unk	1(A)	Poor tadpole hatching & survival

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	2	Negative	
2006	1	Negative	

Comments

No site specific comments.

PA02 - Rough and Tumbling West

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2006	1/0/0	Unk	1(A)	Site discovered 8/10/2006
2007	2/2/2	Unk	3(M,S,A)	Good tadpole hatching & survival

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2006	1	Negative	

Comments

No site specific comments.

PI01 - Conundrum Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	3/1/1	Yes	2+(S,A)	Minimal monitoring
1996	1/1/1	Unk	2+(S,A)	Many metamorphs
1997	2/2/2	Unk	2(2,A)	Poor production
1998	2/2/0	Unk	1(A)	Inadequate monitoring
1999	0/0/0	Unk	Unk	Site not monitored
2000	2/2/2	Unk	2(M,A)	Adequate monitoring
2001	3/9/3	Yes	2(M,A)	100 metamorphs seen
2002	1/1/1	Unk	2(M,1)	Many metamorphs*
2003	0/0/0	Unk	None seen	
2004	0/0/0	Unk	None seen	
2005	0/0/0	Unk	None seen	One site visit
2006	0/0/0	Unk	None seen	One site visit
2007	0/0/0	Unk	None seen	

*No adults seen during many site visits, but at least one egg mass produced, resulting in hundreds of metamorphs.

Bd Testing

Site not tested

Comments

No site specific comments.

PI02 - East Maroon Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	3/3/3	Yes	4(M,1,S,A)	Several ponds at site
2001	3/3/3	Yes	3(1,S,M)	Adults not observed
2002	3/3/3	Yes	4(1,M,S,A)	Breeding in 2 ponds
2003	3/3/3	Yes	3(M,S,A)	Numerous metamorphs
2004	7/1/1	Yes	3(1,S,A)	Possible metamorphs
2005	2/2/2	Yes	4(M,1,S,A)	Breeding in 2 ponds
2006	2/2/2	Yes	4(M,1,S,A)	Good year
2007	2/2/5	Unk	4(M,1,S,A)	

In 2001, about 3 egg masses deposited although adults were not observed; 16 sub-adults and about 50 metamorphs seen.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	4	Negative	
2004	3	Negative	
2005	8	Negative	
2006	20	Negative	
2007	11	Negative	

Comments

No site specific comments.

PI03 - Lincoln Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2005	0/0/0	Unk	1(M)	Site found 9/9/2005
2006	0/0/1	Unk	1(M)	
2007	2/0/0	Unk	2(M,A)	Some issues with drying at site

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2007	3	Negative	

Comments

No site specific comments.

PI04 – Norman & Louise Barker Pond (Grizzly Reservoir)

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2006	0/0/0	Unk		Site discovered 8/21/06
2007	0/0/0	Unk	None seen	New pond constructed in fall

Bd Testing

Site not tested

Comments

At discovery, site contained tadpoles in a shallow, flowing drainage ditch with little to no food. USFS and CDOW developed plans to restore a small pond in the location of a previous wetland. Pond constructed and revegetated in 2007. Site was originally named Grizzly Reservoir but changed to honor caretaker at site who was instrumental in site improvements.

PI05 – Campground Lift Ponds

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2006	0/1/0	Yes	3(1,S,A)	Site discovered 8/1/2006
2007	3/1/0	Unk	4(M,1,A)	Eggs hatched by first visit

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	2	Negative	
2007	14	Positive	

Comments

No site specific comments.

PI06 - Homestake Reservoir

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2006		Unk		Site found
2007	4/0/2	Unk	1(A)	Access issues at site

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2006	4	Negative	
2007	4	Negative	

Comments

Site is difficult to access.

RO01 - First Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	0/0/0	Yes	2(2,3)	Numerous sub-adults
1996	1/1/1	Unk	2(S,A)	Larvae seen
1997	1/0/0	Unk	2(S,A)	Toads along Elkhead Cr.
1998	0/0/0	No	1(S)	Inadequate Monitoring
1999	0/0/0	No	None seen	Monitoring adequate
2000	0/0/0	No	None seen	Monitoring adequate
2001	0/0/0	No	None seen	Monitoring inadequate
2002				Not monitored
2003	0/0/0	Unk	None seen	Site visited once
2004				Not monitored
2005				Not monitored
2006				Not monitored
2007	0/0/0	Unk	None seen	

Bd Testing

Site not tested

Comments

No site specific comments.

RO02 - Soda Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Unk	3 (M,2,A)	Nine metamorphs seen
1997	1/1/1	Yes	2 (M,A)	Numerous metamorphs
1998	0/0/0	No	1(1)	Inadequate monitoring
1999	1/1/0	Yes	1(A)	One female toad seen.
2000	0/0/0	Unk	1(1)	One yearling toad seen
2001	0/0/0	Unk	None seen	Inadequate monitoring
2002	0/0/0	Unk	None seen	Inadequate monitoring
2003	0/0/0	Unk	None seen	Site visited 3 times
2004	0/0/0	Unk	None seen	Site visited once
2005	0/0/0	Unk	None seen	Site visited once
2006	0/0/0	Unk	None seen	Site visited once
2007	0/0/0	Unk	None seen	

Bd Testing

Site not tested

Comments

In 2004, stream net surveys were done in the area around this site.

RO03 - Diamond Park

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Yes	2 (M,A)	20 metamorphs seen
1997	1/1/1	Yes	3 (M,1,A)	Few metamorphs seen
1998	0/1/0	No	1 (1,A)	Inadequate monitoring
1999	0/2/0	No	1(A)	Only two toads seen
2000	0/0/0	Unk	None seen	Site visited three times
2001	0/0/0	Unk	None seen	Inadequate monitoring
2002	0/0/0	Unk	None seen	One site visit
2003	0/0/0	Unk	None seen	Site visited twice
2004				Site not monitored
2005				Site not monitored
2006				Site not monitored
2007				Monitoring report not received

Bd Testing

Site not tested

Comments

No site specific comments.

RO04 - Torso Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	0/1/0	Unk	3(1,S,A)	Numerous 1 year olds
2000	2/2/2	Unk	3(M,2,A)	Approx. 400 metamorphs
2001	2/1/1	Yes	4(M,1,S,A)	>50 metamorphs
2002	1/1/1	Yes	3(1,S,A)	Site dried by August visit
2003	3/2/1	Yes	2(M,A)	<50 metamorphs
2004	1/1/1	Yes	4(M,1,S,A)	1000+ metamorphs
2005	1/1/1	Yes	3(M,S,A)	Numerous sub-adults
2006	0/0/0	Yes	3(M,1,S)	
2007	0/0/0	Unk	1(1)	Numerous one-year olds/sub-adults

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	5	Positive (5 of 5)	
2005	25	Positive (10 of 25)	
2007	10	Positive	

Comments

Site has been fenced to exclude sheep.

RO05 - North Fork Morrison Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	10/2/2	Yes	4(M,1,S,A)	Site found late July.
2000	7/3/3	Yes	4(M,1,S,A)	<50 metamorphs seen.
2001	29/10/1	Unk	4(M,1,S,A)	Three site visits
2002	15/1/1	Unk	2(S,A)	Three site visits
2003	13/1/0	Unk	1(A)	Two site visits
2004	12/1/0	Yes	1(A)	Two site visits
2005	19/5/0	Yes	3(M,1,A)	Three site visits
2006	27/9/4	Unk	4(M,1,S,A)	Egg masses in 4 ponds
2007	0/0/0	Unk		Larvae seen

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	12	Negative	
2004	14	Negative	
2005	30	Negative	
2007	20	Negative	

Comments

No site specific comments.

RO06 - Upper Buck Mountain

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	9/4/4	Yes	3 (M,S,A)	Est. <50 metamorphs
2001	6/2/2	Yes	4(M,1,S,A)	Est.100-500 metamorphs
2002	5/2/2	Yes	3(1,S,A)	Metamorphs not observed
2003	6/6/6	Yes	3(M,1,A)	Est. 50-100 Metamporphs
2004	2/1/1	Yes	4(M,1,S,A)	500-1000 Metamorphs
2005	11/15/6	Yes	3(1,S,A)	Likely many metamorphs
2006	1/0/3	Unk	3(M,1,A)	
2007	0/0/0	Unk	None seen	

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	25	Negative	
2004	9	Positive (2 of 9)	
2005	39	Positive (35 of 4)	

Comments

No site specific comments.

SU01 - Cucumber Gulch

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	1/1/1	No	3+(M,S,A)	Mult. age classes seen
1996	?/?/0	No	2(S,A)	No breeding observed
1997	2/1/1	No	1(A)	Recruitment doubtful
1998	1/0/0	Unk	1(A)	Monitoring minimal
1999	1/1/1	Unk	1(A)	No metamorphs seen
2000	0/1/0	Unk	1(A)	Monitoring adequate
2001	0/0/0	Unk	None seen	Monitoring adequate
2002	0/0/0	Unk	None seen	5 site visits by CNHP
2003	0/0/0	Unk	None seen	4 site visits
2004	0/0/0	Unk	None seen	1 site visit, access issues
2005	1/1/0	Unk	1(A)	
2006				Not monitored
2007	0/0/0	Unk	None seen	

Bd Testing

Site not tested

Comments

Site is an extensive beaver complex that is difficult to monitor. Site receives recreational pressure from neighboring properties.

SU02 - Montezuma

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	7/1/1	No	2(S,A)	Breeding unsuccessful
1996	9/?/0	No	1(A)	No breeding observed.
1997	1/1/1	Unk	1(A)	New site, vs. '95 & '96
1998	0/0/0	Unk	None seen	Monitoring inadequate
1999	3/1/1	Unk	1(A)	Tadpoles observed
2000	0/0/0	Unk	None seen	No access to property*
2001				Not monitored
2002	0/0/0	Unk	None seen	2 site visits
2003				Not monitored
2004				Not monitored
2005				Not monitored
2006				Not monitored
2007				Monitoring report not received

Bd Testing

Site not tested

Comments

Site is on private property and permission for ongoing access is being pursued.

SU03 - Peru Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Yes	3(M,S,A)	May be > 3 age classes
1997	6/2/2	Unk	4(M,1,S,A)	Good metamorphosis
1998	3/1/1	Unk	2(M,A)	Monitoring inadequate
1999	14/1/1	Unk	1(A)	Monitoring minimal
2000	19/1/1	Yes	1(A)	Tadpoles seen
2001	29/1/1	Unk	2(1,A)	Inadequate monitoring
2002	2/1/1	Unk	2(M,A)	>500 metamorphs
2003				Not monitored
2004	0/0/0	Unk	None seen	Low water levels
2005	0/0/0	Unk	None seen	Low water levels
2006	0/0/0	Unk	None seen	Better water levels
2007	0/1/0	Unk	1(A)	Water levels still good

Disturbance from construction was observed in the wetland area, but not the breeding pond itself, on 6/15/01. Monitoring in 2001 did not occur around the time that metamorphosis would be expected.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	2	Positive (2 of 2)	

Comments

No site specific comments.

SU04 - Upper North Tenmile

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	6/6/6	Unk	2(S,A)	Few, if any, metamorphs
1996	17/6/6	Unk	3(M,S,A)	Good production
1997	13/3/3	Unk	2(M,A)	Limited metamorphosis
1998	18/3/1	Yes	2(S,A)	Inadequate monitoring
1999	2/3/3	Unk	4(M,1,S,A)	Inadequate monitoring
2000	7/4/4	Unk	2(S,A)	Metamorphs likely
2001	8/2/2	Yes	1(A)	Larvae disappeared
2002	8/8/8	Yes	4(M,1,S,A)	No night survey
2003	1/1/1	Unk	1(A)	No larvae/metamorphosis
2004	5/1/1	Yes	2(S,A)	Late egg deposition
2005	2/2/2	Unk	2(1,A)	Poor hatching success
2006	0/1/0	Unk	1(A)	No evidence of breeding
2007	3/3/3	Unk	1(A)	Poor tadpole survival

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	3	Negative	
2004	4	Negative	
2005	6	Negative	
2007	1	Negative	

Comments

No site specific comments.

SU05 - Lower North Tenmile

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	4/2/2	Yes	2(M,A)	Few metamorphs
1997	1/2/1	Unk	2(1,A)	Little or no reproduction
1998	5/5/5	Unk	3(M,S,A)	Inadequate monitoring
1999	3/2/1	Unk	1(A)	Inadequate monitoring
2000	5/3/2	Unk	2(M,A)	Monitoring adequate
2001	3/4/3	Yes	2(M,A)	100 metamorphs seen
2002	2/2/2	Yes	3(M,1,A)	No night survey
2003	2/2/2	Unk	2(1,A)	Likely many metamorphs
2004	1/1/1	Yes	1(A)	Likely many metamorphs
2005	4/4/4	Yes	3(M,1,A)	Likely many metamorphs
2006	2/0/0	Unk	2(S,1)	No evidence of breeding
2007	0/0/0	Unk	None seen	No evidence of breeding

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2005	2	Negative	
2006	3	Negative	

Comments

No site specific comments.

SU06 - Upper North Fork of Snake River

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	1/2/1	Unk	3(M,S,A)	1st survey mid-July
1999	1/1/1	Unk	2(S,A)	Some tadpoles seen
2000	1/1/1	Unk	2(M,A)	10-20 metamorphs seen
2001	1/1/1	Yes	2(1,A)	Inadequate monitoring
2002	1/2/1	Unk	2(1,A)	Inadequate monitoring
2003				Not monitored
2004	16/0/0	Unk	1(A)	Site visited 3 times
2005	20/0/0	Unk	1(A)	
2006	20/0/0	Unk	1(A)	No evidence of breeding
2007	0/0/0	Unk	None seen	

One male, one female, and 13 additional toads observed 5/24/01; About 100 tadpoles and 23 yearlings observed 7/20/01.

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	3	Negative	
2004	1	Negative	
2005	14	Negative	

Comments

No site specific comments.

SU07 - Lower North Fork of Snake River

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	1/2/1	Unk	3(M,S,A)	1st survey mid-July
1999	1/2/0	Unk	1(A)	No breeding observed
2000	1/1/0	Unk	1(A)	No breeding observed
2001	1/0/0	Unk	1(A)	Inadequate monitoring
2002	0/0/0	Unk	None seen	Three site visits
2003				Not monitored
2004	1/0/0	Unk	1(A)	Site visited 3 times
2005	0/0/0	Unk	None seen	
2006	0/0/0	Unk	None seen	No evidence of breeding
2007	0/0/0	Unk	None seen	

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2004	16	Negative	

Comments

No site specific comments.

SU08 - Straight Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2003	1/1/1	Unk	3(M,S,A)	Site discovered 5/29/03
2004	0/0/0	Unk	None seen	Site visited 3 times
2005	0/0/0	Unk	None seen	
2006	0/0/0	Unk	None seen	
2007	0/0/0	Unk	None seen	Surveyed surrounding ponds

Bd Testing

Year	Number	Results (# Positive or % Positive)	Comments
2003	7	Negative	

Comments

No site specific comments.

WY01 - Bird Creek

Site Monitoring

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	1/1/1	Yes	1(A)?	No counts of adults/eggs
1994	4/1/1	Yes	3(1,S,A)	
1995	4/1/1	Yes	3(1,S,A)	
1996	2/1/1	Yes	4(M,1,S,A)	17 toadlets collected
1997	3/3/3	Yes	4(M,1,S,A)	Some eggs collected
1998	0/0/0	No	2(1,S)	No reproduction seen
1999	0/0/0	No	None seen	Surveys adequate
2000	0/3/0	No	1(A)	Three & toads seen*
2001	0/1/0	No	1(A)	One female toad seen*
2002	0/1/0	Unk	1(A)	One female toad seen*
2003	1/0/0	Unk	1(A)	One male toad seen
2004	0/0/0	Unk	None seen	
2005	0/0/0	Unk	None seen	
2006	0/0/0	Unk	None seen	
2007				Monitoring report not received

*Two of the three female toads found in 2000 were placed in captivity at the Sybille Wildlife Research Station; the female toads seen in 2001 and 2002 were not taken into captivity.

Bd Testing

Site not tested

Comments

This site is the source stock used for reintroductions at Lake Owen.

