

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

2000



Prepared By The Boreal Toad Recovery Team
Chuck Loeffler, Coordinator/Editor



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Chuck Loeffler, Coordinator/Editor
Colorado Division of Wildlife
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Denver, CO 80216**

February, 2001



TABLE OF CONTENTS

	<i>Page</i>
Introduction and Summary	1
Acknowledgments	3
Management Status and Administration	4
Legal Status of the Boreal Toad	4
The Recovery Team	4
Recovery & Conservation Plans	5
Recovery Objectives & Status	6
Monitoring of Breeding Populations	8
Breeding Populations by Geographic Area	9
Park Range	14
Elkhead Mountains	15
Medicine Bow Range	16
Front Range	17
Gore Range	22
Mosquito & Ten-mile Range	23
Sawatch Range	24
White River Plateau	28
Grand Mesa	28
Elk and West Elk Mountains	29
San Juan Mountains	31
Surveys	33
Public Information & Involvement	33
Captive Propagation and Translocations	34
Research Work	
Studies at the Henderson Mine Area	39
Chytrid Fungus Survey	42
PCR Assay for Chytrid Fungus	43
Research in Rocky Mtn. National Park	45
Chytrid Fungus Research at CU/Boulder	47
Modeling Boreal Toad Breeding Habitat	49
Mark-Recapture Study in Chaffee County	52
UV-B Impacts on Tadpole Food	54
Habitat Management	55
General References and Literature Cited	57

INTRODUCTION AND SUMMARY

This is the fourth in a series of annual reports intended to provide a summary of boreal toad conservation work in the southern Rocky Mountains, and to serve as a status report on progress made to date towards recovery of this species.

Once common in the southern Rocky Mountains, the boreal toad has experienced dramatic declines in population over the past 15 to 20 years. Reasons for declines have not been definitely identified, but may be various, including effects of acidification of water, effects of heavy metals and other toxins in waters, new or more virulent strains of pathogens, habitat disturbance, or a combination of factors, leading to stress-induced immunosuppression, and hence increased susceptibility to naturally occurring pathogens. Recent developments point strongly towards pathogens - specifically a species of chytrid fungus (*Batrachochytrium dendrobatitis*) - as being a major causative agent in declines of certain species of amphibians, including the southern Rocky Mountain boreal toads.

Research in the mid-1990s regarding the genetics of the boreal toad in the southern Rocky Mountains has revealed that this population is a genetically unique lineage, and may warrant classification as a separate subspecies, or even a separate species, within the genus *Bufo*. Hammerson (1999) recognizes this information and suggests that *Bufo boreas* in the southern Rocky Mountains be considered a separate species. Such recognition may lead to giving this species a higher priority in consideration for listing under the Endangered Species Act. For the purpose of this report, the names *Bufo boreas boreas*, and 'boreal toad' will continue to be used.

The boreal toad is presently listed as an endangered species by both Colorado and New Mexico, and is a protected species in Wyoming. The U.S. Fish and Wildlife Service has classified the southern Rocky Mountain population of the boreal toad as a candidate species which is "warranted but precluded" for federal listing - meaning there is adequate justification and information to warrant federal listing as threatened or endangered, but listing has been postponed, as there are presently other species in greater need of listing, and the US Fish & Wildlife Service has limited resources to prepare and process listing packages. Pursuant to the listing of the boreal toad as endangered in Colorado, a recovery plan for the boreal toad was developed by the Colorado Division of Wildlife in 1994 (revised Jan. 1997), and an interagency recovery team was formed that same year. In 1998, the existing Recovery Plan was updated and combined with an existing draft Conservation Strategy to create a comprehensive Boreal Toad Conservation Plan for the southern Rocky Mountains. As part of the conservation planning process, Conservation Agreements have been signed by eight involved state and federal agencies, and by the Colorado Natural Heritage Program, outlining and confirming their respective roles in implementing the Conservation Plan. No new agreements were appended to the plan in 2000. A revised and updated version of the Boreal Toad Conservation Plan is expected to be completed in early to mid 2001.

For the past three years, the recovery team has worked on plans and actions to implement recovery and conservation efforts for the boreal toad. Work to date has involved several state and federal resource management agencies, personnel from universities, the Colorado Natural Heritage Program,

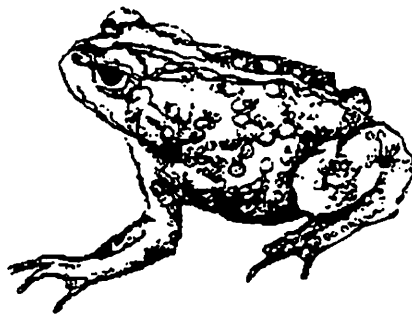
and various other interested parties - including local land use planners and private land owners. Management activities to date have included (1) the conducting of surveys of historic and potential suitable habitats for new toad populations, (2) the annual monitoring of known breeding populations, (3) research work to identify and evaluate both biotic and abiotic limiting factors to toad survival, (4) research to better define good boreal toad habitat and boreal toad biology/ecology, (5) development and testing of techniques and protocols for captive breeding and rearing of boreal toads, (6) experimental reintroductions of toads to vacant historic habitat, (7) protection of boreal toads and their habitats via coordination with land management agencies - in particular with the US Forest Service, (8) work with local land use planners and developers aimed at avoiding or minimizing potential impacts of private land development on boreal toads and their habitat, and (9) efforts to increase public awareness of this species and its plight via informational/educational activities & public involvement in searches for new populations of boreal toads.

As of February, 2001, the boreal toad (SRMP) is known to occur in eleven counties (Routt, Larimer, Grand, Eagle, Summit, Clear Creek, Pitkin, Gunnison, Chaffee, Hinsdale, and Mineral) in Colorado, probably one county (Albany) in southern Wyoming. Indications are that boreal toads may also still occur in Jackson, Garfield, Boulder, Lake, Park, Saguache, and Conejos counties in Colorado, and in Rio Arriba County, New Mexico. This is based on surveys, monitoring of breeding sites, and on confirmed or reliable observations of individual boreal toads during recent years. Breeding populations have been documented during the past five years in 12 counties in Colorado, and at one location in Wyoming. There are presently 56 known breeding localities - some having more than one breeding site - located in nine of the eleven geographic areas, or "mountain ranges of historic occurrence". Two of the historic areas of occurrence (White River Plateau and Grand Mesa, Colorado) have no recent confirmed records of occurrence of boreal toads. Based on the definition of "Breeding Population" (Loeffler 1998), the 56 breeding localities comprise 30 separate populations, of which only one (1) presently meets the criteria to be considered "viable". (See summary table on page 13). The decline in the number of "viable" populations from 1999 to 2000 is due to recent revision of the viability criteria, and the discovery of die-offs caused by the chytrid fungus in at least two of the populations which were formerly considered to be viable.

The criteria for recovery of the boreal toad in the southern Rocky Mountains were reviewed and edited in 1998 to make them more objective and measurable, and again revised at the end of 2000 to reflect improved knowledge of boreal toad population dynamics. Due to the changes in the criteria, direct comparisons of the level of achievement of recovery goals from 1997 to subsequent years may not accurately reflect actual progress towards recovery (See "Recovery Objectives and Status", page 6). Significant progress has been made with the boreal toad recovery and conservation effort in the past five years, and it is anticipated that much can be accomplished towards recovering this species in the next five years, provided adequate funding and personnel time is available. The recovery team recognizes that both time and funding are in short supply, and will pursue innovative approaches to accomplish needed work, including partnerships, and other cooperative efforts. However, *without* a significant, continued commitment of funds and time from all the involved agencies, recovery will be difficult, if not impossible, to achieve in the foreseeable future.