Appendix III - Sites by Population

Population Name	Site Name	Site Code
Albany	Bird Creek	WY01
Big Meadow	Big Meadow	GR06
Big Thompson River, RMNP	Spruce Lake	LR03
	Glacier Basin	LR04
Breckenridge	Cucumber Gulch	SU01
Brown's Creek	Brown's Creek	CF05
Buffalo Peaks	Fourmile Creek	CF07
	Rough and Tumbling Creek	PA01
	Rough and Tumbling West	PA02
Buzzard Creek	Buzzard Creek	ME01
California Park	First Creek	RO01
	Torso Creek	RO04
Clear Creek	Herman Gulch	CC03
	Mount Bethel	CC04
	Bakerville	CC05
Clear Creek South	Silverdale	CC06
	Otter Mountain	CC07
Clear Creek West Fork	Vintage	CC01
	Urad/Henderson	CC02
Conundrum Creek	Conundrum Creek	PI01
	East Maroon Creek	PI02
Cottonwood Creek	Collegiate Peaks Campground	CF01
	Denny Creek	CF02
	Hartenstein Lake	CF03
	South Cottonwood Creek	CF04
	Kroenke Lake	CF06
	Morgan's Gulch	CF08

Population Name	Site Name	Site Code
	South Cottonwood Creek – West	CF10
	Rainbow Lake	CF11
	Middle Cottonwood Creek	CF12
	Denny Creek West	CF13
	Denny Creek South	CF14
	Holywater Beaver Ponds	CF15
Cow Creek	Cow Creek	GU06
East Lake Creek	East Lake Creek	EA02
Goose Creek	Roaring Fork Pond (Boot's Pond)	MI03
Holy Cross City	Holy Cross City	EA01
	Strawberry Lakes	EA04
	Homestake Reservoir	PI06
Lincoln Creek	Lincoln Creek	PI03
	Grizzly Reservoir	PI04
Middle Boulder Creek	Lost Lake	BO01
Morrison Creek	North Fork Morrison Creek	RO05
Muddy Pass	Muddy Pass Lake	JA03
North Fork of Elk River	Diamond Park	RO03
	Upper Buck Mountain	RO06
North Fork, Big Thompson, RMNP	Lost Lake (RMNP)	LR01
	Kettle Tarn	LR02
North Tenmile Creek	Upper North Tenmile Creek	SU04
	Lower North Tenmile Creek	SU05
Panhandle Creek	Panhandle Creek	LR07
Pole Creek	Pole Creek	GR02
Red Canyon	Spike Lake	JA01
Snake River	Montezuma	SU02
	Peru Creek	SU03
	Upper North Fork Snake River	SU06

Population Name	Site Name	Site Code
	Lower North Fork Snake River	SU07
	Straight Creek	SU08
Snowmass Creek	Snowmass Creek	PI05
Soda Creek	Soda Creek	RO02
South Cache la Poudre	Twin Lake	LR05
South Fork	South Fork	GR07
South Fork Lake Creek	Sayre's Gulch	CF09
	Sayre's West	CF16
Texas Creek	Magdalene Gulch	GU03
Trout Creek	West Trout Creek	HI01
	Jumper Creek	MI01
	Trout Creek	MI02
Trout Creek (ARNF)	Trout Creek – ARNF	LR06
Twisty Park	Twisty Park	JA02
Upper Taylor River	Upper Taylor River	GU05
Upper Williams Fork	McQueary Lake	GR04
	Williams Fork River	GR05
Vail	East Vail	EA03
Vasquez Creek	Vasquez Creek	GR03
White Rock Mountain	Triangle Pass	GU01
	West Brush Creek	GU02
	Brush Creek	GU04
Winter Park	Jim Creek	GR01
Ypsilon Lake	Fay Lake Area (Ypsilon)	LR08

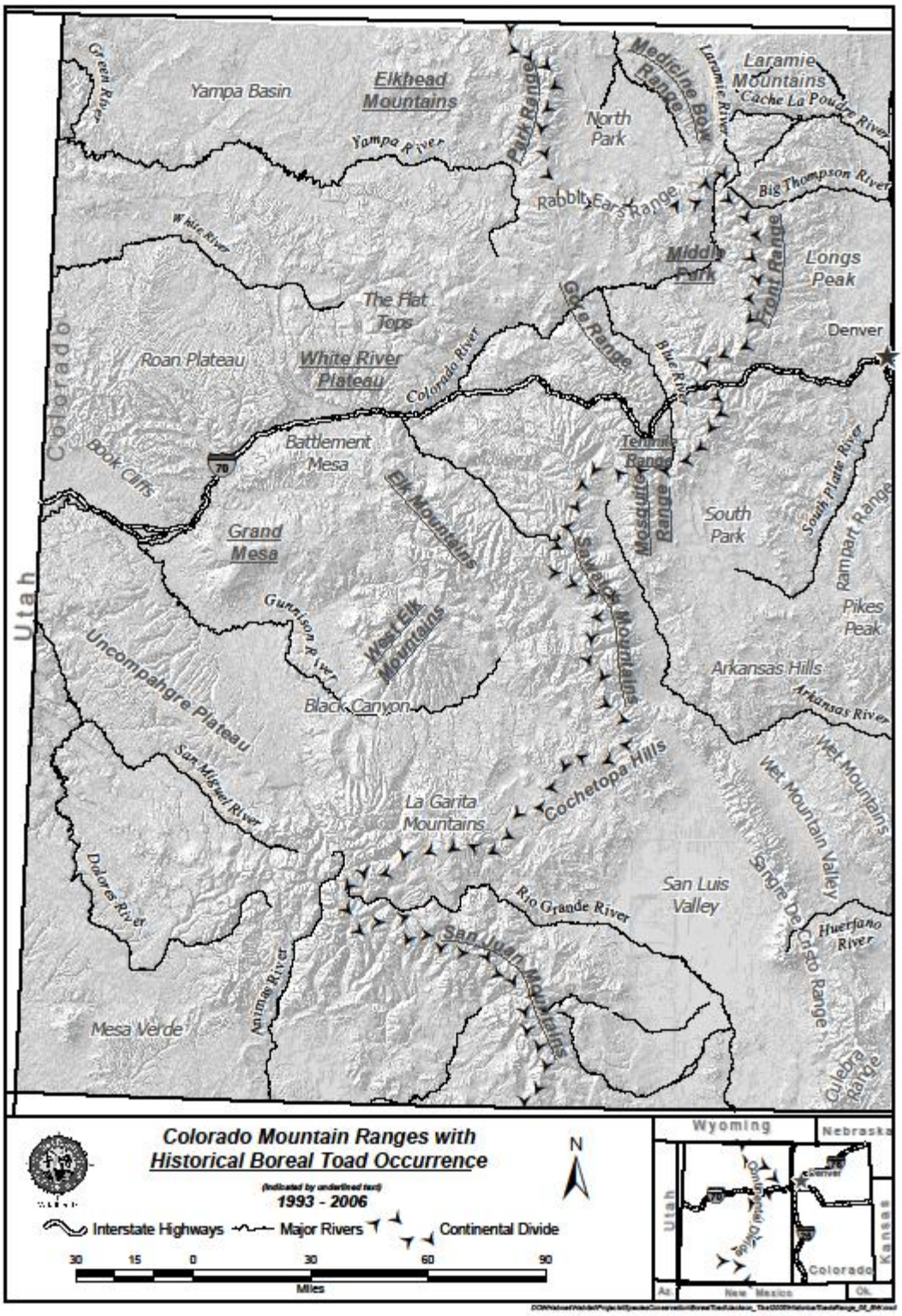
Appendix IV - Sites by Mountain Range

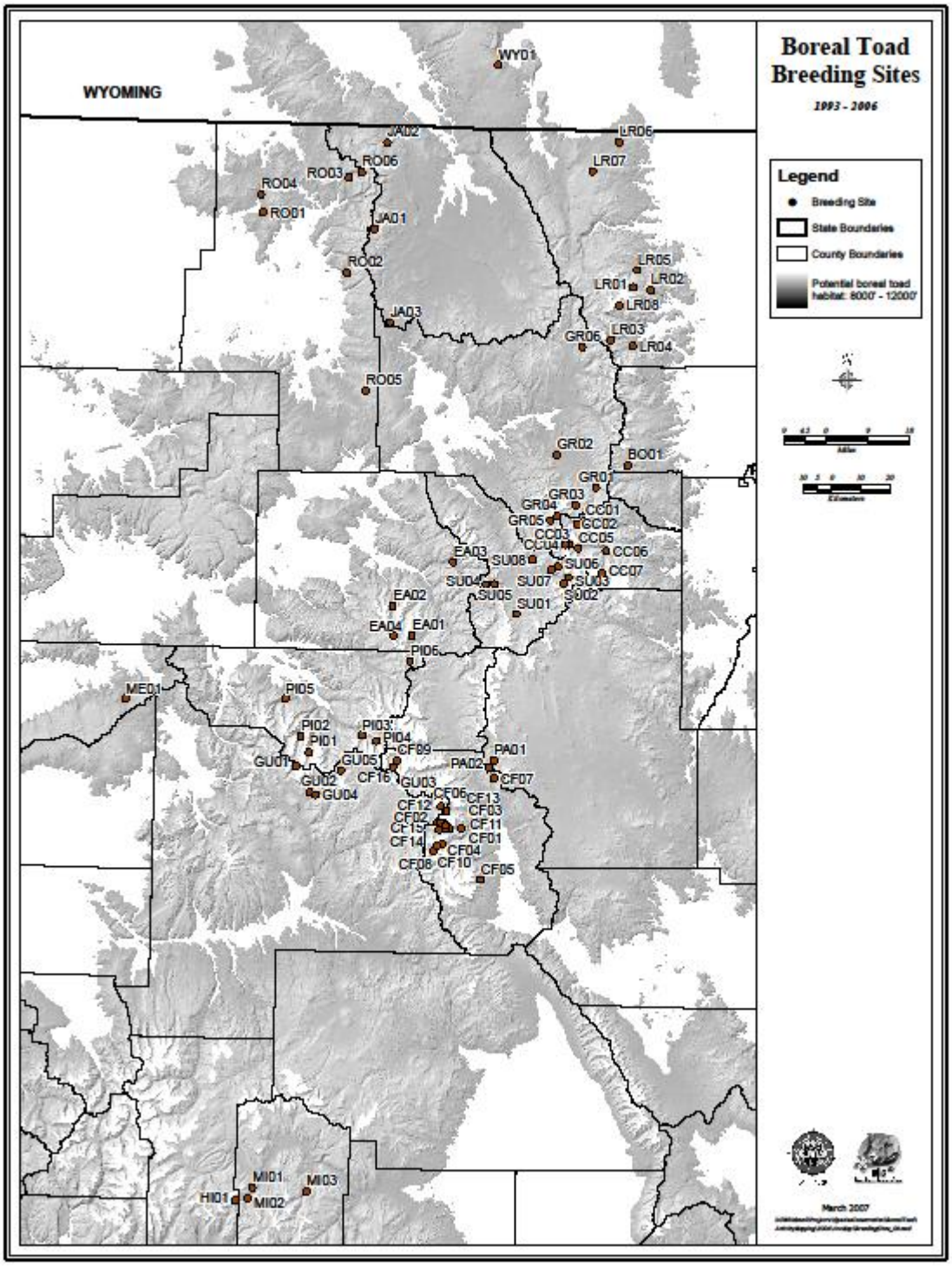
Mountain Range	Population Name	Site Name
Elk & West Elk Mountains	Conundrum Creek	Conundrum Creek (PI01)
		East Maroon Creek (PI02)
	Snowmass Creek	Campground Lift Ponds (PI05)
	Upper Taylor River	Upper Taylor River (GU05)
	White Rock Mountain	Triangle Pass (GU01)
		West Brush Creek (GU02)
		Brush Creek (GU04)
Elkhead Mountains	California Park	First Creek (RO01)
		Torso Creek (RO04)
Front Range	Big Meadow	Big Meadow (GR06)
	Big Thompson River, RMNP	Spruce Lake (LR03)
		Glacier Basin (LR04)
	Clear Creek	Herman Gulch (CC03)
		Mount Bethel (CC04)
		Bakerville (CC05)
	Clear Creek South	Silverdale (CC06)
		Otter Mountain (CC07)
	Clear Creek West Fork	Vintage (CC01)
		Urad/Henderson (CC02)
	Middle Boulder Creek	Lost Lake (BO01)
	North Fork, Big Thompson	Lost Lake (RMNP) (LR01)
		Kettle Tarn (LR02)
	Panhandle Creek	Panhandle Creek (LR07)
	Pole Creek	Pole Creek (GR02)
	Snake River	Montezuma (SU02)
		Peru Creek (SU03)
		Upper North Fork Snake River (SU06)

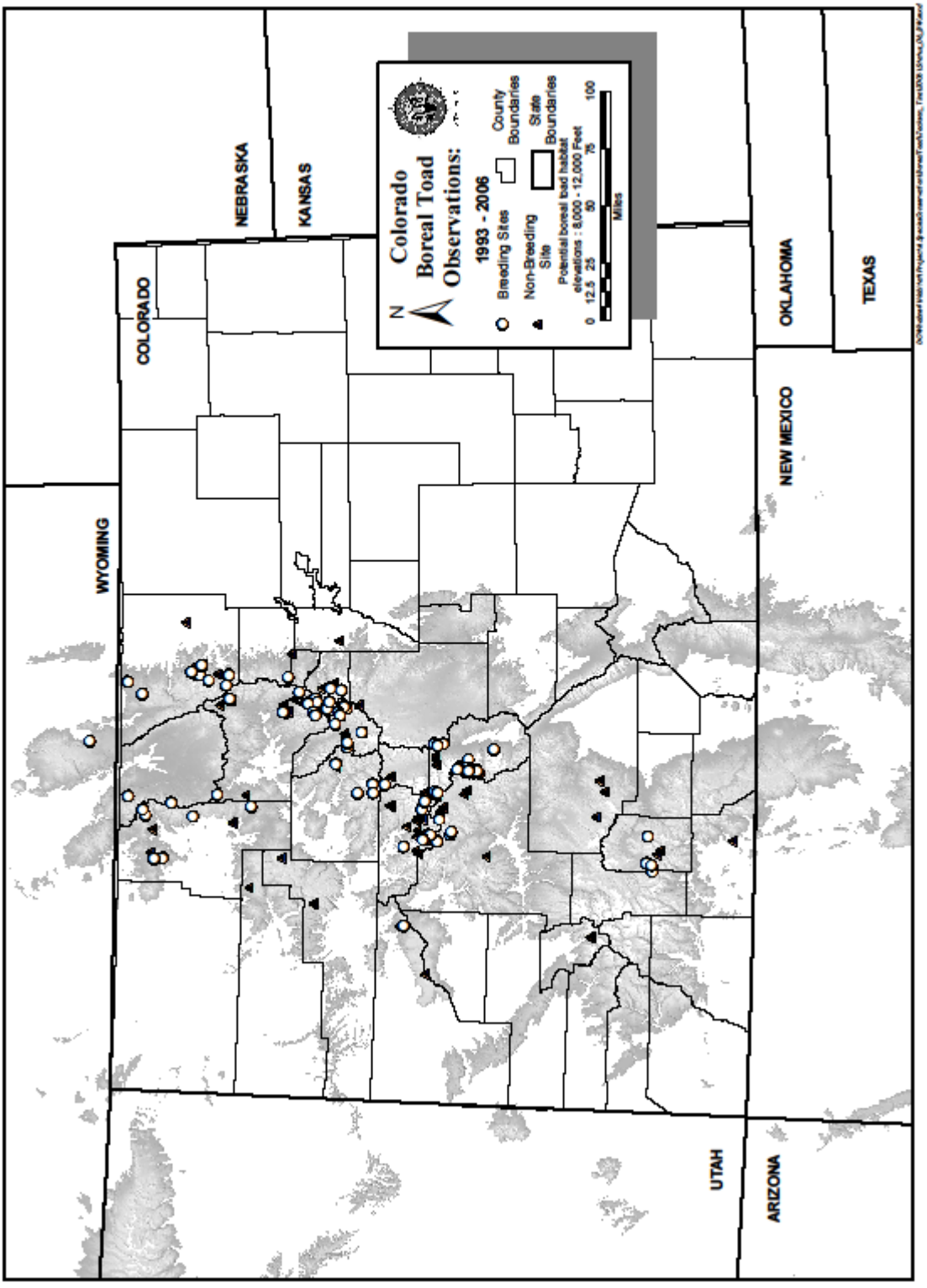
Mountain Range	Population Name	Site Name
		Lower North Fork Snake River (SU07)
		Straight Creek (SU08)
	South Cache la Poudre	Twin Lake (LR05)
	South Fork	South Fork (GR07)
	Trout Creek (ARNF)	Trout Creek – ARNF (LR06)
	Upper Williams Fork	McQueary Lake (GR04)
		Williams Fork River (GR05)
	Vasquez Creek	Vasquez Creek (GR03)
	Winter Park	Jim Creek (GR01)
	Ypsilon Lake	Fay Lakes Area (Ypsilon) (LR08)
Gore Range	Morrison Creek	North Fork Morrison Creek (RO05)
	North Tenmile Creek	Upper North Tenmile Creek (SU04)
		Lowest North Tenmile Creek (SU05)
	Vail	East Vail (EA03)
Grand Mesa	Buzzard Creek	Buzzard Creek (ME01)
Medicine Bow Range	Albany	Bird Creek (WY01)
Mosquito & Ten-mile Range	Breckenridge	Cucumber Gulch (SU01)
	Buffalo Peaks	Fourmile Creek (CF07)
		Rough and Tumbling Creek (PA01)
		Rough and Tumbling West (PA02)
Park Range	Muddy Pass	Muddy Pass Lake (JA03)
	North Fork of Elk River	Diamond Park (RO03)
		Upper Buck Mountain (RO06)
	Red Canyon	Spike Lake (JA01)
	Soda Creek	Soda Creek (RO02)
	Twisty Park	Twisty Park (JA02)
San Juan Mountains	Goose Creek	Roaring Fork Pond (Boot's Pond) (MI03)
		West Trout Creek (HI01)
		Jumper Creek (MI01)
		Trout Creek (MI02)
Sawatch Range	Brown's Creek	Brown's Creek (CF05)

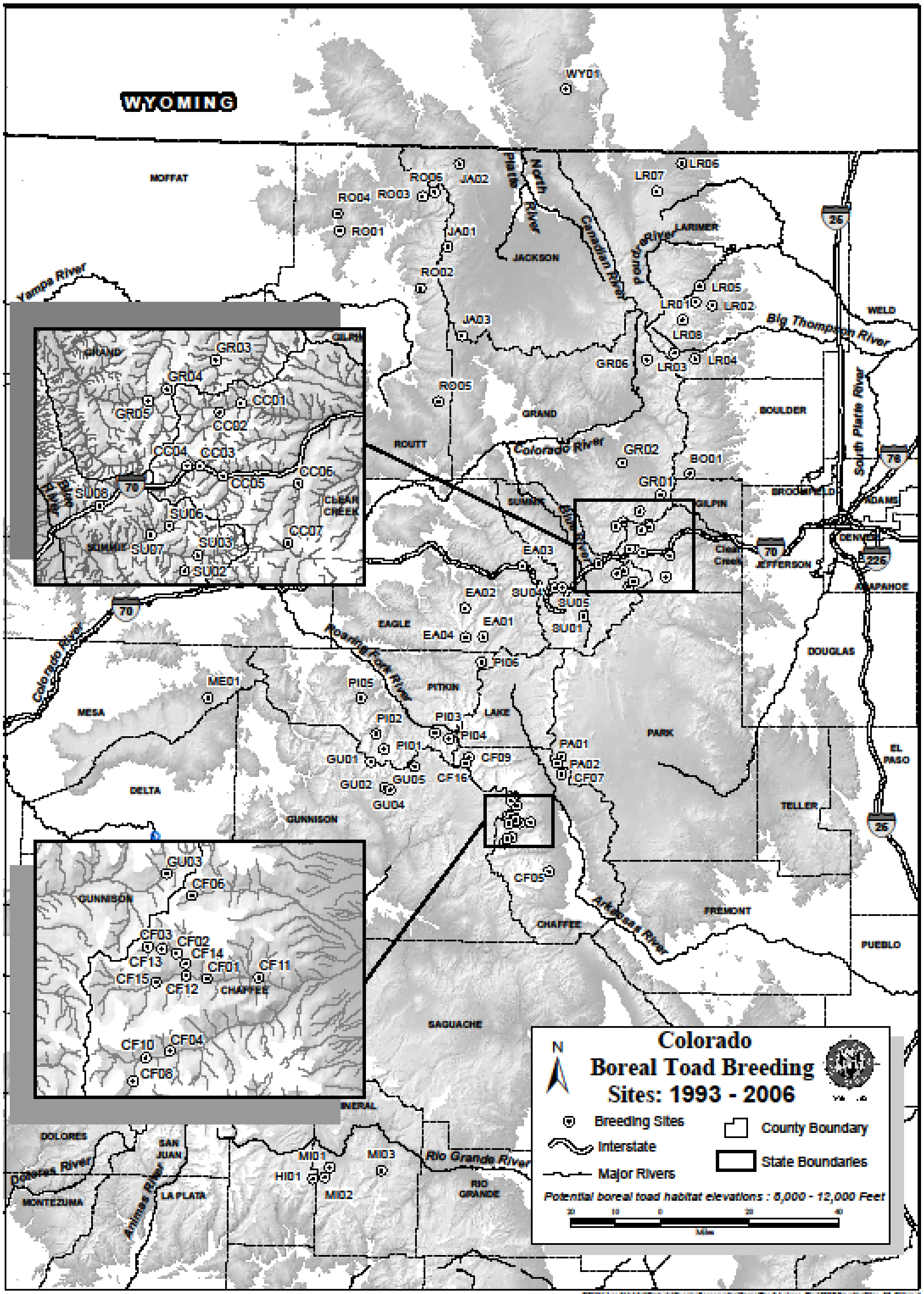
Mountain Range	Population Name	Site Name
	Cottonwood Creek	Collegiate Peaks Campground (CF01)
		Denny Creek (CF02)
		Hartenstein Lake (CF03)
		South Cottonwood Creek (CF04)
		Kroenke Lake (CF06)
		Morgan's Gulch (CF08)
		South Cottonwood Creek – West (CF10)
		Rainbow Lake (CF11)
		Middle Cottonwood Creek (CF12)
		Denny Creek West (CF13)
		Denny Creek South (CF14)
		Holywater Beaver Ponds (CF15)
	Cow Creek	Cow Creek (GU06)
	East Lake Creek	East Lake Creek (EA02)
	Holy Cross City	Holy Cross City (EA01)
		Strawberry Lakes (EA04)
		Homestake Reservoir (PI06)
	Lincoln Creek	Lincoln Creek (PI03)
		Grizzly Reservoir (PI04)
	South Fork Lake Creek	Sayre's Gulch (CF09)
		Sayre's West (CF16)
	Texas Creek	Magdalene Gulch (GU03)

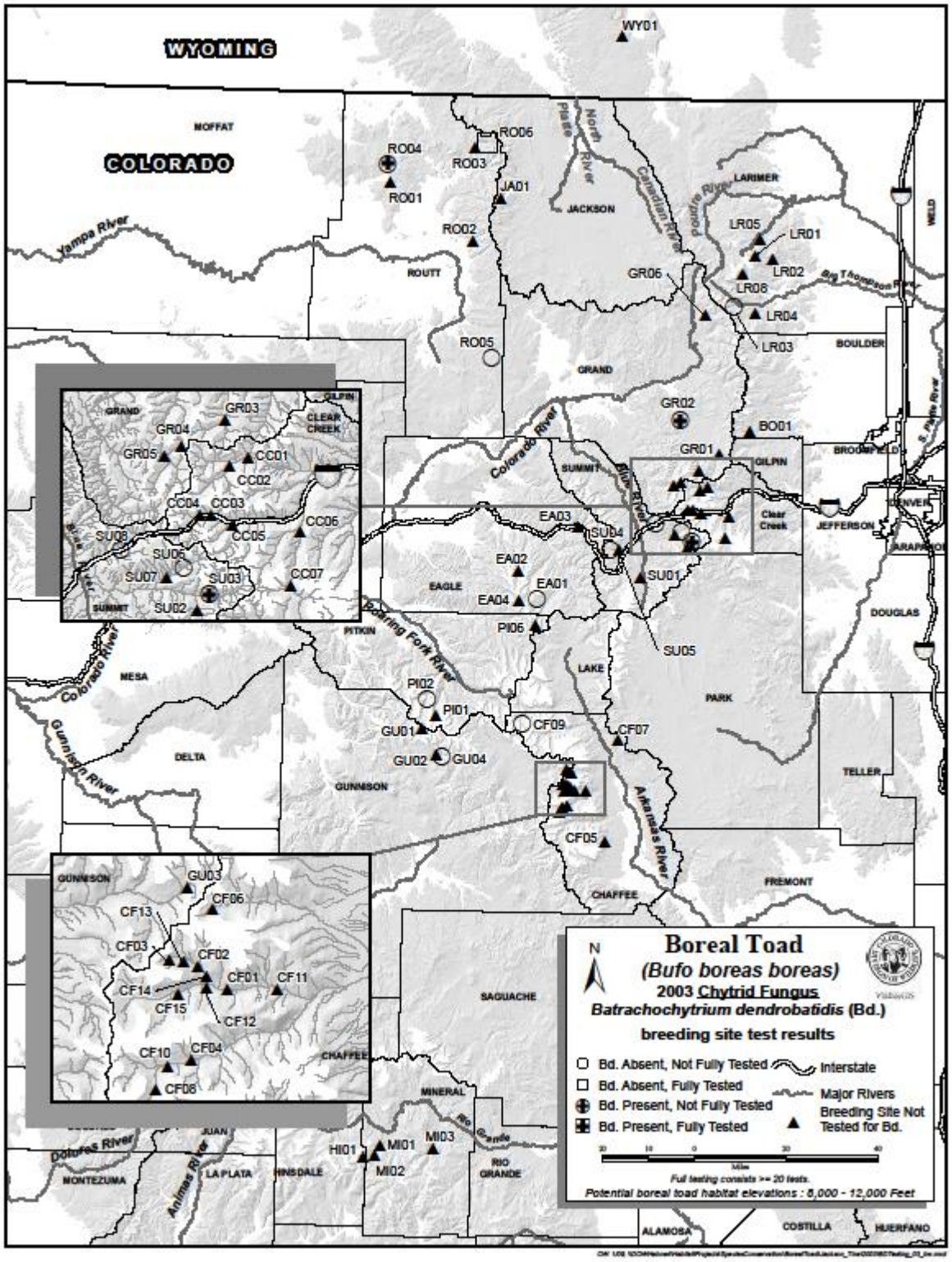
Appendix V – Maps

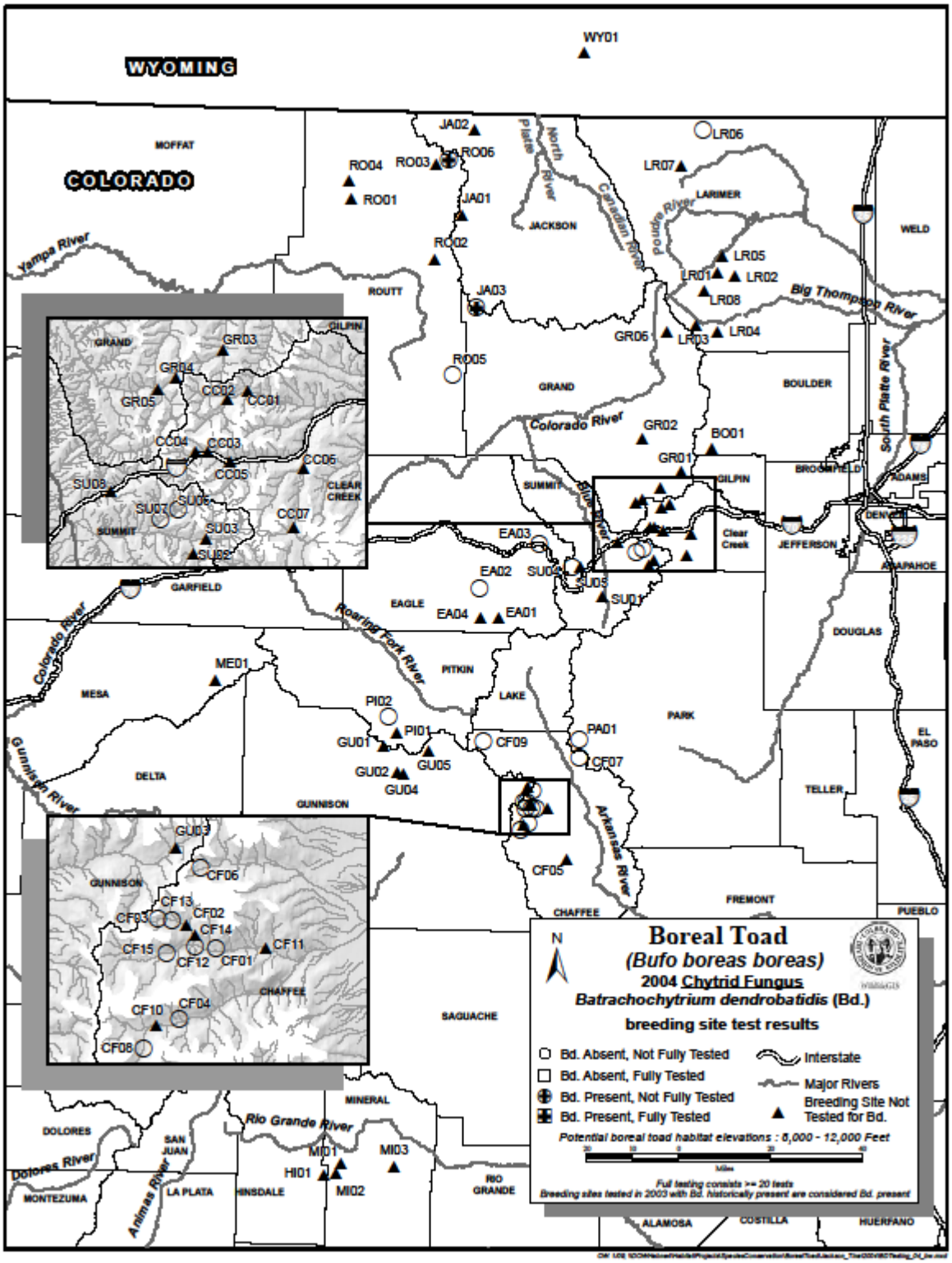


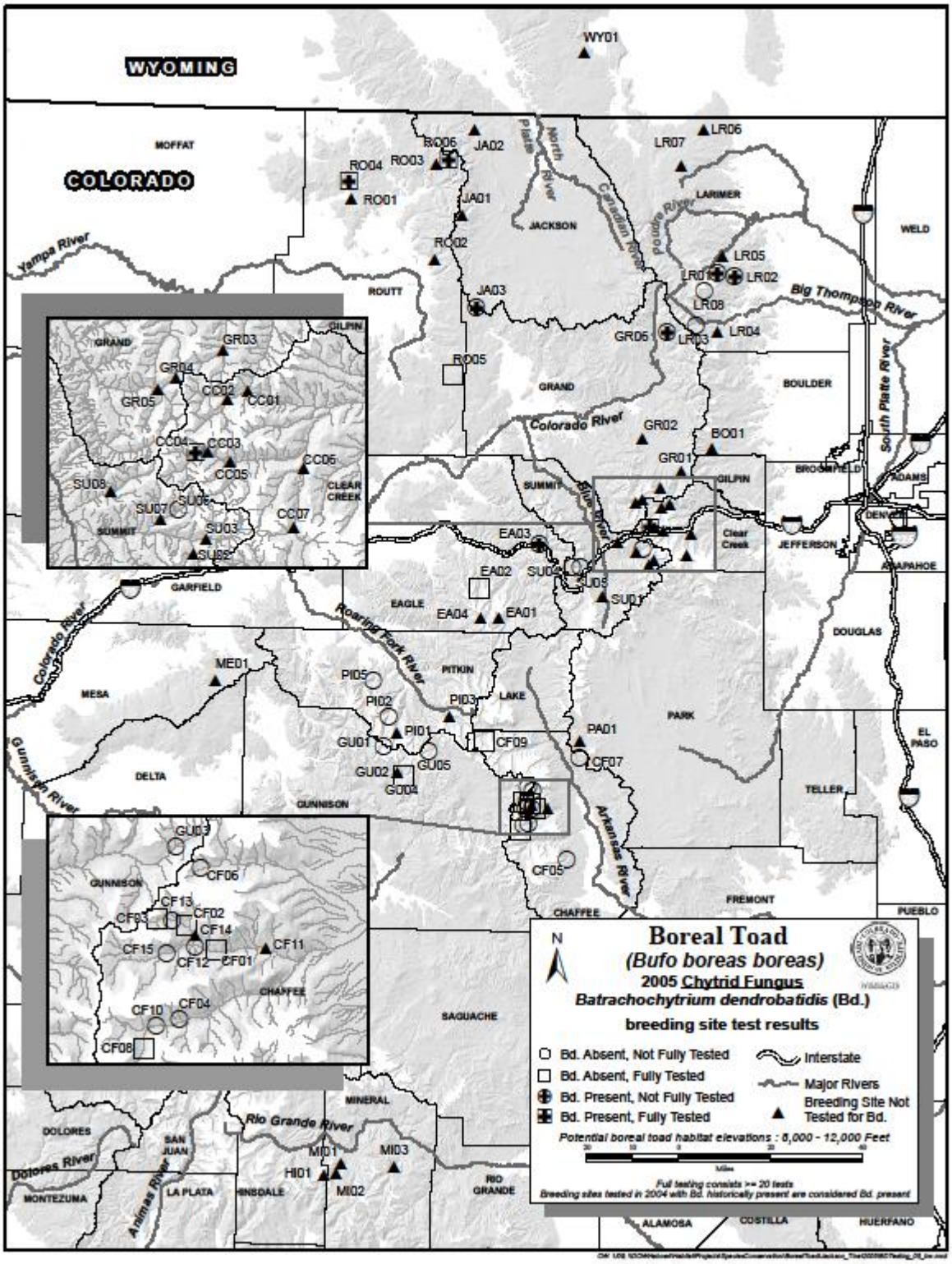

Boreal Toad
Breeding Sites
1993 - 2006
Legend
Breeding Site
State Boundaries
County Boundaries
Potential boreal toad habitat: 8000' - 12000'
WYOMING
WY01
JA02
LR06
RO06
LR07
RO03
RO04
RO01
JA01
RO02
LR05
LR01
LR02
LR08
JA03
GR06
LR03
LR04
RO05
GR02
BO01
GR01
GR03
GR04
CC01
GR05
CC02
CC03
CC05
CC04
CC06
EA03
SU08
SU06
CC07
SU04
SU07
SU03
SU05
SU02
EA02
SU01
EA04
EA01
PI06
ME01
PI05
PI02
PI03
PI01
PI04
CF09
PA01
GU01
GU05
PA02
CF07
GU02
CF16
GU03
CF06
CF13
GU04
CF12
CF03
CF02
CF11
CF15
CF01
CF14
CF04
CF08
CF10
CF05
MI01
MI03
HI01
MI02
March 2007