ACKNOWLEDGMENTS

The Boreal Toad Recovery Team appreciates the substantial contributions made towards the implementation of the Boreal Toad Recovery Plan by various agencies - particularly the Colorado Division of Wildlife, the USGS/Biological Resources Division, and the US Forest Service. Also appreciated is the funding which has been provided by *Great Outdoors Colorado* (GOCO) in support of the boreal toad conservation and recovery effort during the past several years, and technical assistance and advice provided by scientists from the **IRCEB** group (Integrated Research Challenges in Environmental Biology - National Science Foundation) in regard to evaluation and management of the chytrid fungus problem.



MANAGEMENT STATUS AND ADMINISTRATION

Legal Status of the Boreal Toad

The boreal toad has been state listed as an endangered species in New Mexico since 1976 and in Colorado since November, 1993. It is a protected species in Wyoming, and is federally classified as a candidate species which is "warranted but precluded" - meaning there is adequate data to warrant federal listing as threatened or endangered, but listing has been postponed, as there are presently other species in greater need of listing, and the US Fish & Wildlife Service has limited resources to prepare and process listing packages.

The Recovery Team

The Recovery Team for the Southern Rocky Mountain Population of the Boreal Toad was formed in late 1994, although a loosely organized group of people, from various agencies, had been working on boreal toad issues for two to three years prior to that time. Since 1994, it has evolved in to a multi-agency team, consisting of a core recovery team and a technical advisory group. At this time, the team consists of the following personnel:

Boreal Toad Recovery Team

This group has primary responsibility for the development and implementation of a recovery/conservation plan, and represents all agencies who have legal responsibility and authority to implement management actions. Members of this group have the "voting" authority to make decisions and recommendations for, and to, their agencies regarding management actions. It is composed of one representative from each such agency, or in the case of the US Forest Service, one representative from each involved region:

Colorado Division of Wildlife
New Mexico Game & Fish Dept.
Wyoming Game & Fish Dept.
US Fish & Wildlife Service
USGS/Bio. Resources Division
US Forest Service (Region 2)
US Forest Service (Region 3)
NPS/Rocky Mtn. National Park
Bureau of Land Management
Environmental Protection Agency

Chuck Loeffler, Denver, CO
Charles Painter, Santa Fe, NM
Don Miller, Laramie, WY
Terry Ireland, Grand Jct., CO
Erin Muths, Ft. Collins, CO
Doreen Sumerlin, Granby, CO
Donna Storch, Taos, NM
Therese Johnson, Estes Park, CO
Jay Thompson, Lakewood, CO
Ed Stearns, Denver, CO

Boreal Toad Technical Advisory Group

This group is composed of persons who have specialized or technical expertise and knowledge regarding the species, habitat, and/or other specific areas of knowledge which are vital to the implementation of recovery and conservation efforts. In the process of plan development, formulation of guidelines and protocols for implementation, and weighing of alternatives in decision

making, this group is relied on to help guide and advise the recovery team. As a general rule, technical/biological recommendations which represent a majority consensus of this group will be accepted and followed by the Recovery Team, unless there are overriding socio-economic and/or political factors which dictate other courses of action. The present recognized composition of this group is as follows, and is open to other qualified and interested participants:

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
Craig Fetkavich	Colorado Division of Wildlife, Alamosa, CO
Anna Goebel	University of Colorado, Boulder, CO
Mary Jennings	US Fish & Wildlife Service, Cheyenne, WY
Mark Jones	Colorado Division of Wildlife, Ft. Collins, CO
Don Kennedy	Denver Water Board, Denver, CO
Brad Lambert	Colorado Natural Heritage Program, Ft. Collins, CO
Lauren Livo	University of Colorado, Boulder, CO
Michelle VanVleet	University of Wyoming, Laramie, WY

The Recovery Team meets at least twice each year - once in the Spring and once in the Fall - to review and plan needed field work and other management actions. A mailing list of numerous interested parties is used to disseminate information on Recovery Team actions and boreal toad conservation efforts. Minutes of Recovery Team meetings are available upon request from the team coordinator (see below).

The Colorado Division of Wildlife (CDOW) has assumed the responsibility for leadership and coordination of the Boreal Toad Recovery Team, and at this time, CDOW Wildlife Manager, Chuck Loeffler, is the coordinator for the group. Contact with the Recovery Team may be made via Mr. Loeffler as follows:

By Mail: Chuck Loeffler, Species Conservation Section, Colorado Division of Wildlife, 6060 Broadway, Denver, CO 80216.

By Phone: 719-481-1902 (Monument, CO) OR 303-291-7451 (Denver, CO)

By E-Mail: chuck.loeffler@state.co.us

Recovery and Conservation Plans

Boreal toad recovery work from 1994 through 1998 was based primarily on the Boreal Toad Recovery Plan, which was prepared by, and for, the State of Colorado, pursuant to the listing of the boreal toad as a state endangered species in 1994 (Revised in 1997). The Recovery Team, with primary direction from the US Fish & Wildlife Service and the US Forest Service, also developed a draft Conservation Strategy, which focused on actions needed to protect and conserve boreal toad habitats on public lands - primarily US Forest Service lands.

In 1998, the Recovery Team agreed that it would be in the best interest of the recovery effort to revise and combine the State Recovery Plan and the draft Conservation Strategy in to a single, comprehensive document. Therefore, in October, 1998, the existing documents were combined in the new, *Boreal Toad Conservation Plan and Agreement*. This document is being revised and updated in early 2001, and provides guidance to all participating agencies in regard to management and conservation of boreal toads and their habitat, and provides the opportunity for each agency to sign a Conservation Agreement to define and confirm their commitment to the boreal toad conservation effort. As of February, 2001, eight state and federal agencies and the Colorado Natural Heritage Program, based at Colorado State University, have signed such agreements, which are appended to the Conservation Plan. Copies of this plan are available upon request from the Recovery Team coordinator (see previous page for contact information). The plan may also be accessed via the Internet at the following address: <http://www.dnr.state.co.us/wildlife/aquatic/boreal/index.html>

Recovery Objectives and Status

The objectives of the management and conservation actions outlined in the Boreal Toad Conservation Plan and Agreement are to (1) prevent the extirpation of boreal toads from the area of their historic occurrence in the southern Rocky Mountains, which includes eleven mountain ranges, or geographic areas, covering southern Wyoming, much of Colorado, and a portion of northern New Mexico (2) to avoid the need for federal listing of the boreal toad under the ESA, and (3) to recover the species to a population and security level that will allow it to be de-listed from its present endangered status in Colorado and New Mexico.

The present, revised recovery objectives and criteria are based on objectives for boreal toad recovery formulated and previously approved by the interagency Boreal Toad Recovery Team in Colorado's *Boreal Toad Recovery Plan*. The CDOW has already adopted these criteria, and is pursuing conservation actions described in this plan for recovery of the boreal toad in Colorado. Should federal listing of this species occur, these criteria should be incorporated into any subsequent federal recovery plan for this species.

The following are criteria for downlisting and delisting of the boreal toad in the State of Colorado:

To downlist from "endangered" to "threatened", there must be at least two (2) viable breeding populations of boreal toads in each of at least six (6) of the eleven (11) areas, or mountain ranges, of its historic distribution, AND the number of viable breeding populations throughout the historic range must total at least fifteen (15).

To delist the boreal toad in Colorado, there must be at least two (2) viable breeding populations of boreal toads in each of at least nine (9) of the eleven (11) areas, or mountain ranges, of its historic distribution, AND the number of viable breeding populations throughout the historic range must total at least twenty-five (25).