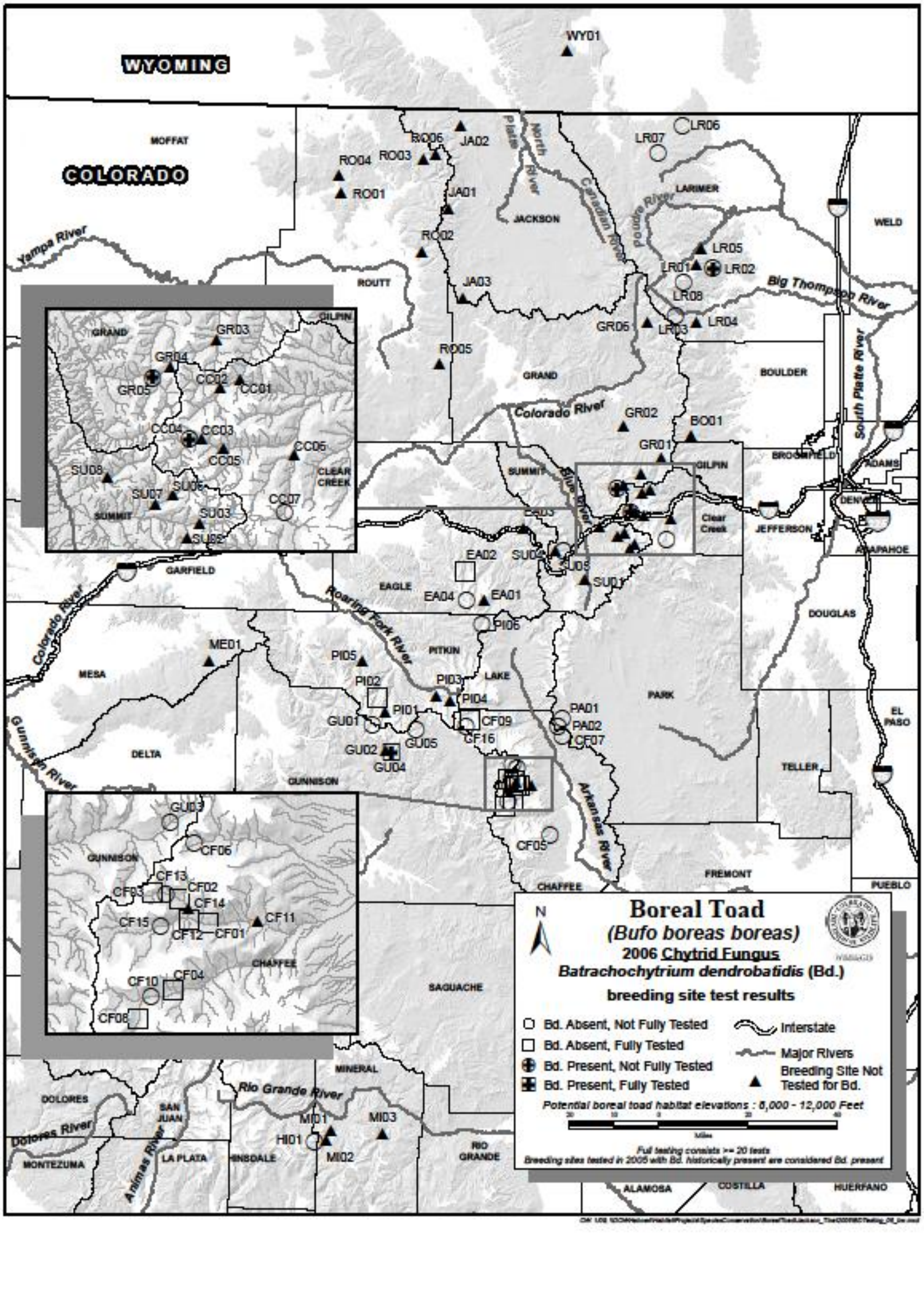

Colorado
Boreal Toad
Observations:
1993 - 2006
Breeding Sites
Non-Breeding Site
County Boundaries
State Boundaries
Potential boreal toad habitat elevations : 8,000 - 12,000 Feet
0 12.5 25 50 75 100
Miles
N
NEBRASKA
KANSAS
COLORADO
WYOMING
NEW MEXICO
OKLAHOMA
TEXAS
UTAH
ARIZONA

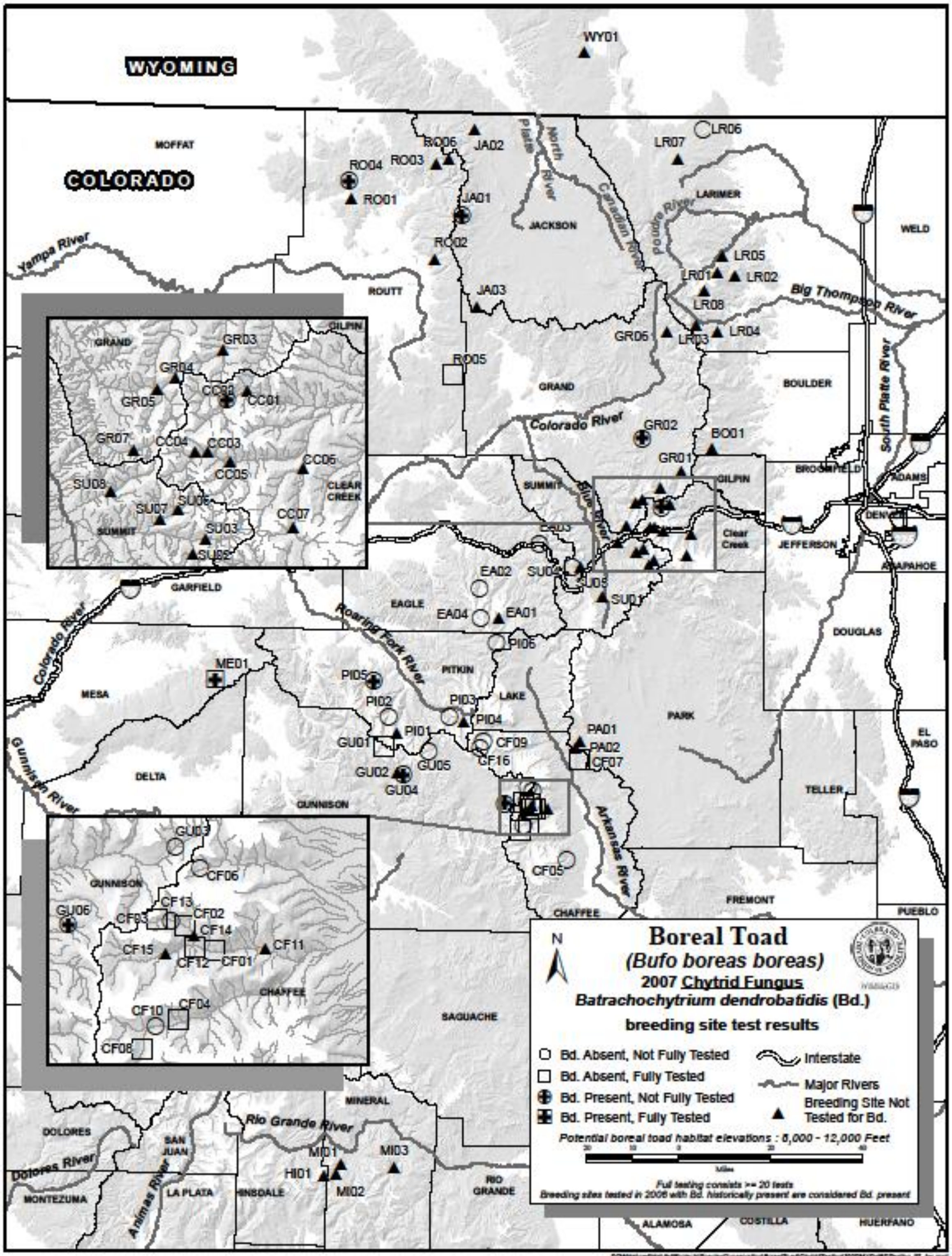

Colorado
Boreal Toad Breeding
Sites: 1993 - 2006
Breeding Sites
Interstate
Major Rivers
County Boundary
State Boundaries
Potential boreal toad habitat elevations : 8,000 - 12,000 Feet
WYOMING


WYOMING
COLORADO
WY01
MOFFAT
RO04
RO01
RO06
RO03
JA01
RO02
JACKSON
North Platte River
Canadian River
Poudre River
LARIMER
WELD
LR05
LR01
LR02
LR08
LR04
LR03
Big Thompson River
BOULDER
GR06
RO05
GRAND
ROUTT
Yampa River
GR02
BO01
GR01
GILPIN
BROOMFIELD
S. Platte River
Colorado River
SUMMIT
Blue River
Clear Creek
JEFFERSON
DENVER
ARAPAHOE
EA03
SU04
SU01
EA02
EA01
EA04
EAGLE
PI06
SU05
DOUGLAS
Roaring Fork River
PITKIN
LAKE
PARK
MESA
Colorado River
PI02
PI01
GU01
GU02
GU04
CF09
CF07
DELTA
Gunnison River
GUNNISON
TELLER
Arkansas River
CF05
CHAFFEE
FREMONT
SAGUACHE
MINERAL
Rio Grande
HI01
MI01
MI03
MI02
RIO GRANDE
Dolores River
MONTEZUMA
LA PLATA
Animas River
HINSDALE
JUAN
ALAMOSA
COSTILLA
HUERFANO
GR03
GR04
GR05
CC01
CC02
CC04
CC03
CC06
CC05
SU08
SU06
SU07
SU03
CC07
SU02
GU03
CF06
CF13
CF03
CF02
CF01
CF11
CF14
CF15
CF12
CF10
CF04
CF08
N
Boreal Toad
(Bufo boreas boreas)
2003 Chytrid Fungus
Batrachochytrium dendrobatidis (Bd.)
breeding site test results
Bd. Absent, Not Fully Tested
Bd. Absent, Fully Tested
Bd. Present, Not Fully Tested
Bd. Present, Fully Tested
Interstate
Major Rivers
Breeding Site Not Tested for Bd.
Full testing consists >= 20 tests.
Potential boreal toad habitat elevations : 8,000 - 12,000 Feet


WYOMING
COLORADO
WY01
MOFFAT
JA02
RO06
RO04
RO03
RO01
JA01
JACKSON
North Platte River
Canadian River
Poudre River
LARIMER
WELD
LR06
LR07
Yampa River
RO02
LR05
LR01
LR02
LR08
Big Thompson River
ROUTT
JA03
GR06
LR03
LR04
RO05
GRAND
BOULDER
South Platte River
Colorado River
GR02
BO01
GR01
GILPIN
BROOMFIELD
ADAMS
SUMMIT
Blue River
Clear Creek
JEFFERSON
DENVER
ARAPAHOE
EA03
EA02
SU04
SU05
SU01
GARFIELD
EAGLE
EA04
EA01
Roaring Fork River
Colorado River
DOUGLAS
ME01
PITKIN
LAKE
MESA
PARK
PI02
PI01
PA01
GU01
CF09
CF07
GU02
GU05
GU04
DELTA
GUNNISON
Gunnison River
TELLER
EL PASO
Arkansas River
CF05
CHAFFEE
FREMONT
PUEBLO
SAGUACHE
MINERAL
DOLORES
SAN JUAN
Rio Grande River
Dolores River
MI01
MI03
HI01
MI02
MONTEZUMA
LA PLATA
HINSDALE
RIO GRANDE
Animas River
ALAMOSA
COSTILLA
HUERFANO
GRAND
GR03
GR04
GR05
CC02
CC01
CC04
CC03
CC06
CC05
SU08
SU06
SU07
SU03
SU02
CC07
CLEAR CREEK
SUMMIT
GILPIN
GU03
CF06
CF13
CF03
CF02
CF14
CF15
CF12
CF01
CF11
CF10
CF04
CF08
CHAFFEE
Boreal Toad
(Bufo boreas boreas)
2004 Chytrid Fungus
Batrachochytrium dendrobatidis (Bd.)
breeding site test results
Bd. Absent, Not Fully Tested
Bd. Absent, Fully Tested
Bd. Present, Not Fully Tested
Bd. Present, Fully Tested
Interstate
Major Rivers
Breeding Site Not Tested for Bd.
Potential boreal toad habitat elevations : 8,000 - 12,000 Feet
Full testing consists >= 20 tests
Breeding sites tested in 2003 with Bd. historically present are considered Bd. present


WYOMING
COLORADO
MOFFAT
ROUTT
JACKSON
LARIMER
WELD
GRAND
BOULDER
GILPIN
CLEAR CREEK
SUMMIT
EAGLE
GARFIELD
PITKIN
LAKE
PARK
MESA
DELTA
GUNNISON
CHAFFEE
FREMONT
TELLER
EL PASO
PUEBLO
DOUGLAS
JEFFERSON
ARAPAHOE
ADAMS
BROOMFIELD
SAGUACHE
MINERAL
DOLORES
SAN JUAN
MONTEZUMA
LA PLATA
ARCHULETA
RIO GRANDE
ALAMOSA
COSTILLA
HUERFANO
Yampa River
North Platte River
Cache la Poudre River
Big Thompson River
South Platte River
Colorado River
Blue River
Clear Creek
Roaring Fork River
Gunnison River
Arkansas River
Rio Grande River
Dolores River
Animas River
WY01
RO06
JA02
RO04
RO03
RO01
JA01
RO02
JA03
RO05
LR06
LR07
LR05
LR01
LR02
LR08
LR03
LR04
GR06
GR02
BO01
GR01
EA03
EA02
SU02
SU05
SU01
EA04
EA01
ME01
PI05
PI02
PI03
PI01
GU01
GU05
GU02
GU04
CF09
PA01
CF07
CF05
GR03
GR04
GR05
CC02
CC01
CC04
CC03
CC06
CC05
SU08
SU06
SU07
SU03
SU02
CC07
GU03
CF06
CF13
CF03
CF02
CF14
CF15
CF12
CF01
CF11
CF10
CF04
CF08
MI01
MI03
HI01
MI02
Boreal Toad
(Bufo boreas boreas)
2005 Chytrid Fungus
Batrachochytrium dendrobatidis (Bd.)
breeding site test results
Bd. Absent, Not Fully Tested
Bd. Absent, Fully Tested
Bd. Present, Not Fully Tested
Bd. Present, Fully Tested
Interstate
Major Rivers
Breeding Site Not Tested for Bd.
Potential boreal toad habitat elevations : 6,000 - 12,000 Feet
Full testing consists >= 20 tests
Breeding sites tested in 2004 with Bd. historically present are considered Bd. present


Boreal Toad
(Bufo boreas boreas)
2006 Chytrid Fungus
Batrachochytrium dendrobatidis (Bd.)
breeding site test results
Bd. Absent, Not Fully Tested
Bd. Absent, Fully Tested
Bd. Present, Not Fully Tested
Bd. Present, Fully Tested
Interstate
Major Rivers
Breeding Site Not Tested for Bd.
Potential boreal toad habitat elevations : 8,000 - 12,000 Feet
Full testing consists >= 20 tests
Breeding sites tested in 2005 with Bd. historically present are considered Bd. present
WYOMING
COLORADO
MOFFAT
JACKSON
LARIMER
WELD
ROUTT
GRAND
BOULDER
SUMMIT
GILPIN
CLEAR CREEK
JEFFERSON
GARFIELD
EAGLE
PITKIN
LAKE
PARK
DOUGLAS
MESA
DELTA
GUNNISON
CHAFFEE
FREMONT
TELLER
EL PASO
PUEBLO
SAGUACHE
MINERAL
DOLORES
SAN JUAN
MONTEZUMA
LA PLATA
HINSDALE
RIO GRANDE
ALAMOSA
COSTILLA
HUERFANO
Yampa River
Colorado River
North Platte River
Cache la Poudre River
Big Thompson River
South Platte River
Roaring Fork River
Gunnison River
Arkansas River
Rio Grande River
Dolores River
Animas River


Boreal Toad
(Bufo boreas boreas)
2007 Chytrid Fungus
Batrachochytrium dendrobatidis (Bd.)
breeding site test results
Bd. Absent, Not Fully Tested
Bd. Absent, Fully Tested
Bd. Present, Not Fully Tested
Bd. Present, Fully Tested
Interstate
Major Rivers
Breeding Site Not Tested for Bd.
Potential boreal toad habitat elevations : 8,000 - 12,000 Feet
Full testing consists >= 20 tests
Breeding sites tested in 2006 with Bd. historically present are considered Bd. present
WYOMING
COLORADO
MOFFAT
ROUTT
JACKSON
LARIMER
WELD
GRAND
BOULDER
SUMMIT
GILPIN
Clear Creek
JEFFERSON
GARFIELD
EAGLE
PITKIN
LAKE
PARK
DOUGLAS
MESA
DELTA
GUNNISON
CHAFFEE
FREMONT
TELLER
SAGUACHE
MINERAL
DOLORES
SAN JUAN
HINSDALE
MONTEZUMA
LA PLATA
RIO GRANDE
ALAMOSA
COSTILLA
HUERFANO
PUEBLO
Yampa River
Colorado River
Roaring Fork River
Gunnison River
Arkansas River
Rio Grande River
Dolores River
Animas River
Big Thompson River
South Platte River
North Platte River
Poudre River
Canadian River
Blue River

Appendix VI - Research Updates

Effect of contrasting population exposure to *Batrachochytrium dendrobatidis* (naïve vs. experienced) and its effect on survival of boreal toad (*Bufo boreas*), Cindy Carey and Lauren J. Livo, University of Colorado at Boulder

Boreal toad populations in Colorado have a variety of exposure histories to the amphibian pathogen *Batrachochytrium dendrobatidis* (referred to hereafter as *Bd*). For some populations, such as those in the Urad Valley (Clear Creek County, Colorado), exposure to this pathogen has been continuous since 1999, while the Buck Mountain population (Routt County, Colorado) has been exposed to *Bd* since 2004. In contrast, the Denny Creek (Chaffee County, Colorado) population has no known exposure to *Bd* to date.

This experiment was designed to test whether prior exposure of boreal toad populations to *Bd* influenced survival of toadlets after exposure to *Bd*. In June, 2005, I collected egg samples from 2 (Buck Mountain) or 4 (Urad Valley and Denny Creek) individual clutches at breeding areas. These 10 lots of toadlets were reared at the Native Aquatic Species Restoration Facility for this experiment. An effort was made to maintain the same number of toadlets for each lot, as density affects growth rates and toadlet size. In January 2006, 20 toadlets from each lot were transferred to the University; after some mortality in transit, 75% of the remaining 194 toadlets were randomly assigned to exposure groups and the remaining 25% served as controls.

In the exposure groups, toadlets were housed individually for 24 hours in a solution containing an estimated 1 million *Bd* zoospores, while control toadlets were housed for 24 hours in a solution that lacked *Bd* zoospores but was otherwise identical. After this exposure period, all toadlets were housed individually in plastic containers holding 20 ml of 20% Holtfreter's solution.

Although all the toadlets exposed to *Bd* eventually died, there were significant differences in survival among the toadlets associated with their geographic origin. In particular, *Bd*-exposed toadlets from Denny Creek (a site without prior exposure to *Bd*) survived significantly fewer days than *Bd*-exposed toadlets from Urad and Buck Mountain (Logrank test Chi-square = 48.947, DF = 2, $P < 0.0001$).

These results suggest that boreal toads at sites at which *Bd* is present have undergone selection for characteristics that permit them to survive for a longer time compared to boreal toads from sites where this pathogen has not invaded.

***

Variation in zoospore production over the course of infection with *Batrachochytrium dendrobatidis,* Cindy Carey and Lauren J. Livo, University of Colorado at Boulder

Previous exposure experiments suggest that amphibians infected with *Batrachochytrium dendrobatidis* (*Bd*) succumb after the fungus exceeds some threshold density of infection on the skin of the affected amphibian (Carey et al., 2006). The experiment described here was designed to determine how *Bd* zoospore production varied over the course of infection.

We exposed boreal toads (*Bufo boreas*) and Woodhouse's toads (*Bufo woodhousii*) in individual containers to a solution containing an estimated 1 million *Bd* zoospores. After this exposure period, all toads were housed individually in plastic containers holding 20 ml of 20% Holtfreter's solution.

Bd zoospores were collected weekly from each toad by placing the toad in a clean plastic container with 10 ml of Holtfreter's solution for 15 minutes, then decanting the liquid into individual tubes for quantitative polymerase chain reaction (qPCR) analysis.

Boreal toad mass ranged from 1.3 to 26.8 g (mean = 11.6 ± 3.0 S.E. g, N = 11), and there was a highly significant correlation between boreal toad mass and the number of days survived (R = 0.743, N = 11, P = 0.0068). In contrast, the Woodhouse's toads were larger, ranging from 12.3 to 68.5 g (mean = 23.9 ± 5.8 S.E. g, N = 9), and there was no significant correlation between mass and the number of days survived (R = 0.472, N = 9, P = 0.2093).

Zoospore production, estimated from qPCR, rose from initially low values to very high values. For 9 of the 11 boreal toads, and 5 of the 9 Woodhouse's toads, the maximum number of zoospores was produced during the toad's final sampling episode (at or within a week of the toad's death). The table below shows the mean and range of zoospores produced at the maximum rates recorded for both species of toad in this study.

Species	Mean zoospores produced per day	Range of zoospore production per day
Boreal toad	10,980,567	32,544 to 30,470,496
Woodhouse's toad	8,131,744	178,848 to 9,947,616

Models of infection dynamics in individuals and populations require information on disease progression and its association with zoospore production rates. This study provides baseline information for modeling these processes.

***

Boreal toad and mountain yellow-legged frog susceptibility to *Batrachochytrium dendrobatidis,* Cindy Carey and Lauren J. Livo, University of Colorado at Boulder

Boreal toads (*Bufo boreas*) and mountain yellow-legged frogs (*Rana muscosa*) are high elevation anuran species that have both proven to be susceptible to population declines associated with the pathogenic chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*). In this experiment, we used a strain of *Bd* isolated from boreal toads in Colorado and a strain of *Bd* isolated from yellow-legged frogs in California and challenged groups of each anuran species with either 1 million zoospores of the toad *Bd*, 1 million zoospores of the frog *Bd*, or a sham solution that contained no *Bd* (controls).

Most of the controls of both anuran species survived throughout the experiment. Of the anurans exposed to *Bd*, boreal toads died much more rapidly than yellow-legged frogs, although this may be an effect of the greater mass of the frogs compared to the toads.

Further, boreal toads died significantly faster when exposed to the strain of *Bd* isolated from boreal toads than when exposed to the strain of *Bd* isolated from yellow-legged frogs (Logrank test, Chi-square = 11. 890, DF = 1, $P < 0.0006$). There was no significant difference in survival time for yellow-legged frogs exposed to toad *Bd* versus frog *Bd* (Logrank test, Chi-square = 1.148, DF = 1, $P = 0.2840$).

This experiment demonstrates that variation in the pathogenicity of *Bd* depends not only on the identity of the *Bd* isolate, but also on the anuran species that is challenged by it.

***

The effects of environmental factors on chytridiomycosis in a tropical anuran, Cindy Carey and Lauren J. Livo, University of Colorado at Boulder

Atelopus zeteki is a tropical anuran native to Panama that has experienced population declines attributed to chytridiomycosis. We exposed individual *Atelopus* to a range of dosages of the amphibian chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*) and maintained the anurans at either a relatively cool temperature (17°C) or a warm temperature (23°C). In some groups, *Atelopus* were housed in individual small, round containers where the entire floor was covered in liquid (wet conditions), versus in individual large rectangular containers that were tilted so that liquid was available to the animals at one end, but the remainder of the container floor was dry (dry conditions).

We observed that the *Bd* dosage affected the survival time of the animals, with animals exposed to low doses surviving longer than animals exposed to high doses.

Both temperature (cool versus warm) and conditions (wet versus dry) affected survival as well. At 17°C, *Atelopus* exposed to 1 million zoospores and held in dry conditions survived longer than those held in wet conditions. At 23°C, the outcome was reversed, with *Atelopus* exposed to 1 million zoospores and held in wet conditions surviving longer than those held in dry conditions.

Acknowledgements: We thank Kevin Rogers, Tina Jackson, and the staff of the Native Aquatic Species Restoration Facility for facilitating these studies. Cheryl J. Briggs and Vance T. Vredenburg collaborated on the *Bufo boreas/Rana muscosa* study. The Baltimore Zoo provided surplus *Atelopus zeteki* for these studies. Cassia Rye and Heidi Bustamante assisted with animal care and sample collection.

Literature cited

CAREY, C., J. E. BRUZGUL, L. J. LIVO, M. L. WALLING, K. A. KUEHL, B. F. DIXON, A. P. PESSIER, R. A. ALFORD, AND K. B. ROGERS. 2006. Experimental exposures of boreal toads (*Bufo boreas*) to a pathogenic chytrid fungus. EcoHealth 3: 5-21.

***

2006 CNHP Boreal toad modeling effort, Chris Gaughan, CNHP, Ft. Collins, CO

This last summer was the 8th summer of focused inventory and monitoring for the Boreal toad in Colorado by The Colorado Natural Heritage Program (CNHP). Along with the 8 years of our inventory data CNHP also compiles location data for the toad going as far back as 1902 and some of the post-1998 data is from other sources then CNHP inventory and monitoring. The Boreal toad data currently has 969 spatially distinct positive records (there are only 131 element occurrences when the 8 km separation distance combines records into sub-populations). Because CNHP has been a major part of this data collection effort we also have negative data. There are 797 spatially distinct negative records. Even after all this inventory effort we are still finding new occupied habitat and breeding sites. This past summer 5 new breeding sites were found. With more to discover about the Boreal toad CNHP has begun a spatial distribution modeling effort to refine the data we have into predictive GIS surfaces that may be utilized to adapt our inventory methodology or the management of the species.

For the purpose of the Boreal toad distribution model the spatially distinct data was clipped out with 2 sets of dependent binomial variables attributed to the points, one for breeding/non-breeding, and the other for occupied/unoccupied sites. A general linear model (GLM) was used with both actual negative data and pseudo-absence data generated from random points within Colorado counties that have Boreal toad records. The environmental covariates chosen were; elevation, aspect, slope, distance to river, stream or creek, distance to major highway, and landcover. Climate data was available, but at a 1 km resolution (unlike the rest of the grids that are 30 meter resolution) these covariates were left out for the first runs of these models so as not to cut the resolution of the resulting surfaces. Climate data such as frost free days and annual precipitation may be worth exploring in the future when the resolution improves or we run a coarse scale model.

The environmental covariate values were added to the data points using Hawth's point intersect tool in ArcGIS then converted into a text file to load into the Statistical Program R. In R the GLM and stepwiseAIC functions were run to find the environmental variables with the best fit to the toad data. Elevation, slope, and distance to river where chosen as the covariates that best explain the toad data. From the best fitting models, the coefficients from each grid cell in Colorado were then exported back to ArcGIS as a text file and converted to a probability surface.

The values from the probability surface were then intersected back to the original data points to test the model and create a receiver operating characteristic (ROC) plot and find the best probability cutoff values for the data surface created. The next step for this winters modeling effort is to refine the GLM with a general additive model (GAM) and run the data through a binary regression tree (CART) model and weigh the results with the GLM.

Potential uses for this model by CNHP as well as others include; targeted (informed or refined) inventory locating potential and isolated populations which could help prioritize field inventory, establish better estimates of species distribution, coarse scale conservation planning (emphasis on coarse as this has the potential for misuse), and informing taxonomic revisions. Most importantly we plan to use this product during the 2007 field season to refine our targeted inventory areas to increase the probability of finding new populations of the Boreal toad in Colorado.

***

Chaffee County mark-recapture study 2006, Brad Lambert, CNHP, Ft. Collins, CO

In 2006 we continued a mark-recapture study in the Cottonwood Creek drainage in Chaffee County. The following breeding sites were monitored with multiple visits to collect data on the adult populations for the study: Collegiate Peaks Campground, Denny Creek, South Cottonwood, South Cottonwood West, Morgan's Gulch, Rainbow Lake, Hartenstein Lake, Holywater beaver ponds and Middle Cottonwood Creek. The purpose of this study is to collect baseline data for evaluating population size and trends, and to detect toad movement between breeding sites.

At each site adult toads within the study area were collected in individual zip lock bags and were processed on site after the area was surveyed. The majority of adult toads were captured early in the spring during the breeding season. Avid PIT (Passive Integrated Transponders) tags were used to individually mark toads. Only toads weighing more than 20g were marked. The protocol outlined in the *Boreal Toad Conservation Plan and Agreement* was followed for marking toads. An incision was made with sterile scissors and the PIT-tag was inserted on the dorsal side, horizontal to the toad's mid-dorsal line. The entry wound was sealed with New Skin Liquid Antiseptic Bandage. The toads were weighed with an Acculab 0-250g

electronic scale and measured snout to vent length with dial calipers. The toads were then released near the point of capture.

Since 1998, 1,111 adult males and 310 adult females have been tagged in the Middle Cottonwood Creek and South Cottonwood Creek drainages. In 2006 there were 133 new males with 188 recaptured individuals and 13 new females with 13 recaptured individuals. Adult captures continue to be high at the Collegiate and Denny Creek sites and at the South Cottonwood Creek sites. There has been no apparent decline in the Cottonwood Creek metapopulation since this study began, although breeding success and adult high counts have fluctuated from year to year at several breeding sites. Rainbow Lake and the Holywater Beaver Ponds site have both shown no evidence of breeding since 2003 with low numbers of adults. The long term viability of these breeding sites are of concern, but also might just be marginal sites on the edge of the more robust core sites along Middle Cottonwood Creek.

The data reveals that, although rare, there is movement by toads along the Middle Cottonwood Creek sites and between the South Cottonwood Creek and South Cottonwood Creek West sites. There have been two documented movements between the Middle Cottonwood Creek and the South Cottonwood Creek drainages. One adult male was tagged at Collegiate Peaks Campground in 1999 and was recaptured in 2002 at the South Cottonwood Creek site approximately 7 km away and another adult male tagged at the Denny Creek site in 2004 was recaptured in 2006 at the South Cottonwood Creek site approximately 8 km away. Eleven adult males have been recaptured every year since this project began (1998 – 2006) and one female tagged in 1998 was recaptured in 2006. Given that there were adults at the time they were tagged in 1998 they are at least 10 years old now.

Currently, the data from the 1998-2006 are being analyzed to look at year to year population estimates.

Representative publications with this data:

Muths, E., R. D. Scherer, P. S. Corn, and B. A. Lambert. 2006. Estimation of temporary emigration in male toads. Ecology 87(4):1048-1056.

Scherer, R. D., E. Muths, and B. A. Lambert. *In Prep*. The effect of weather on survival in populations of boreal toads in Colorado, U.S.A.

****

Investigations into the phylogeographic structure of Bufo boreas boreas with emphasis on the southeastern Rocky Mountains region , John Switzer, USGS, Leetown Science Center

BACKGROUND AND JUSTIFICATION:

Bufo boreas is distributed across much of the western U.S. and western Canada (Fig. 1). It is locally common, but rapid losses and declines of many populations, even in relatively pristine environments, have caused concern. Southern Rocky Mountain (SRM) populations of *B. boreas* in Colorado, Wyoming and New Mexico have undergone a drastic decline since the 1970s due principally to a chytrid fungus (*Batrachochytrium dendrobatidis*). For resource managers to effectively address the decline of this species a conservation strategy that preserves genetic variation at all levels of diversity must be adopted. The initial stages of this process must be to identify species boundaries and intraspecific management units. Heritable genetic information offers an objective means of depicting these units and provides an evolutionary framework from which to develop and evaluate conservation priorities.

A recent genetic analysis of *Bufo boreas* mitochondrial DNA (mtDNA) control region sequence data identified at least five separate clades that may warrant management consideration (Goebel 2003). These results also indicate that *B. boreas* may be more than one species, a result consistent with other phylogenetic analyses of the *B. boreas* species group which includes *B. canorus*, *B. exsul* and *B. nelsoni* (Goebel 2005; Pauly et al. 2004; Graybeal 1993). Of particular interest is evidence that the SRM mountain population of *B. boreas* may be a distinct evolutionary lineage. In order to resolve relationships within the *B. boreas* species group, both at the inter-specific and intra-specific levels, a phylogeographic analysis with increased sampling of this group must be undertaken. For this study, mitochondrial DNA sequence data from the control region, as well as microsatellite genotype data from 15 loci are being collected and analyzed for populations from throughout the range of *B. boreas* as well as other members of the *B. boreas* species group. The use of microsatellite DNA markers in the present study will provide a robust survey of the nuclear DNA variation for this species complex. The usage of microsatellite genotype data along with mitochondrial control region sequence data will allow for accurate identification of genetic diversity from the species level to fine scale population structure.

PRELIMINARY FINDINGS:

Sampling to date includes 1117 individuals from 193 collection sites throughout the range of *Bufo boreas* and *B. nelsoni* (Figure 1). In addition to these samples, curators at the Museum of Vertebrate Zoology, University of California, Berkeley, have agreed to supply tissue of 10 *B. exsul* and 15 *B. canorus* from their collections for this study. DNA has been extracted from 1117 samples, including 1109 *B. boreas* and 8 *B. nelsoni* to date.