In order for a population of boreal toads to be considered "viable", it must meet the following criteria:

1. There must be documented breeding activity *and* recruitment to the population in at least four (4) out of the past ten (10) years. However, if breeding activity has not been documented in the past four (4) years, there must be reliable observations of toads, including at least one sub-adult age class, in the area during at least two (2) of those four years.

OR

2. There has been an average observed total of at least twenty (20) breeding adults in the population, producing an average of at least four (4) viable egg masses per year, and the number of breeding adults observed in the population has remained stable or increased over a period of at least ten (10) years.

AND

3. The population faces no known, significant and imminent threat to its habitat, health, and environmental conditions.

For the purpose of interpreting the above criteria, the following definitions will apply:

Breeding population:

Toads associated with one or more breeding localities which are located within a common second or third order drainage, and separated by no more than five (5) miles (approx. 8 km).

Breeding Locality:

A geographic area containing one or more breeding sites which are separated by a distance of no more than ½ mile (approx. 0.8 km).

Breeding Site:

A specific location in any body of water where toads congregate to breed and deposit eggs.

Recruitment:

The presence of one-year-old toads in any given year will be considered to be successful recruitment from the previous year's breeding activity.

* * *

MONITORING & STATUS OF BREEDING POPULATIONS

Based on various historic reports and observations since the early part of the 20th century, boreal toads were considered to be fairly common in much of the southern Rocky Mountain area, from southern Wyoming to Northern New Mexico. One of the earliest published reports of boreal toads in Colorado is from the Buena Vista area, in Chaffee County, where numerous toads were seen under street lights and along irrigation ditches. (Ellis and Henderson, 1915). Records of boreal toad observations over the years are somewhat sparse and scattered. Most are associated with a few specific studies, such as James Campbell's work in the late 1960's and early 1970's (Campbell, 1970; Campbell, 1972).

By the early 1980s, the boreal toad was still considered fairly common throughout its known range in Colorado (Hammerson and Langlois 1981), but evidence of dramatic declines had already been noted. Carey (1993) observed the disappearance of 11 populations of boreal toads between 1974 and 1982 in the West Elk Mountains. Subsequent surveys have shown no recolonization of these former breeding sites. Surveys of 38 historic breeding locations in eight national forests in Colorado covering Boulder, Chaffee, Delta, Gunnison, Jackson, Larimer, Mesa, and Summit counties from 1982 to 1992 revealed only one occupied site in Chaffee County (Lauren Livo, pers. comm.). In 1989, Hammerson (1989) surveyed 143 sites in the Arapaho Lakes, Big Creek Lakes, and Lone Pine Creek areas of Jackson County; 31 sites in the White River plateau within Garfield and Rio Blanco counties; five sites in the Elkhead Mountains in Moffat and Routt counties; 49 sites on the Grand Mesa including Delta and Mesa counties; and 22 sites in Chaffee, Clear Creek, Gilpin, Gunnison, and Park counties. Boreal toads were found in only two of these 250 sites, in Chaffee and Garfield counties. In 1991 Hammerson (1992) surveyed 377 sites in the following Colorado locations or river basins: Upper Alamosa, Upper Arkansas, Conejos, Upper Eagle, Grand County, Grand Mesa, Upper Gunnison, Upper Rio Grande, San Juan, San Luis Valley, Upper San Miguel, and Upper South Platte, and observed only a single population of boreal toads which was subsequently confirmed in 1992 by Livo. Corn et al. (1989) found that toads were absent from 83 percent of historic locations in Colorado and 94 percent of the historic sites in Wyoming. This represented a decline from 59 to 10 known localities from 105 sites surveyed in 1986-1988 in Boulder and Larimer Counties, Rocky Mountain National Park, and in the Park Range in Colorado, and in Albany and Carbon Counties in Wyoming. Boreal toads were thought to be extirpated from the southern periphery of their range in the San Juan Mountains in New Mexico (Stuart and Painter 1994; New Mexico Department of Game and Fish 1988), but a report of a sighting of one adult boreal toad and one boreal toad tadpole in September 1996 gives hope that a breeding population may still exist in New Mexico (C. Painter, unpubl. 1996).

Since the listing of the boreal toad as a state endangered species in Colorado, in 1993, efforts to survey known historic and potential toad habitats, and to monitor known existing breeding populations, has been intensified. The following is a summary of what is known about boreal toad occurrence, distribution and status as of late 2000.

Breeding Populations by Geographic Area

The objectives for recovery of the boreal toad in the southern Rocky Mountains, as outlined in the Boreal Toad Conservation Plan (1998, revised 2001), are based on the documentation and/or establishment of a certain number of secure populations within each of the "mountain ranges of its historic distribution". These are presently recognized to include the Park Range, Elkhead Mountains, Medicine Bow Range, Front Range, Gore Range, Mosquito & Ten-Mile Range, Sawatch Range, White River Plateau, Grand Mesa, Elk & West Elk Mountains, and the San Juan Mountains. The "mountain ranges of historic occurrence" are presented in this report in roughly geographic order from north to south. See page 11 for a map of general locations.

The borders or limits of these mountain ranges are often difficult to define precisely. For the purpose of boreal toad recovery, and for clarification, the descriptions in the following pages will serve to define these areas, and provide a brief summary of boreal toad status in each. In cases where toad populations may be found which do not fit neatly in to one of these areas, the Boreal Toad Recovery Team will make a determination as to which "mountain range of historic distribution" the population is most closely linked.

Based on the definition of "Breeding Population" (Loeffler 1998), there are presently 56 breeding localities comprising 30 separate populations, of which only one (1) presently meets the criteria to be considered "viable" (See summary table on page 13). This population is the Cottonwood Creek population in Chaffee County. The decline in the number of "viable" populations from 1999 to 2000 is due to recent revision of the viability criteria, and the discovery of die-offs caused by the chytrid fungus in at least two of the populations which were formerly considered to be viable. In most cases, breeding populations are defined such that there is normally no migration of toads between populations. However, due to the continuity of habitat, and the fact that breeding populations can occur in separate drainages which are in close proximity at their headwaters, some populations may be closer to each other than the minimum 5-mile separation, and some toads may occasionally migrate from one to the other by crossing high mountain passes. A case in point would be the Conundrum Creek population in Pitkin County and the White Rock Mtn. (Triangle Pass) population in Gunnison County. In a straight line they are within 5 miles of each other, but they are located in different primary drainages, separated by a 12,500'+ mountain pass. Whereas these localities are in different major drainages, they are considered parts of different populations.

Monitoring of the 56 known breeding localities in 2000 showed that 33 of the sites had breeding activity, 19 sites apparently were inactive, and 4 sites are of unknown status due to lack of adequate monitoring. Breeding activity was documented in at least 18 of the 30 known populations in 2000. Overall, boreal toad populations showed fair to good reproduction. However, the populations at Urad/Henderson (Clear Creek County) and the North Fork of the Big Thompson (Rocky Mtn. National Park) continue to show the effects of the chytrid fungus caused die-offs.

Year 2000 survey efforts located one previously undocumented breeding *population*, and four new breeding *localities* within known populations. The newly documented population is in the Goose Creek drainage, in Mineral County, and the four new breeding localities are in Routt, Pitkin, Gunnison, and Hinsdale Counties.

Interpretation of Breeding Locality Tables

Locality Numbers: These are assigned chronologically to localities on a county by county basis. The two-letter designation indicates the county, and the number is the chronological number of the locality for that county, based on when the locality was originally found. All breeding localities within a specific county may not fall within the same geographic area or mountain range.