Mitochondrial DNA Sequence Data

A portion of the mitochondrial control region, 473 base pairs in length, has been sequenced in 522 individuals (514 *B. boreas*, 8 *Bufo nelsoni*) thus far. Preliminary analysis of the control region data using the statistical parsimony algorithm implemented by TCS resulted in four major unconnected networks of *B. boreas* and *B. nelsoni* haplotypes (Figure 2): Group A comprised of individuals from Colorado, Utah, southern Wyoming and southeastern Idaho; Group B comprised of individuals from northwestern Wyoming, Montana, northern Idaho, Washington, Oregon, and California; Group C comprised of individuals from southern California and *B. nelsoni*; Group D comprised of individuals from southern Utah. The four major networks are unconnected as the number of inferred haplotype changes between them is greater than the 95% confidence limit of statistical parsimony. This indicates a relatively high level of divergence between these groups. A preliminary phylogenetic analysis of the control region DNA sequence data with parsimony using a heuristic search in PAUP* resulted in 10 most parsimonious trees at 226 steps. The strict consensus of these 10 trees with bootstrap support is shown in Figure 4. Major relationships of the clades recovered were: the southern Utah *B. boreas* haplotype (D) sister to the *B. boreas* clade (A) from southeast WY, southeast ID, and UT; a clade (B) of *B. boreas* from northern WY, MT, ID, WA, OR and CA, sister to A and D; and a haplotype (C) found in both *B. nelsoni* and southern CA B. boreas sister to A, B and D.

Microsatellite DNA Genotype Data

In addition to sequencing the control region for a subset of samples, all individuals are being genotyped at 15 polymorphic microsatellite DNA loci. At this point the findings are too preliminary to provide detailed results. The markers are sufficiently variable to provide good estimates of population structure within the A and B clades.

Conclusions

The mitochondrial control region data provides strong evidence for populations of *B. boreas* from Colorado, southern Wyoming, Utah and southern Idaho (clade A) being a distinct lineage. Within this evolutionary lineage, populations referred to as the SRM populations, Colorado and southern Wyoming, do not appear to be significantly differentiated from Utah and southern Idaho populations at the mitochondrial control region examined. Data is currently being collected from 15 microsatellite loci that will help delineate populations, relationships among populations, and demographic histories within the major lineages recovered with the mitochondrial sequence data.

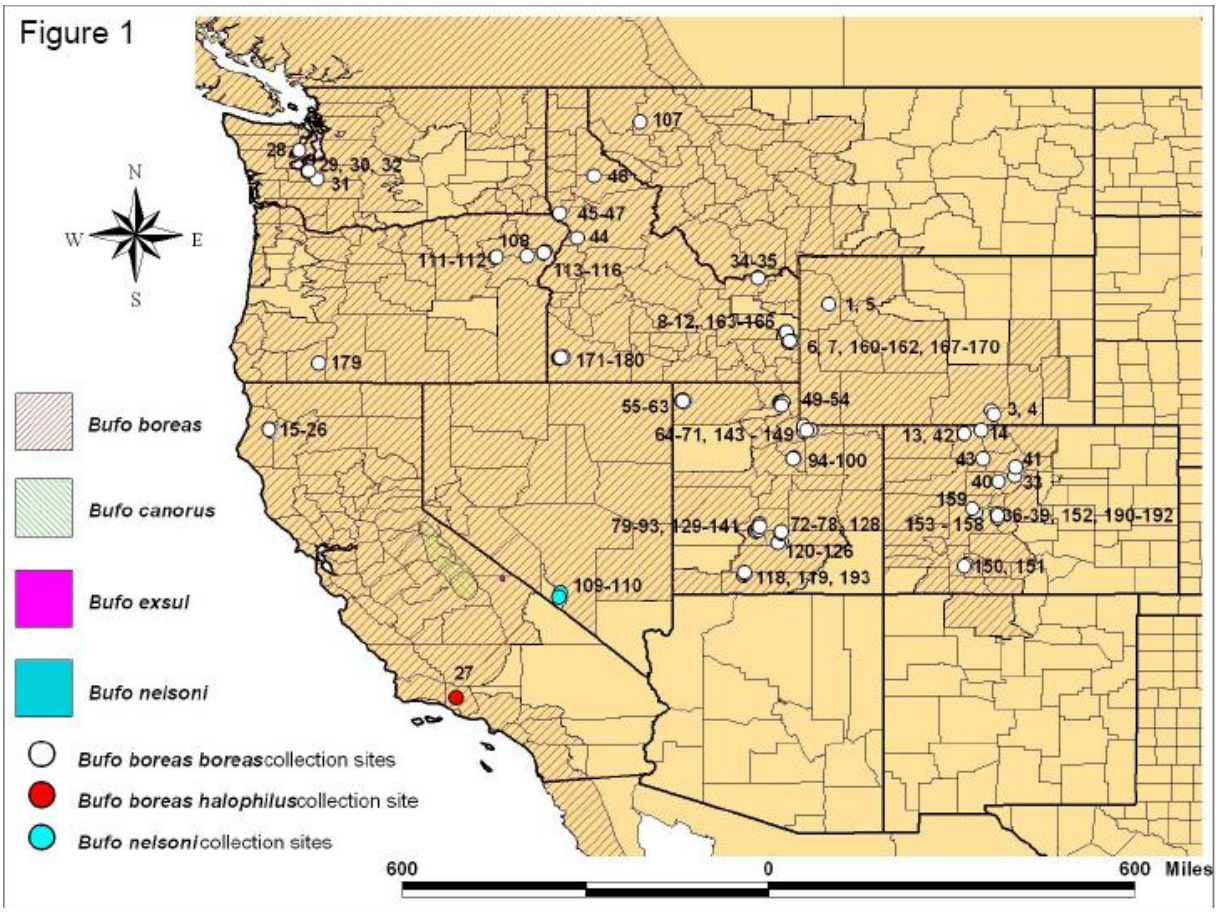


Figure 1. Map of sampling localities and distributions of *Bufo boreas*, *B. canorus*, *B. exsul* and *B. nelsoni*.

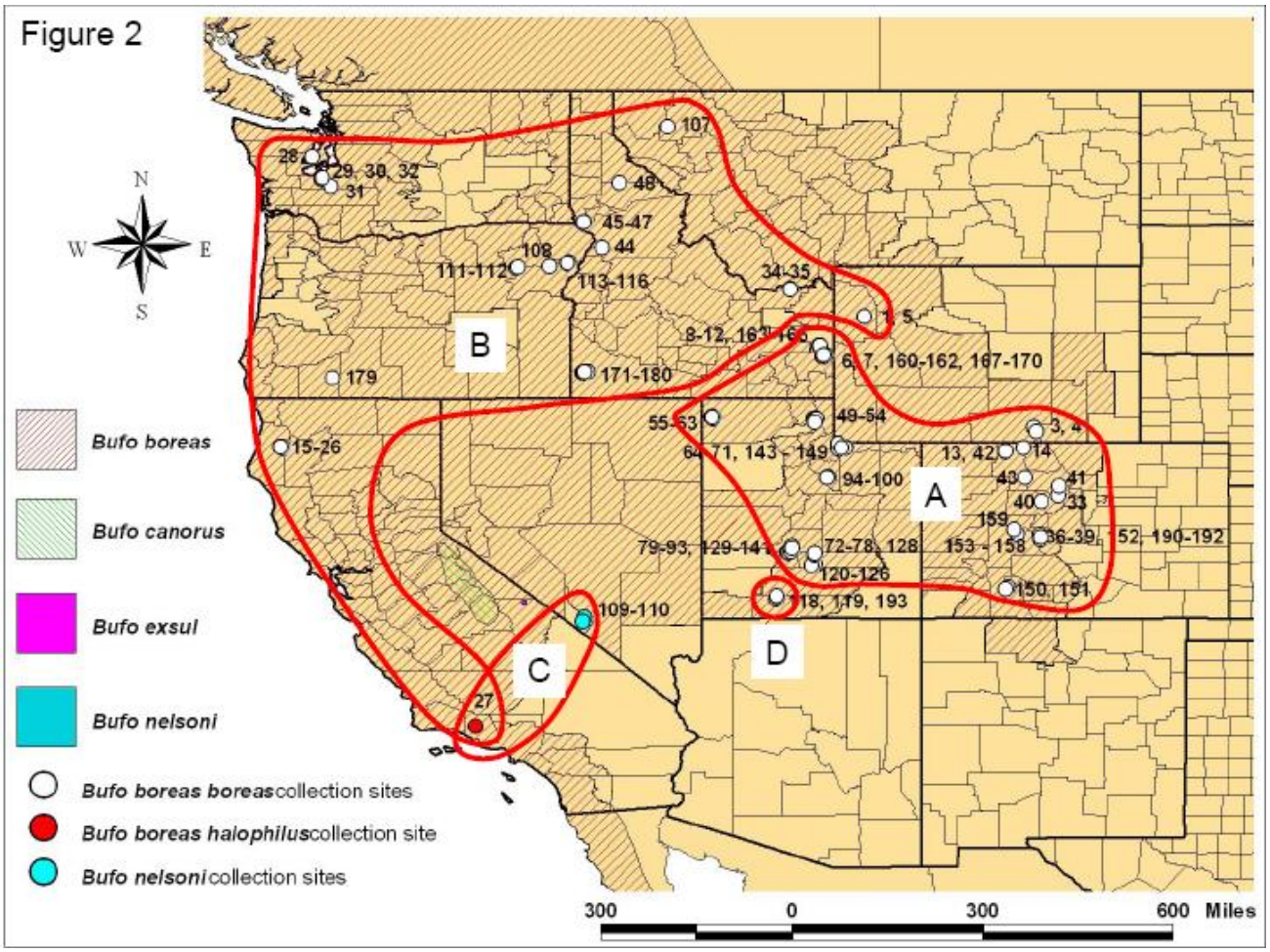


Figure 2. Map of sampling localities and four networks of *Bufo boreas* and *B. canorus* haplotypes. The distributions of haplotypes recovered in each of the major haplotype networks are outlined in red and labeled A-D.

Figure 3

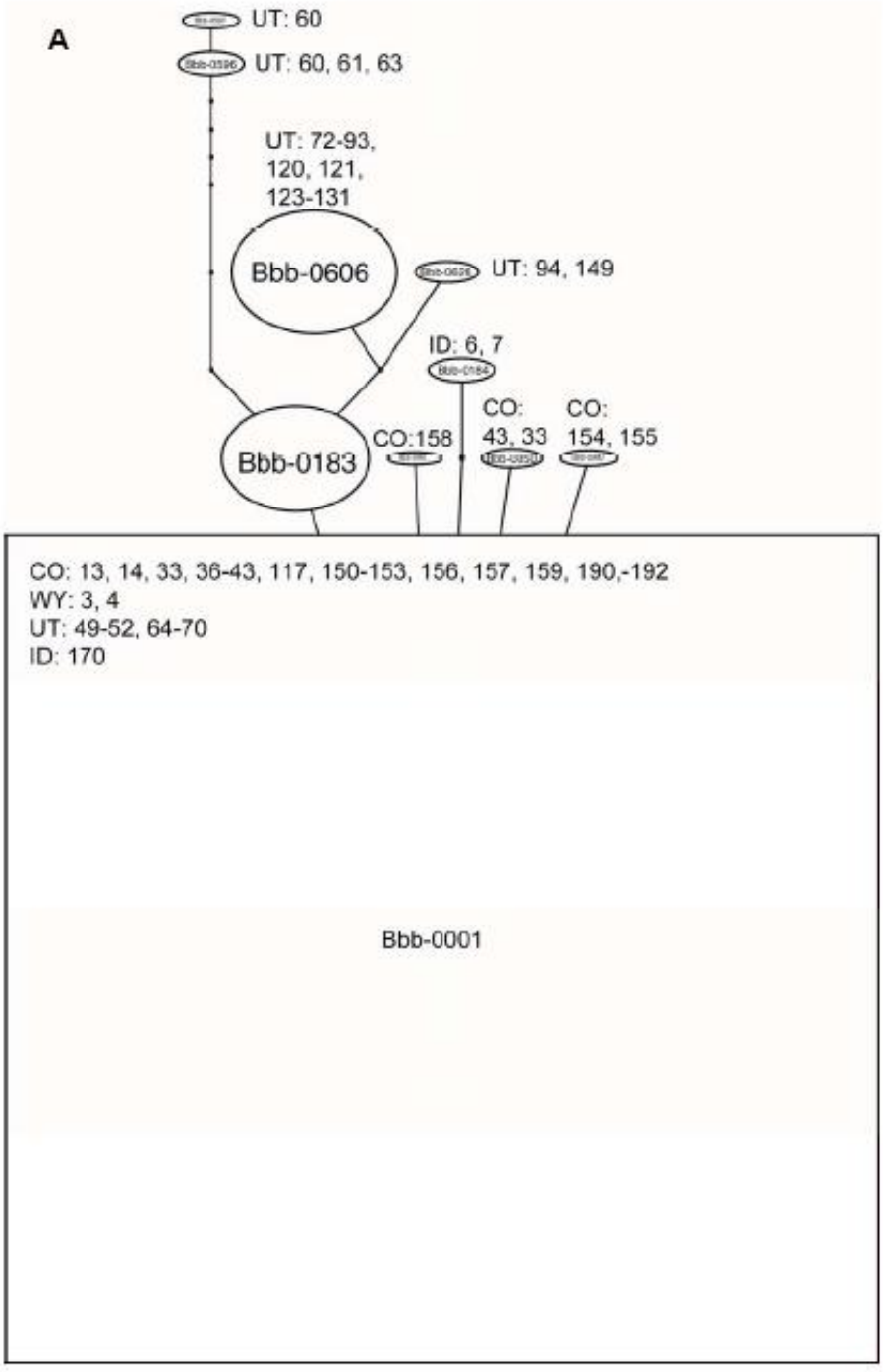


Figure 3. Haplotype network A resulting from TCS analysis of mitochondrial control region sequences of 522 individuals. The size of each ellipse/square representing a haplotype is proportional to the number of samples with that haplotype. Collection localities from which each haplotype was observed are labeled.

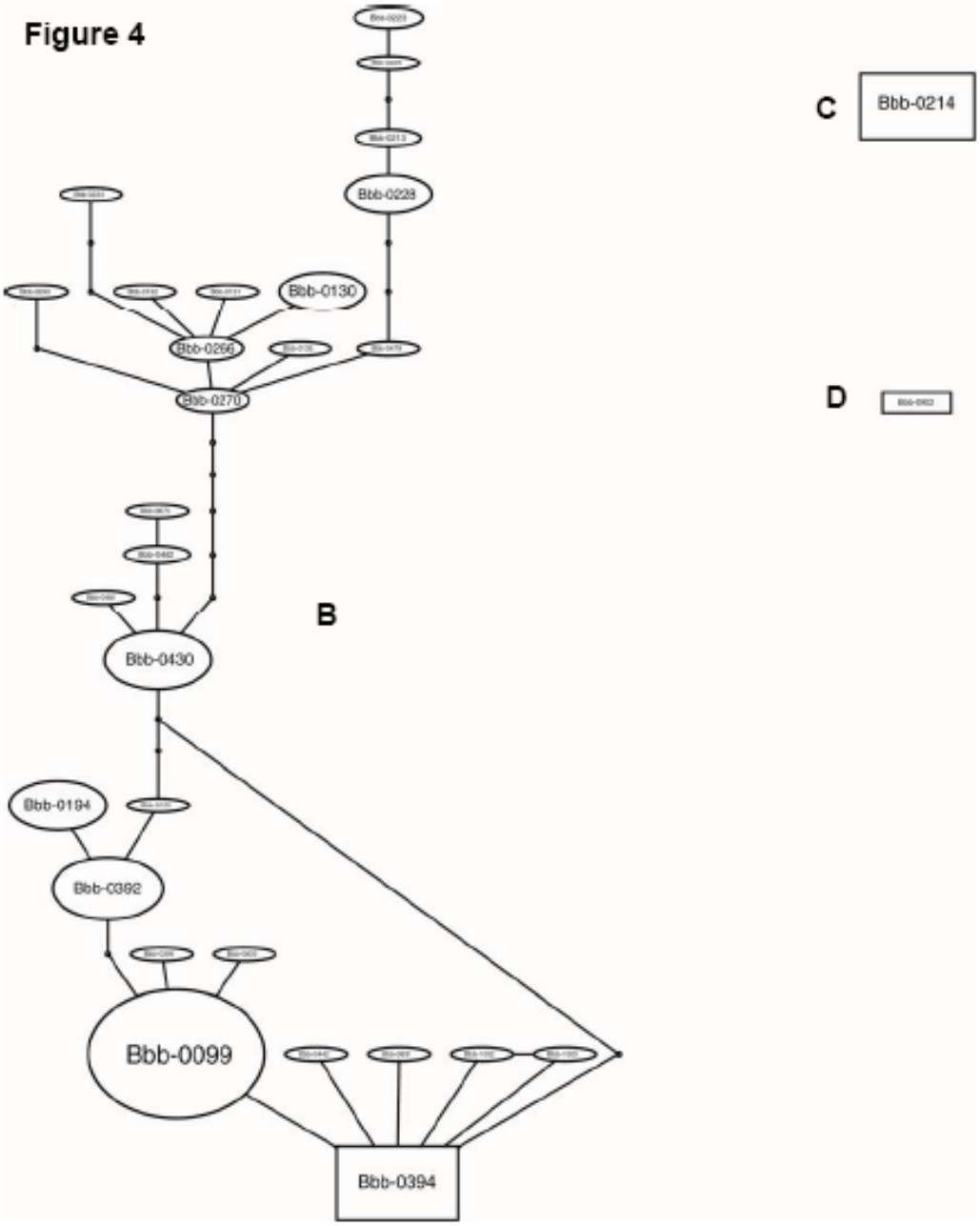


Figure 4. Haplotype networks B, C, and D, resulting from TCS analysis of mitochondrial control region sequences of 522 individuals. The size of each ellipse/square representing a haplotype is proportional to the number of samples with that haplotype.

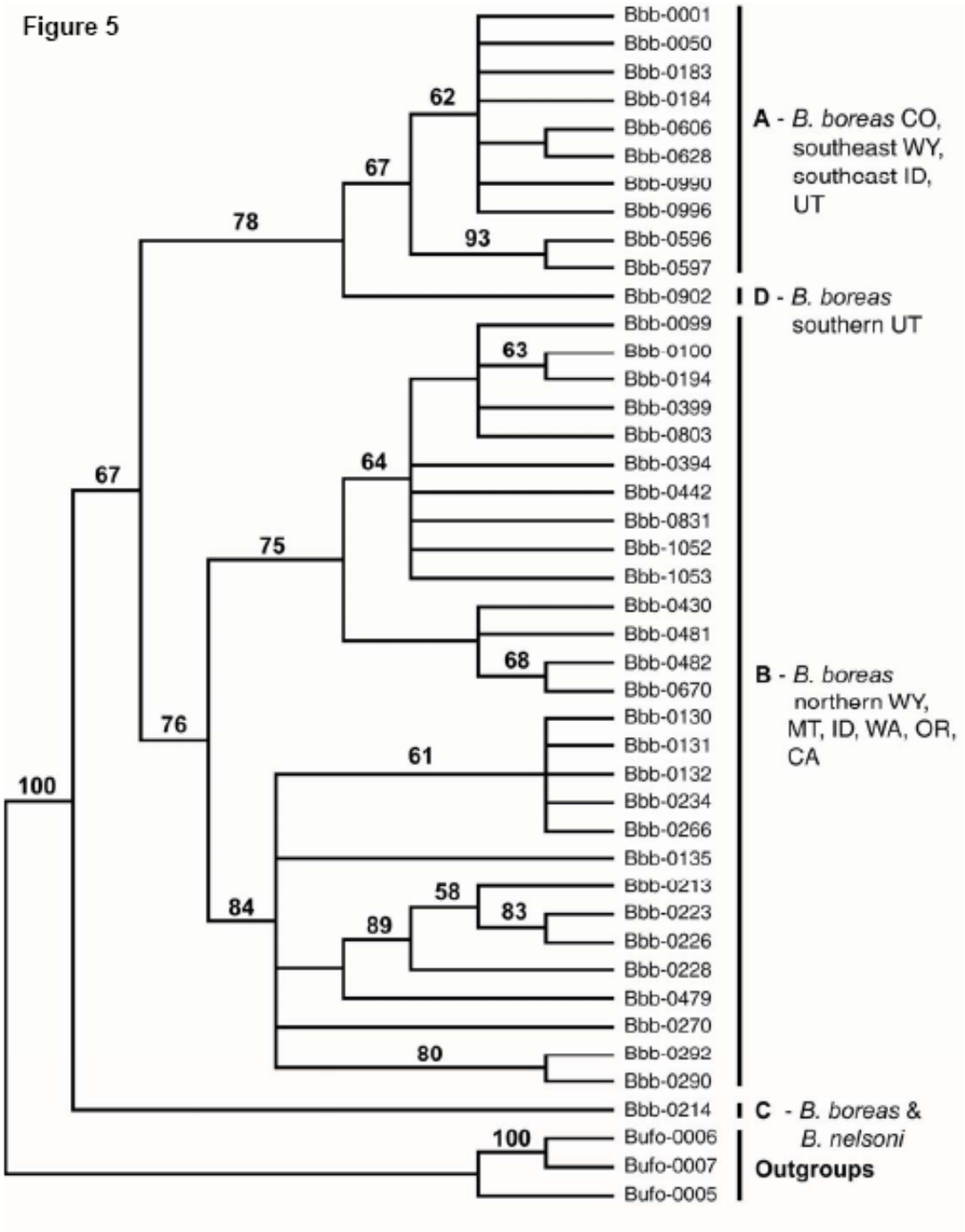


Figure 5. Strict consensus of 10 most parsimonious trees resulting from a heuristic search of search of 43 control region haplotypes. Numbers above branches support resulting from 1000 bootstrap replicates. The tree is rooted with three outgroup taxa haplotypes from *B. americanus* and *B. fowleri*.

***

Repatriation of boreal toads *Bufo boreas* (*Anaxyrus boreas*) on the Grand Mesa, Colorado, Kevin Thompson, Colorado Division of Wildlife

Previous research updates on this repatriation effort described the release protocols and numbers of animals involved. Although releases were scheduled to be concluded in 2005, about 2300 additional tadpoles were released in 2006 at a single pond within the Kannah Creek study area. These animals were released directly to the pond since previous research had indicated there was no advantage of any release method among those tried (wild release, pen-reared and then released, or released as toadlets).

Since the oldest released toads were age four in 2007 we hoped that the population would contain some sexually mature animals. Consequently we scheduled considerable survey effort during the summer of 2007 to try to find evidence of boreal toad breeding. Surveys commenced on June 4 and concluded on September 4, and were conducted at least weekly during June. Not all potential breeding sites were visited on each survey, and effort was concentrated within the Kannah Creek valley where ponds 1 – 4 are located. With the exception of the first occasion, all toads captured were photographed to capture an image of their unique belly pattern. These photos were tied to Bd swab sample numbers, and initial swab sample numbers became the individual identification number of each toad captured. Physical comparison of photographs later allowed us to determine which toads had been recaptured versus which were new captures.

Overall, about 84.5 hours of survey time were logged at the Kannah Creek study site. Although toads were found, all were age 1 juvenile survivors of the 2006 tadpole plant. Fourteen individual toads were identified based on belly photos. Five of the toads were re-captured on one or more occasions. All toad captures occurred in the immediate vicinity of Pond 4 where the tadpoles were released.

***

Photographic identification of boreal toads *Bufo boreas* (*Anaxyrus boreas*) and development of a computer program for identifying toads based on photos, Kevin Thompson, Colorado Division of Wildlife

Boreal toads exhibit unique coloration patterns in the ventral region. Other animals that have unique patterns have been individually identified by those patterns for research purposes, including penguins, sharks, polar bears, and several species of amphibians. In some instances,

such identification was made by computer aided image processing or pattern recognition software. The ability to accomplish identification in such a fashion would have great utility at NASRF because previous research showed that the brood animals housed there shed PIT tags at unacceptably high rates, compromising our ability to track toads and their offspring in the hatchery. Such tracking could become increasingly important if wild populations of boreal toads continue to decline. It could also prove useful in the field as an alternative to current marking methods for the purpose of mark-recapture studies, given the reasonable assumption that toads will never lose the mark comprised of their unique spotting pattern.

During 2007 all adult toads at NASRF were photographed and assigned an individual identification number. Individual numbers include the lot number of the toad and, for mature toads, a letter code denoting sex. A first photograph was taken with identification information visible in the background on a dry erase whiteboard. Additional photographs were taken with a closer perspective to maximize pattern visibility. The best close up photograph of each toad was incorporated into PowerPoint slides at six photographs per portrait-oriented letter size page, printed in color by lots, and laminated to preserve the images. Two sets were provided to NASRF, one for the files and one for floor use in identifying toads. They have proven useful to hatchery staff, so we plan to continue this effort for newer lots of toads as they grow.

On the field front, collaboration was initiated with Carlos Anderson, a PhD student at Michigan State University. Mr. Anderson developed and used a software program to identify individual polar bears based on whisker spot patterns during his M.S. research at the University of Central Florida. We provided him with pairs of photographs from field and hatchery toads to allow him to modify his polar bear software for use with boreal toad belly patterns. After modifications, the program was able to discriminate toads with a high degree of accuracy. Using the best quality photo comparisons (photos taken in May and in December), only 2 of 32 toads weren't identified correctly. Moreover, only 3 of 992 comparisons of different toads resulted in a score that would ordinarily indicate a match. Therefore the accuracy of the system on this test set was 93.75% and the probability of false positives was 0.3%.

A technician has begun entering all of the NASRF toads into the program with reference photographs. Once that process is complete, the system will be tested with unidentified photographs to determine its accuracy with a much larger dataset.

***

***Batrachochytrium dendrobatidis* – looking for environmental test subjects, Kevin Thompson, Colorado Division of Wildlife**

Previous research has explored the utility of several items to test environmentally for Bd in areas where there are no amphibians to test. Items tested included a number of insect species, fathead minnows, and cotton swabs baited with keratin. None of these items proved reliable. In 2007 we collected simultaneous *Pseudacris triseriata* belly swabs and replicate samples of mosquito pupae and larvae. Mosquito aquatic stages were proposed as a potential carrier of Bd, and their ubiquitous presence in amphibian habitats would fit with the expansion of Bd in numerous areas around the world. While the chorus frog samples routinely exhibited a high proportion of individuals testing positive, only two mosquito samples yielded a positive signal. Both positive samples came from the same site and near the end of the three-week trial. We intend to try this test again in 2008, using fewer mosquitoes per sample (less DNA material for the testing lab to deal with) and also including filtered water samples as described by Kirshtein et al. (2007).

***

Chaffee County mark-recapture study 2007, Brad Lambert and Chris Gaughan, CNHP, Ft. Collins, CO

In 2007 we continued a mark-recapture study in the Middle and South Cottonwood Creek drainages in Chaffee County that began in 1998. The following breeding sites were monitored with multiple visits to collect data on the adult populations for the study: Collegiate Peaks Campground, Denny Creek, Denny Creek West, Middle Cottonwood Creek, Rainbow Lake, Hartenstein Lake, Holywater Beaver Ponds, South Cottonwood Creek, South Cottonwood West and Morgans Gulch. The purpose of this study is to collect baseline data for evaluating population size, survival, movement and other demographic parameters.

At each site adult toads within the study area were collected by hand or with a dip net, placed in individual zip lock bags, and processed on site after the breeding area was surveyed. Avid PIT (Passive Integrated Transponders) tags were inserted subcutaneously to individually mark adult (> 20g) toads. The protocol outlined in the *Boreal Toad Conservation Plan and*

Agreement was followed for marking toads. An incision was made with sterile scissors and the PIT-tag was inserted on the dorsal side, horizontal to the toad's mid-dorsal line. The entry wound was sealed with New Skin Liquid Antiseptic Bandage. Toads were weighed with an electronic scale and snout to vent length was measured using dial calipers. Toads were released near the point of capture after processing.

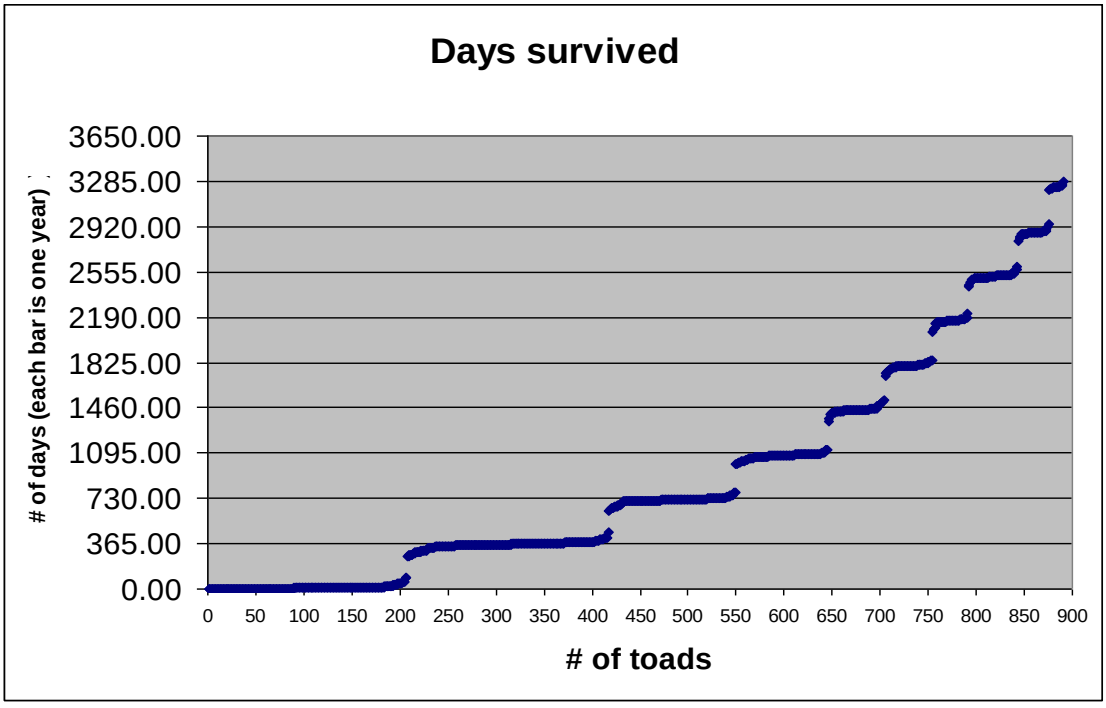
Since 1998, 1,317 adult males and 307 adult females have been tagged in the Middle Cottonwood Creek and South Cottonwood Creek drainages. Adult captures and recaptures continue to be high at the Collegiate and Denny Creek sites and at the South Cottonwood Creek sites when compared to other sites in Chaffee County. There has been no apparent decline in the Cottonwood Creek metapopulation since this study began, although breeding success and adult high counts have fluctuated from year to year at several breeding sites. Rainbow Lake and the Holywater Beaver Ponds site have both shown no evidence of breeding since 2003 with low numbers of adults. The long term viability of these breeding sites are of concern, but also might just be marginal sites on the edge of the more robust core sites along Middle Cottonwood Creek. Of the 409 (371M/38F) individuals captured in the 2007 field season 210 (179M/31F) were new captures this year. To date 1624 (1317M/307F) toads have been marked. At the Collegiate Peaks Campground 61 (58M/3F) toads were captured this year, 5 male toads had immigrated from Middle Cottonwood. Denny Creek West had 10 (9M/1F) toads caught in 2007, 1 male emigrated from Hartenstein Lake. South Cottonwood West had 8 (5M/3F) captures, one male had immigrated from South Cottonwood and one male immigrated from Morgan's Gulch, the first time we have documented movement between Morgan's Gulch and the South Cottonwood Creek sites. Hartenstein Lake had 59 (52M/7F) captures, Denny Creek had 57 (46M/11F) captures, Middle Cottonwood had 40 (39M/1F) captures, Morgan's Gulch had 44 (42M/2F) captures, and South Cottonwood had 131 (121M/10F) captures this year.

Sixteen males marked in 1998 were recaptured in the summer of 2007 and two females have been recorded over an eight year period (Table 1). This longevity data is also displayed graphically in Figure 1. During the course of the study the highest number of captures for one male is 27 (1998-2007 at Collegiate) however over 95% of the toads have been captured no more than ten times and the highest number of recaptures for a female is five.

Table 1. **Numbers of years marked toads have been recaptured over all sites and all years.**

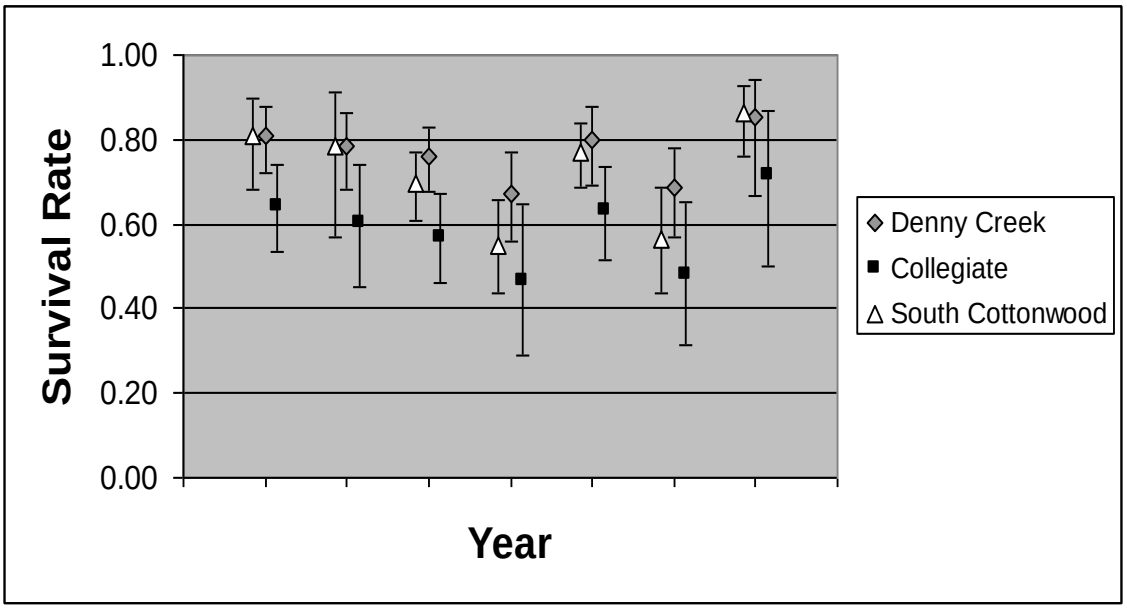
Years known to be alive	Male	Female	Total
Unknown (Single Capture)	508	225	733
<1 year	177	30	207
1 year	200	10	210
2 years	115	17	132
3 years	90	6	96
4 years	51	8	59
5 years	48	2	50
6 years	32	5	37
7 years	50	2	52
8 years	30	2	32
9 years	16	0	16
Totals	1317	307	1624

Figure 1. **The number of day's that individual marked toads are known to have survived**.