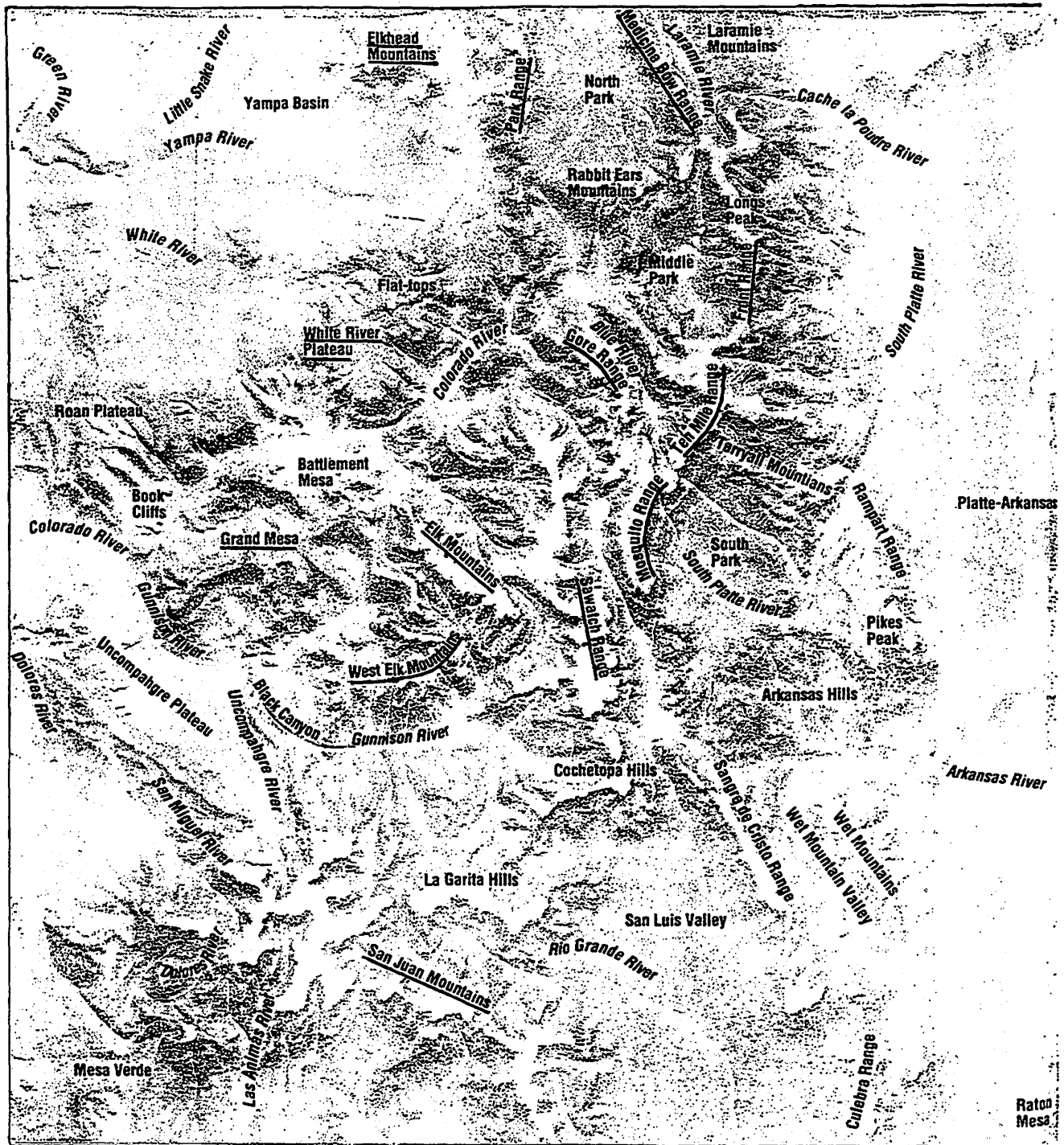
Locality and Population Names: After the locality number will be the name of the locality, followed by the name of the population of which it is considered a part. The population name is in parentheses, and in some cases may be the same as the locality name.

M/F/Egg Masses: This column shows the *minimum* number of breeding-age males (M), females (F), and number of viable egg masses at the locality in each year. These numbers may represent actual counts, or they may be presumed, based on other evidence. For instance, if tadpoles are observed at a locality, it is assumed that there had to be at least one adult male and one adult female present. If three separate egg masses are observed, but no adults are seen, the table will still show 3/3/3, as it is assumed that one pair of breeding toads was present to produce each of the egg masses. A question mark "?" in this column indicates that data are lacking or ambiguous. It should be noted that more intensive studies, using PIT tagging, in Rocky Mtn. National Park, the Urad/Henderson Mine area and the Cottonwood Creek drainage in Chaffee County demonstrate that standard monitoring reveals only a small proportion of adult toads actually present at a site or in a population.

Recruitment: A "Yes" entry means that one-year-old toadlets were observed at the site in the Spring of the *following* year, or two-year-old toads were seen the second year. For example; one year old toadlets in June, 1997, would indicate successful recruitment from the 1996 breeding season, and would be noted by a "Yes" entry in 1996. Therefore, all sites will, at this time, show either a "Unk" (unknown) entry or a "No" entry for 2000, as success can not be determined until the Spring or Summer of 2001, or it is known that there were no metamorph toadlets produced at the site in 2000.

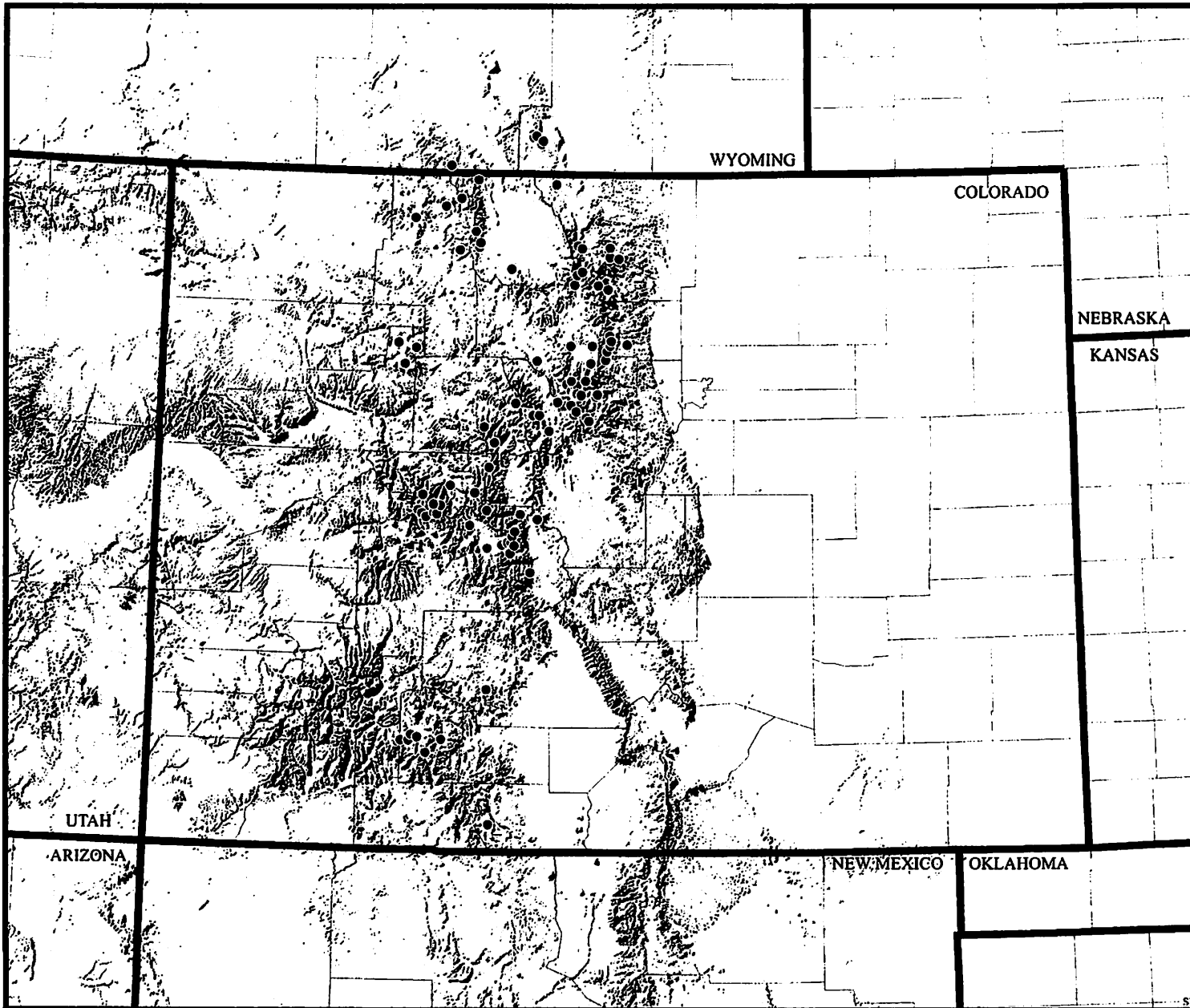
Age Classes: The first number in the entry indicates the minimum number of age classes observed/reported at a specific site. Numbers within parentheses indicate which age classes were observed: M = Metamorphs (young of the year), 1 = one year olds (new "recruits"), S = Subadults (generally two to three year old toads), 2 or 3 = Subadults which were specifically identified as either two or three year old toads, A = Adult toads (generally 4 years old and older).

* * *







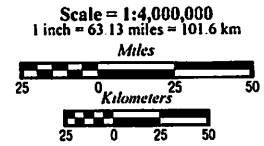
MOUNTAIN RANGES IN WESTERN COLORADO
(Mtn. ranges of historic occurrence of boreal toads shown underlined)

Figure 2
RECENT BOREAL TOAD OBSERVATIONS
 1991- 2000



Legend

-  Potential boreal toad range: 8,000' - 12,000'
-  State boundary
-  County boundary
-  Site of boreal toad observation



FIVE YEAR SUMMARY OF BOREAL TOAD BREEDING POPULATIONS IN THE SOUTHERN ROCKY MOUNTAINS

Dec. 2000

Geographic Area (Mtn. Range of Historic Occurrence)	Number of Populations	Populations w/Breeding/Recruitment					Populations w/20+ Breeders & 4+ Eggm.					"Viable" Populations
		1996	1997	1998	1999	2000	1996	1997	1998	1999	2000	
Park Range	2	2/1	2/2	?/0	1/1	1/?	0	0	0	0	0	0
Elkhead Mountains	1	1/?	0/0	1/1	0/?	1/?	0	0	0	0	0	0
Medicine Bow Range	1	1/1	1/1	0/0	0/0	0/0	0	0	0	0	0	0
Front Range	11	6/4	5/1+	7/1+	6/4	6/?	3	3	3	2	3	0
Gore Range	3	1/1	1/0	1/1	3/2	3/?	1	1	1	0	1	0
Mosquito & Ten-mile Range	2	1/1	2/1	1/?	2/0	0/0	0	0	0	0	0	0
Sawatch Range	6	4/1	5/2	4/2+	5/2	3/?	1	1	1	1	1	1
White River Plateau	0	0/0	0/0	0/0	0/0	0/0	0	0	0	0	0	0
Grand Mesa	0	0/0	0/0	0/0	0/0	0/0	0	0	0	0	0	0
Elk & West Elk Mountains	2	2/1	2/1	1/?	2/1	2/?	0	0	1	1	1	0
San Juan Mountains	2	1/1	1/1	1/?	1/0	2/?	0	0	0	0	0	0
TOTALS	30	20/11	19/9+	16/5+	18/10	18/?	5	5	6	4	6	1

Number of Populations: Number of toad populations, based on the definition of "population" in the Boreal Toad Conservation Plan.

Populations w/Breeding/Recruitment: Populations where any type of breeding activity was documented and/or recruitment of toadlets from that year was observed in following year # Before / = Breeding, # After / = Recruitment

NOTE: Recruitment from 2000 production can not be determined until 2001 suveys are done.

Populations w/20+ Breeders & 4+ Eggm.: Indicates number of populations where 20 or more breeding adults were observed and 4 or more viable egg masses were produced.

"Viable" Populations: Represents the number of populations in the historic area of occurrence which meet the criteria for "viable populations" as presented in the Boreal Toad Conservation Plan, and can be counted towards delisting goals.

Park Range

This area extends from south-central Carbon County, WY, through western Jackson County and eastern Routt County, CO, along the continental divide to approx. Rabbit Ears Pass. It is located primarily within the Routt and Medicine Bow National Forests.

There are presently two known boreal toad breeding populations in this area. The Soda Creek population has only one known breeding locality, and the N. Fork of the Elk River population has two localities as of 2000. A new breeding locality was found at Buck Mountain in 2000. Recent (1999-2000) observations show a pattern consistent with a possible die-off of toads due to chytrid fungus. The area was sampled this year to be tested for chytrid fungus, but as of this writing the chytrid PCR test was not completed and ready for use. Samples will be tested in 2001, and if chytrid is found, these localities should continue to be closely monitored for possible chytrid caused die-offs.

ROUTT COUNTY

Locality RO-2 - Soda Creek (Soda Creek)

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

Locality RO-3 - Diamond Park (N. Fork of Elk River)

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

Locality RO-6 - Upper Buck Mountain (N. Fork of Elk River)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	9/4/4	Unk	3 (M,S,A)	Est. <50 metamorphs.

* * *

Elkhead Mountains

This mountain area is in western Routt County and eastern Moffat County, CO, northeast of Craig. It is located primarily within the Routt National Forest.

The only known boreal toad breeding population in this area is in California Park. There are two known breeding localities at this time (First Creek and Torso Creek). Evidence of at least one other possible breeding site in the area was found along Elkhead Creek in 1997. Although evidence of reproduction has been observed in several locations, a specific breeding site was not found until this year (2000), at Torso Creek.

ROUTT COUNTY

Locality RO-1 - First Creek (California Park)

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	Unk	None seen	Monitoring adequate

Locality RO-4 - Torso Creek (California Park)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	0/1/0	Unk	3(1,S,A)	Numerous 1-yr. olds.
2000	2/2/2	Unk	3(M,2,A)	Approx 400 metamorphs

This site was found in 1999, but presence of sub-adult toads indicates breeding in 1998 and earlier.

* * *

Medicine Bow Range

This is an area extending from southeastern Carbon County and western Albany County, WY, south through eastern Jackson County and western Larimer County, CO, to approx. Cameron Pass. It is situated primarily within the Routt and Roosevelt National Forests and on the Colorado State Forest.

At this time, there is only one known breeding site. This is the Bird Creek site, which is located in Albany County, Wyoming. Based on historic and recent observation reports of toads, it is likely that other breeding populations will be found in the Medicine Bow Range, given adequate survey effort. A reliable sighting of an adult boreal toad was made in the upper Laramie River drainage, in Larimer County, CO in 1998, but surveys in 1999 and 2000 failed to find a breeding site or toads.

ALBANY COUNTY, WY

Locality WY-1 - Bird Creek (Albany)

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	Unk	None seen	Surveys adequate
2000	0/3/0	Unk	1(A)	Three ♀ toads seen.*

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

*Two of the three female toads found in 2000 were placed in captivity at the Sybille Wildlife Research Station.