Another analysis was to examine correlations between weather variables and the probability of survival of adult males at three sites in Chaffee County (Scherer et al. 2008). Analysis from mark-recapture data collected at the Denny Creek, South Cottonwood Creek and Collegiate Campground sites from 1998 – 2004 found that minimum daily winter air temperatures were positively correlated with survival at these sites with site and population characteristics playing an important role in determining the magnitude. In addition, differences in water depth, soil characteristics, and availability and quality of hibernacula may affect the relationship between survival and winter temperature. The Collegiate Campground site had lower survival then Denny Creek and South Cottonwood Creek (Figure 2), possibly due to its proximity to a high traffic road. There was weak evidence for the probability of survival being positively correlated with snow depth and negatively correlated with precipitation prior to winter.

Figure 2. **Survival estimates from three breeding sites in Chaffee County 1998 – 2004 (From: Scherer et al. 2008).**



Survival and Population Estimates

We analyzed the mark-recapture data collected since 1998 in Program MARK (White and Burnham 1999). For all but three sites sample sizes were too small to provide meaningful estimates for all years. Data collected from the South Cottonwood Creek (CF-05), Denny Creek (CF-02), and Collegiate Peaks Campground (CF-01) breeding sites were analyzed using a robust

design model structure. We modeled population parameters using our knowledge of the biology of the species. The most parsimonious models were chosen using Akaike's Information Criterion (Burnham and Anderson 1998). The model that explained the most variability in the data was one that modeled survival different for both sexes, temporary movement parameters as constant and equal, and capture and recapture probabilities equal for each time period and sex specific. Survival is estimated by gender and site in this model (Figure 3 and Table 2).

Figure 3. **Survival estimates for male and female boreal toads at three breeding sites in the Cottonwood Creek drainage (1998 – 2007)**.

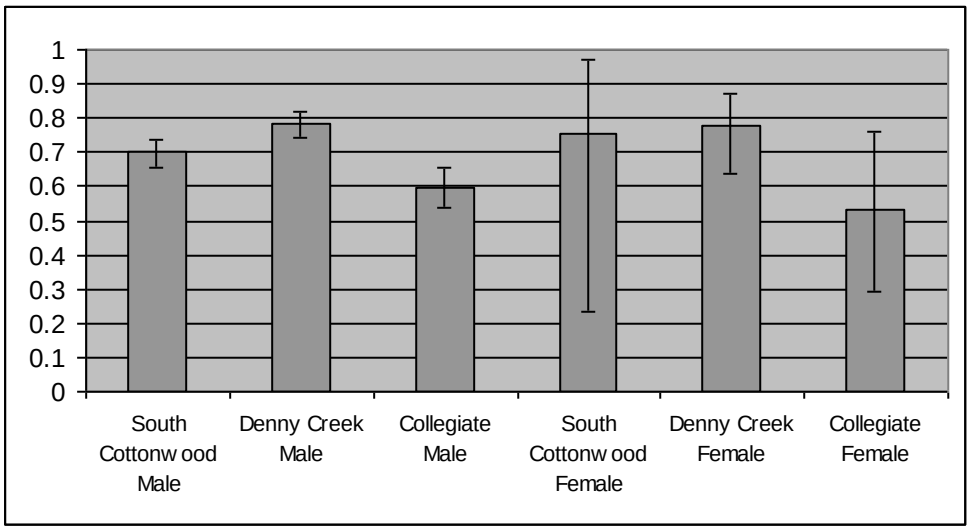
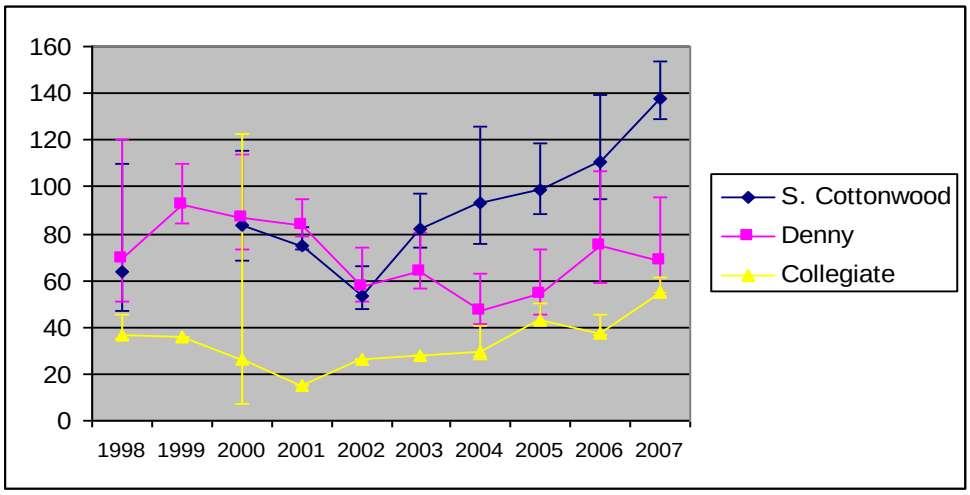


Table 2. **Survival estimates for male and female boreal toads at three breeding sites in the Cottonwood Creek drainage**.

Overall survival (1998-2007)	Estimate	SE	LCI	UCI
South Cottonwood Male	0.699094	0.020996	0.656415	0.738583
Denny Creek Male	0.782738	0.019232	0.742698	0.818073
Collegiate Male	0.598018	0.031435	0.53517	0.657803
South Cottonwood Female	0.754252	0.217339	0.235633	0.968312
Denny Creek Female	0.77533	0.059352	0.638955	0.870623
Collegiate Female	0.532286	0.129944	0.290347	0.75994

Population size estimates are often difficult parameters to estimate and therefore we present the following results from the model with the caveat that there is most likely some bias in the estimate (Thompson 2004). Also, due to a lack of data for males at South Cottonwood in 1999 population estimates are left blank. Data for most years and locations for females did not produce reliable results and therefore not presented; however it is assumed that breeding site high counts presented in the previous section most accurately represent the number of females. Despite these difficulties the general trend presented in these population models has utility for managing the species and their habitat (Figure 4).

Figure 4. **Male boreal toad population estimates from three Cottonwood Creek breeding sites.**



The general patterns presented in the model results show three major points. First and foremost is a high probability that the survival rate at the Collegiate site is lower than those at Denny Creek and South Cottonwood. Possible reasons for the lower survival rate at Collegiate could be the close proximity of this site to a large campground and high traffic road. With educational signs at the dirt pull off and campsite management there may be ways to improve survival rates at the Collegiate site.

Another reason might be lack of extensive wetlands at Collegiate unlike the South Cottonwood Creek and Denny Creek sites. These wetland areas may be an important component in summer foraging. Toads at Collegiate may have to travel farther after the breeding season to access associated resources. Adult males are more commonly found after the breeding season at

the South Cottonwood Creek and Denny Creek sites, where as, at the Collegiate site adults are rarely found after the spring breeding.

The third most notable point is a possible drainage wide decline in toad population during 2001 and 2002 followed by possible population increases since that low period at South Cottonwood and Collegiate and a more stable population at Denny Creek. Along with a lower survival rate the Collegiate site appears to have a smaller population size than the other two sites we have consistent data for. Environmental conditions such as precipitation and winter severity are possible factors.

References:

Burnham, K. P., and D. R. Anderson. 1998. Model selection and multimodel inference: a practical information-theoretic approach. Second edition. Springer-Verlag, New York, New York, USA.

Thompson, W. L. 2004. Sampling rare or elusive species: Concepts, designs, and techniques for estimating population parameters. Island Press, Washington.

White, G. C. and K. P. Burnham. 1999. Program MARK: Survival estimation from populations of marked animals. Bird Study 46 Supplement, 120-138.

***

Rocky Mountain National Park – Research update 2007, Erin Muths, USGS

Northfork capture-recapture project

We have made multiple breeding season, night time visits to the two known breeding sites in this drainage since the late 1980s and witnessed a severe decline in the mid to late 1990s. Since the decline, there have been a number of years when no toads were seen, some years when a few animals (~ 3 – 5) were observed and a couple of years where 1-2 egg masses were laid and metamorphs were produced (2003). In 2007, we observed one female at Kettle Tarn and two males were captured at Lost Lake. We have swabbed captured animals to test for Bd and have found that the amphibian chytrid is still present at these sites. While modeling analysis is difficult with such low numbers, these data are important because they document a. the potential recovery of these populations, b. immigration of animals into this drainage, or c. the return of temporary emigrants to their natal pond.

Assistance with ROMO reintroduction of boreal toads to west side of park

We have assisted the park in choosing and assessing potential reintroduction sites, testing surrogate amphibians and the environment (water) for the amphibian chytrid fungus, and

planning the release and monitoring of tadpoles and adults. Due to issues at the hatchery, only a few tadpoles were released but a release of tadpoles and adults is planned for 2008.

***

Appendix VII – References and Literature Cited

Campbell, J. B. 1972. Reproduction and transformation of boreal toads in the Colorado Front Range. J. Colorado-Wyoming Academy of Sciences 7:114.

Campbell, J. B. 1970. Life history of *Bufo boreas boreas* in the Colorado Front Range. Ph.D. thesis, Univ. of Colorado, Boulder. 110 pp.

Carey, C. 1993. Hypothesis concerning the causes of the disappearance of boreal toads from the mountains of Colorado. Conservation Biology 7:355-362.

Colorado Division of Wildlife. 1994. Boreal Toad Recovery Plan. Denver, CO. pp. + appendix.

Colorado Division of Wildlife. 1997. Boreal Toad Recovery Plan. Denver, CO. 45 pp. + appendix.

Corn, P. S., W. Stolzenburg, and R. B. Bury. 1989. Acid precipitation studies in Colorado and Wyoming: interim report of surveys of montane amphibians and water chemistry. U.S. Fish and Wildl. Serv. Biol. Rept. 80(40.26). 56 pp.

Ellis, M. M. and J. Henderson. 1915. Amphibia and Reptilia of Colorado. Part II. The University of Colorado Studies. Vol. XI(4):253-264.

Hammerson, G. A. 1999. Amphibians and reptiles in Colorado. Second edition. University Press of Colorado and Colorado Division of Wildlife. 484 pp.

Hammerson, G. A. 1992. Field surveys of amphibians in the mountains of Colorado, 1991. Report funded by the U.S. Fish and Wildlife Service, U.S. Forest Service, Colorado Division of Wildlife, and the Colorado Office of the Nature Conservancy. Colorado Division of Wildlife, Denver.

Hammerson, G. A. 1989. A field survey of amphibians in the Rocky Mountains of Colorado, August 1989. Unpubl. Rept., November 30, 1989, Colorado Division of Wildlife, Denver. 53 pp.

Hammerson, G. A. and D. Langlois (eds). 1981. Colorado reptile and amphibian distribution latilong study, 2nd edition. Colorado Division of Wildlife, Denver. 24pp.

Horstman, G. P. 2007. The Crooked/Pole Project, Final Report – Phase VIII. Unpubl. Rept., November 2007. 14pp.

Jackson, T. (ed.), 2005. Report on the status and conservation of the boreal toad (*Bufo boreas boreas*) in the Southern Rocky Mountains 2004. Boreal Toad Recovery Team. 67 pp.

Jackson, T. (ed.), 2006. Report on the status and conservation of the boreal toad (*Bufo boreas boreas*) in the Southern Rocky Mountains 2005. Boreal Toad Recovery Team. 68 pp.

Jones, M. (ed.), 2000. Boreal Toad Research Progress Report 1999. Colorado Division of Wildlife, Ft. Collins, CO. 157 pp.

Jones, M. (ed.), 1999. Boreal Toad Research Progress Report 1998. Colorado Division of Wildlife, Ft. Collins, CO. 118 pp.

Jones, M., et.al., 1998. Boreal Toad Research Progress Report 1995-1997. Colorado Division of Wildlife, Ft. Collins, CO. 171 pp.

Jungwirth, T. (ed.), 2004. Report on the status and conservation of the boreal toad (*Bufo boreas boreas*) in the Southern Rocky Mountains 2003. Boreal Toad Recovery Team. 60 pp.

Lambert, B. 2001. Colorado Natural Heritage Program boreal toad survey and monitoring project 2001. Prepared by the Colorado Natural Heritage Program for the Colorado Division of Wildlife and the U.S. Forest Service. 73 pp.

Lambert, B. 2002. Colorado Natural Heritage Program boreal toad survey and monitoring project 2002. Prepared by the Colorado Natural Heritage Program for the Colorado Division of Wildlife and the U.S. Forest Service. 66 pp.

Lambert, B. 2003. Colorado Natural Heritage Program Boreal Toad Survey and Monitoring Project 2003. Prepared by the Colorado Natural Heritage Program for the Colorado Division of Wildlife and the U.S. Forest Service. 147 pp.

Lambert, B. 2004. Colorado Natural Heritage Program Boreal Toad Survey and Monitoring Project 2004. Prepared by the Colorado Natural Heritage Program for the Colorado Division of Wildlife and the U.S. Forest Service. 72 pp.

Lambert, B and C. Gaughan. 2006. Colorado Natural Heritage Program Boreal Toad Survey and Monitoring Project 2005. Prepared by the Colorado Natural Heritage Program for the Colorado Division of Wildlife and the U.S. Forest Service. 75 pp.

Lambert, B., C.R. Malleck, and B. Christman. 1999. Boreal Toad Surveys in Colorado: Summer 1999. Prepared by the Colorado Natural Heritage Program for the Colorado Division of Wildlife and the U.S. Forest Service. 22 pp.

Lambert, B., C. R. Malleck, and K. Huhn. 2000. Boreal Toad Survey and Monitoring Project: 2000. Prepared by the Colorado Natural Heritage Program for the Colorado Division of Wildlife and the U.S. Forest Service. 59 pp. + appendices.

Livo, L. and C. Loeffler (ed.), 2003. Report on the status and conservation of the boreal toad (*Bufo boreas boreas*) in the Southern Rocky Mountains 2001-2002. Boreal Toad Recovery Team. 66 pp.

Loeffler, C. (ed.), 2001. Report on the status and conservation of the boreal toad (*Bufo boreas boreas*) in the Southern Rocky Mountains 2000. Boreal Toad Recovery Team. 58 pp.

Loeffler, C. (ed.), 2000. Report on the status and conservation of the boreal toad (*Bufo boreas boreas*) in the Southern Rocky Mountains 1999. Boreal Toad Recovery Team. 48 pp.

Loeffler, C. (ed.), 1999. Report on the status and conservation of the boreal toad (*Bufo boreas boreas*) in the Southern Rocky Mountains 1998. Boreal Toad Recovery Team. 51 pp.

Loeffler, C. (ed.), 1998. Conservation plan and agreement for the management and recovery of the Southern Rocky Mountain population of the boreal toad (*Bufo boreas boreas*), Boreal Toad Recovery Team. 66 pp. + appendices.

Loeffler, C. (ed.), 2001. Conservation plan and agreement for the management and recovery of the Southern Rocky Mountain population of the boreal toad (*Bufo boreas boreas*), Boreal Toad Recovery Team. 76 pp. + appendices.

Muths, E., T. L. Johnson, and P. S. Corn. 2001. Experimental repatriation of boreal toad (*Bufo boreas*) eggs, metamorphs, and adults in Rocky Mountain National Park. Southwestern Naturalist 46:106-113.

New Mexico Department of Game and Fish. 1988. Handbook of species endangered in New Mexico. D-108:1-2. Santa Fe, NM 87503.

New Mexico Department of Game and Fish. 2006. Boreal Toad (Bufo boreas boreas) Recovery Plan.http://www.wildlife.state.nm.us/conservation/documents/NMBorealToadRecoveryPlan_Final.pdf

Stuart, J.N. and C.W. Painter. 1994. A review of the distribution and status of the boreal toad *Bufo boreas boreas,* in New Mexico. Bull. Chicago Herp. Soc. 29:113-116.

White, G. C., D. R. Anderson, K. P. Burnham, and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory, Los Alamos, NM.