* * *

Front Range

This is an extensive area in northern Colorado, which includes southwestern Larimer County, eastern and southern Grand County, the western portions of Boulder, Gilpin, and Clear Creek counties, and eastern Summit County. It extends from the Mummy Range, in the north, south through Rocky Mtn. National Park to Loveland Pass and the Mt. Evans Wilderness Area. Much of the area is situated within the Arapahoe/Roosevelt National Forest.

There are twenty-nine (19) known breeding localities, comprising eleven (11) populations, within the Front Range area as of 2000. These breeding populations and localities are located in five counties, as follows:

LARIMER COUNTY

Locality LR-1 - Lost Lake (North Fork of Big Thompson River, RMNP)

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

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

Locality LR-2 - Kettle Tarn (North Fork of Big Thompson River, RMNP)

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-yr. old seen.*

* Minimal recruitment in 1999 based on observation of one 1-yr. old toad in 2000.

Locality LR-3 - Spruce Lake (Big Thompson River, RMNP)

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-yr. olds seen.

Locality LR-4 - Glacier Basin (Big Thompson River, RMNP)

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

This site will no longer be regularly monitored after 2000. Translocation appears unsuccessful.

Locality LR-5 - Twin Lake (South Cache la Poudre)

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	Unk	None seen	Low water

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

BOULDER COUNTY

Locality BO-1 - Lost Lake (Middle Boulder Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	0/1/0	No	2(M,A)	Toadlets introduced
1997	0/1/0	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	Unk	None seen	Monitoring adequate

This is an experimental reintroduction site. Monitoring should continue at least through 2002.

GRAND COUNTY

Locality GR-1 - Jim Creek (Winter Park)

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

Population indicates breeding pre-1996, but no actual breeding observed.

Locality GR-2 - Pole Creek (Pole Creek)

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	Unk	3(M,S,A)	One clutch desiccated

This locality is on Pole Creek Golf Course, near holes #4 and #15.

* Recruitment from 1998 production based on observation of subadult toads in 2000.

Locality GR-3 - Vasquez Creek (Vasquez Creek)

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

* 16 toadlets from 1999 clutch were captive reared and released in Vasquez Creek drainage in 2000.

SUMMIT COUNTY

Locality SU-2 - Montezuma (Snake River)

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*

*This site is on private property, and permission for ongoing access needs to be obtained.

Locality SU-3 - Peru Creek (Snake River)

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	Unk	1(A)	Tadpoles seen.

Locality SU-6 - Upper North Fork of Snake River (Snake River)

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

Locality SU-7 - Lower North Fork of Snake River (Snake River)

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

CLEAR CREEK COUNTY

Locality CC-1 - Vintage (Clear Creek West Fork)

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	Unk	1(A)	No breeding observed
2000	0/0/0	Unk	None seen	Minimal monitoring

Locality CC-2 - Urad/Henderson (Clear Creek West Fork)

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)	Chytrid fungus mortality
2000	34/34/34	Unk	2(M,A)	

This locality is comprised of several closely associated breeding sites.

Locality CC-3 - Herman Gulch (Clear Creek)

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

Locality CC-4 - Mount Bethel (Clear Creek)

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	Unk	4(M,1,S,A)	Many metamorphs seen

Locality CC-5 - Bakerville (Clear Creek)

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

Locality CC-6 - Silverdale (Clear Creek South)

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 observed	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*

* Apparent breeding occurring at this locality, but breeding site has not been found.

Gore Range

This is a geographic area extending from west-central Routt County and northwestern Grand County south to western Summit County, including the Eagle's Nest Wilderness Area. Much of this area is located within the White River and Arapahoe National Forests.

Prior to 1999, there were only two known breeding localities in the Gore Range, both in east-central Summit County, and each with two or more breeding sites. Surveys in 1999 located two new breeding populations in the Gore Range. One is at east Vail, in Eagle County, and the other on the North Fork of Morrison Creek, in southeastern Routt County. No new populations or breeding sites were located in 2000.

ROUTT COUNTY

Locality RO-4 - North Fork Morrison Creek (Morrison Creek)

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	Unk	4(M,1,S,A)	<50 metamorphs seen.

EAGLE COUNTY

Locality EA-3 - East Vail (Vail)

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.

SUMMIT COUNTY

Locality SU-4 - Upper North Tenmile (North Tenmile Creek)

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

Locality SU-5 - Lower North Tenmile (North Tenmile Creek)

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

Mosquito and Ten-Mile Range

This is an area extending from southern Summit County south to the Buffalo Peaks Wilderness Area in western Park County and northeast Chaffee County. Much of it is situated within the Arapahoe and Pike/San Isabel National Forests.

As of 2000 there are only two known boreal toad breeding localities in this geographic area, as follows:

SUMMIT COUNTY

Locality SU-1 - Cucumber Gulch (Breckenridge)

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

CHAFFEE COUNTY

Locality CF-7 - Fourmile Creek (Buffalo Peaks)

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

* * *

Sawatch Range

This geographic area includes western Lake and Chaffee counties and eastern Pitkin and Gunnison counties, and extends from the Holy Cross Wilderness Area south to Monarch Pass. It includes the upper Fryingpan drainage and eastern Taylor Park, and is situated primarily within the White River, San Isabel and Gunnison National Forests.

There are sixteen (16) known breeding localities within this area. Thirteen (13) of these are located in the Collegiate Peaks area of Chaffee County, two (2) in southern Eagle County, and one (1) in eastern Gunnison County. The eleven sites in the Cottonwood Creek drainage of Chaffee County compose one of the most substantial remaining metapopulations of boreal toads in the southern Rocky Mountains, and presently is the only population which meets the viability criteria in the Conservation Plan. No new breeding localities were found in 2000.

CHAFFEE COUNTY

Locality CF-1 - Collegiate Peaks Camp Ground (Cottonwood Creek)

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)	Subadults 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

Locality CF-2 - Denny Creek (Cottonwood Creek)

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(1,2,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	Unk	4(M,1,S,A)	Good production

Locality CF-3 - Hartenstein Lake (Cottonwood Creek)

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	Unk	2(M,A)	Few metamorphs

Locality CF-4 - South Cottonwood Creek (Cottonwood Creek)

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	Unk	4(M,1,S,A)	Numerous metamorphs

Locality CF-5 - Brown's Creek (Brown's Creek)

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

Locality CF-6 - Kroenke Lake (Cottonwood Creek)

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

Locality CF-8 - Morgan's Gulch (Cottonwood Creek)

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

Locality CF-9 - Sayre's Gulch (South Fork Lake Creek)

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*

* Most larvae apparently lost to mallard and/or dytiscid predation in 1999 and 2000.

Locality CF-10 - South Cottonwood Creek - West (Cottonwood Creek)

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	Unk	3(M,1,A)	Good production

Locality CF-11 - Rainbow Lake (Cottonwood Creek)

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

This site is on private land, and subject to considerable human use, and predation by mallards.

Locality CF-12 - Middle Cottonwood (Cottonwood Creek)

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 matamorphs seen

Locality CF-13 - Denny Creek West (Cottonwood Creek)

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

Locality CF-14 - Denny Creek South (Cottonwood Creek)

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

Marginal site, subject to dessication.

EAGLE COUNTY

Locality EA-1 - Holy Cross City (Holy Cross City)

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

Locality EA-2 - East Lake Creek (East Lake Creek)

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

Two closely associated breeding sites at this locality.

GUNNISON COUNTY

Locality GU-3 - Magdalene Gulch (Texas Creek)

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

* * *

White River Plateau

This geographic area includes southwestern Routt County, western Rio Blanco County, and northwest Eagle County. It includes the Flat Tops Wilderness and is situated primarily on the White River National Forest.

There are presently no known breeding sites in this area, although there have been reports of toad observations in recent years - primarily from the Trapper's Lake area. It is very likely that breeding sites will be located in this area, given adequate survey effort.

* * *

Grand Mesa

This area incorporates western Gunnison County, northern Delta County, and eastern Mesa County, and is located primarily on the Grand Mesa and Gunnison national forests.

Grand Mesa, historically, had an abundance of boreal toads. However, no toads have been seen in this area in recent years. A survey of suitable breeding habitat and searches for boreal toads was completed in 1999. No toads were found, but suitable habitat still exists. Grand Mesa is a high priority site for a possible experimental reintroduction of boreal toads.

* * *

Elk and West Elk Mountains

This area consists of parts of western and northern Gunnison County west of Taylor Park, and southwest Pitkin County. It includes the Maroon Bells/Snowmass and West Elk wilderness areas.

Prior to 2000 there were three known boreal toad breeding sites in this area - one in southern Pitkin County, and the other two in northern Gunnison County. In 2000, new breeding sites were found on Brush Creek in Gunnison County, and on East Maroon Creek in Pitkin County. There have also been recent, reliable reports of toads from other localities within this area, such as Mt. Crested Butte, the Snowmass Lake area, near the town of Aspen, and in the Roaring Fork Drainage. With additional survey effort it is likely that more breeding populations will be located - especially in the Elk Mountains.

PITKIN COUNTY

Locality PI-1 - Conundrum Creek (Conundrum Creek)

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

Dead female toad found in 2000 tested positive for chytrid fungus.

Locality PI-2 - East Maroon Creek (Conundrum Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	3/3/3	Unk	4(M,1,S,A)	Several ponds at site

GUNNISON COUNTY

Locality GU-1 - Triangle Pass (White Rock Mountain)

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	2(M,S,A)	One subadult seen.

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

Locality GU-2 - West Brush Creek (White Rock Mountain)

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

Locality GU-4 - Brush Creek (White Rock Mountain)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	3/3/3	Unk	4(1,2,S,A)	Minimal monitoring

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San Juan Mountains

This is a large area in southern Colorado and northern New Mexico, which includes portions of Hinsdale, Archuleta, Mineral, Saguache, western Rio Grande, and Conejos counties in Colorado, and Rio Arriba County in New Mexico. It extends along the Continental Divide from Poncha Pass in to northern New Mexico. Most of the boreal toad habitat in this area is located within the Gunnison, Rio Grande, San Juan, and Carson national forests.

Prior to 2000, there were only two known breeding sites in this area, and one of those two sites (Trout Creek) is questionable, as the tadpoles observed there in 1996 may have been the result of an unauthorized translocation from the Jumper Creek site, rather than natural breeding at that location. In 2000, two additional breeding localities were found. One is in Mineral County, in the Goose Creek drainage, and the other in the upper portion of West Trout Creek, just in to Hinsdale County.

There have been several good reports of observations of boreal toads from other localities in the San Juan Mtn. area - most notably from the Elk Creek drainage in Conejos County, Miner's Creek in Saguache County, and from near Chama, New Mexico. Survey efforts in these areas should continue.

MINERAL COUNTY

Locality MI-1 - Jumper Creek (Trout Creek)

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	Unk	1(A)	Site dessicated

Locality MI-2 - Trout Creek (Trout Creek)

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

NOTE: This site is questionable. 1996 observations may have been result of unauthorized transplant from Jumper Creek.

Locality MI-3 - Boots Pond (Goose Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	1/1/1	Unk	2(M,A)	Site found late season

HINSDALE COUNTY

Locality HI-1 - West Trout Creek (Trout Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	2/2/2	Unk	2(M,A)	Site found mid-season

* * *

BOREAL TOAD SURVEYS

In addition to annual monitoring of known breeding sites, surveys of historic and other suitable boreal toad habitats are conducted each year. The amount of survey work has been constrained by the availability of qualified personnel to conduct and supervise the work and by limited funding. Areas where surveys have concentrated over the past five years include the Park Range, Front Range, Gore Range, Saguache Range, Elk Mountains, and the San Juan Mountains in Colorado, Albany County, Wyoming, and Rio Arriba County, New Mexico. In 1999 a cooperative effort was initiated between the Colorado Division of Wildlife, Region 2 of the US Forest Service, and the Colorado Natural Heritage Program to conduct statewide surveys and a considerable portion of the breeding site monitoring work. Surveys since 1999 have resulted in the location of five previously unknown breeding populations located in Routt, Eagle, Grand, Gunnison, and Mineral counties, and eight new breeding localities within known populations in Routt, Chaffee, Gunnison, Mineral, and Hinsdale counties.

In 2000, in Wyoming, a total of four female boreal toads were found during surveys in the South Fork of Bird Creek and in Rock Creek Park, but surveys conducted on the North Fork of Bird Creek and at Lake Owen failed to find any toads. Surveys done in the Lagunitas Lake and Canjilon Lake areas, in New Mexico, by personnel from the Carson National Forest, also were unsuccessful.

Data regarding areas surveyed, where no toads were found, is in the process of being gathered from various sources and compiled, and will be used to help plan future survey efforts. In 2001, ongoing survey efforts will continue, with a focus on southeastern Routt County, Pitkin County, the San Juan Mountain area, the White River Plateau, and several other specific locations from where reliable reports of boreal toad observations have been received in the past two years. Sampling of populations for presence/absence of chytrid fungus will continue.

PUBLIC INFORMATION AND INVOLVEMENT

Ongoing efforts to involve the general public in the search for boreal toad populations include the distribution of picture post cards, which provide basic information about the toad, and directions on how, and where, to report toad observations. In addition, toad "wanted" posters continue to be distributed to inform the public, and personnel in various resource management agencies, about the boreal toad, and to provide information on how & where to report toad observations. Reports of boreal toad observations resulting from the cards and posters have increased somewhat from previous years, indicating that the information is reaching more people.

In the vicinity of known boreal toad breeding populations, information is posted at camp grounds, trailheads, and near breeding sites on National Forest lands to inform recreationists about the presence of the toads, in an effort to prevent inadvertent or intentional damage to the toads and their habitat.

Several news releases and public information videos have been produced to help inform the public about the boreal toad and about ongoing conservation efforts. These have been well received by most news media, and widely distributed. In addition, a 30-minute slide presentation on the boreal toad and its management was produced, and continues to be presented to various groups.

CAPTIVE PROPAGATION AND TRANSLOCATIONS

Reintroduction or translocation of animals are tools which may be used in the recovery of threatened or endangered species. These actions may involve captive propagation and/or rearing. Preliminary work with experimental translocations and captive rearing of boreal toads has been done in the southern Rocky Mountains. However, it has been decided by the Boreal Toad Recovery Team that this approach will be used only in cases where no other viable alternatives exist to re-establish boreal toads in areas where they are known to be extirpated, and for experimental/research purposes. The following are the guidelines, as established by the Boreal Toad Recovery Team in 1997, to determine if/when translocations/reintroductions should be done:

1. Boreal toads are determined to be extirpated from a historically occupied mountain range, based on thorough surveys*, and suitable habitat for toads still exists in that area.
(* Methodology outlined in the Boreal Toad Conservation Plan, 1998)
2. The chances of natural recolonization of the unoccupied area is minimal.
3. There is no known, significant and imminent environmental threat in the area which would preclude successful reintroduction and survival of boreal toads.
4. Available source stock of toads for transplants is sufficient to provide the numbers needed without doing harm to the source population(s).
5. There is a firm commitment from involved agencies to make the reintroduction effort a top priority for long-term funding, and to do long-term monitoring and evaluation. Ideally, such commitment should be stated in the form of a Cooperative Agreement or Memorandum of Understanding.

In light of the recent discovery of the presence of the chytrid fungus in Colorado, and ongoing research, these guidelines will most likely be revised in 2001 to incorporate considerations regarding presence of this and other pathogens at potential translocation sites.

Captive Propagation and Rearing

During the early 1990's, techniques and procedures for captive rearing and breeding of boreal toads were developed by both the Wyoming Game & Fish Department and the Colorado Division of Wildlife. At the Sybille Wildlife Research Center, in Wyoming, boreal toads were reared in conjunction with efforts to raise captive Wyoming toads, and captive reared boreal toads were subsequently released at the Lake Owen site (see 'Experimental Translocations', below). In Colorado, a small number of tadpoles were reared to toadlet stage at the University of Colorado in 1993 and 1994, for a subsequent experimental release in Boulder County (see page 37), and numerous toads

were reared in captivity by the Colorado Division of Wildlife, at its Fish Research Hatchery in Bellvue, CO, from 1995 through 1997. The Division of Wildlife effort resulted in the development of standard practices for rearing of boreal toads, and the "Hatchery Manual for the Rearing and Propagation of Captive Boreal Toads", March, 1997. Captive propagation and rearing of toads in Colorado was discontinued in late 1997, with the intent of reinstating it only if it is needed for a future reintroduction. After the recent discovery of chytrid fungus in Colorado, and the associated die-off of boreal toads in Clear Creek County in 1999, the Recovery Team decided it would be prudent to establish disease-free captive stocks of boreal toads from several key populations in the southern Rocky Mountains. The primary location for housing of this captive stock presently is the Colorado Division of Wildlife's new Native Aquatic Species Restoration Facility, near Alamosa, CO. In order to minimize risk of loosing all captive stock to an unforeseen die-off or accident, and to promote more effort towards development and testing of captive propagation and rearing techniques, selected stocks of toads are also housed at several other facilities, including the Sybille Wildlife Research Center in Wyoming, and at various AZA certified zoos, including, as of January 2001, the Henry Doorly Zoo, in Omaha, NE, the Cheyenne Mtn. Zoo, in Colorado Springs, CO, and the Toledo Zoo, in Ohio. The primary purpose of establishment of captive stocks is to preserve genetic diversity in the event of catastrophic die-offs. Secondly, captive stocks will be used to develop and test propagation and rearing techniques, and to provide source stock for possible future reintroductions to areas where the species has been extirpated.

Colorado Native Aquatic Species Restoration Facility (NASRF)

The Colorado Division of Wildlife constructed a modern facility, near the town of Alamosa, which will be used for the captive propagation and rearing of various native aquatic species which are considered to be at risk in Colorado. The "hatchery" was opened for operation in May, 2000, and boreal toads were one of the first species to be placed in the new facility. As of late 2000, there are groups of toads at the NASRF representing eleven different populations from throughout Colorado, and comprised of a total of twenty-three different genetic lots.

Sybille Wildlife Research Center

As of late 2000, there are 26 boreal toads in captivity at the Sybille Wildlife Research Center in Wyoming, which continue to be used for experimental captive breeding and rearing work. In 2000, Sybille experienced eight boreal toad mortalities, and three additional adult female toads were collected from the wild in Albany County and added to the captive stock to increase genetic diversity and secure maximum stock from what appears to be a dwindling wild population. Few toads have been successfully captive bred and reared at Sybille during the past three years, and no further releases of captive reared stock to the Lake Owen site were done in 1999 or 2000. It had been recommended in 1999 that the remaining toads at Sybille be split between Sybille and the Saratoga National Fish Hatchery to reduce the chances of loosing all captive toads to a disease outbreak or other disaster, but this has not yet been accomplished.

Cheyenne Mountain Zoo

In 1993, personnel from the Cheyenne Mtn. Zoo, in Colorado Springs, collected three yearling toadlets and 17 tadpoles from the Denny Creek breeding site, in Chaffee County, Colorado. These

tadpoles were reared to metamorphs at the zoo, and some were over-wintered in a Percival Environmental Chamber. As of late 1997, all boreal toads at the Cheyenne Mtn. Zoo had died due to unknown causes.

In 2000, the Cheyenne Mtn. Zoo, in cooperation with the Colorado Division of Wildlife, has revived its effort to captive rear boreal toads. Twenty toads (10 from each of two different lots of eggs collected at Hartenstein Lake, and reared at the CDOW's Native Aquatic Species Restoration Facility) have been provided to the Cheyenne Mtn. Zoo for captive rearing and propagation work.

Henry Doorly Zoo

Due to the limited number of known breeding boreal toads remaining in the San Juan Mtn. area as of the mid 1990s, it was thought advisable to attempt to establish a captive brood stock of boreal toads from that geographic area. In 1996, the Henry Doorly Zoo, in Omaha, Nebraska, obtained boreal toads from Colorado for experimental propagation projects. Forty toadlets, originating from Mineral County, Colorado, were sent to the zoo. Most of these died within the first two to three months due to unknown causes. As of late 1997, three boreal toads (one male and two females) remained in captivity at Henry Doorly Zoo. Unfortunately, these three toads died of unknown causes in 1998. The CDOW provided 10 metamorph toadlets, taken from the Jumper Creek site in Mineral County, to Henry Doorly Zoo in August, 1998, to be used for further captive rearing and breeding work. As of late 2000, nine of these ten toads were still alive, and being hibernated at the Henry Doorly Zoo. An additional 10 toadlets, also from the Jumper Creek breeding site, were sent to Henry Doorly Zoo in August, 2000, in order to improve the genetic diversity of that stock.

Toledo Zoo

In October, 2000, one lot of 10 toadlets from the North Fork of Morrison Creek breeding locality, and one lot of 12 toadlets from the West Trout Creek breeding locality were sent to the Toledo Zoo, in Ohio. As of early 2001, these toads were alive and in good condition.

In addition to the toads at the locations mentioned above, there are boreal toads at several other sites, primarily being used for educational, display, and research purposes. These include (1) Adams State College, in Alamosa, (2) the University of Colorado, in Boulder, (3) Colorado's Ocean Journey, in Denver, (4) Colorado Division of Wildlife, in Ft. Collins, (5) Colorado Division of Wildlife, in Durango, and (6) the Morrison Natural History Museum, in Nederland. Some toads will also be provided to specific members of the IRCEB (Integrated Research Challenges in Environmental Biology - National Science Foundation) group, for essential research on the chytrid fungus.

The Boreal Toad Recovery Team plans to work in cooperation with the AZA and various accredited zoos in 2001 to initiate a "stud book" database for the purpose of tracking all captive southern Rocky Mountain boreal toads and their progeny.

Experimental Translocations

Prior to the development of specific guidelines for translocations and reintroductions of boreal toads, in 1999, some translocations did take place. Although these were, in general, done according to acceptable standards, they did not follow strict and consistent protocols, which should be adhered to for any future translocations.

In August of 1993 and 1994, 44 and 200 boreal toadlets, respectively, were released near **Caribou**, in western Boulder County, CO, to determine if such releases could ultimately result in creation of a new breeding population at a site at which toads historically existed, but at which no toads had been seen in 20 years. The source of the tadpoles was a breeding site along Interstate Hwy. 70, west of Denver, in Clear Creek County. The toadlets were released about a month after metamorphosis. They were fed as much as possible during the entire time they were being raised in order to maximize their growth and their chances of surviving the first winter. One-day surveys in 1995 and 1997 indicated that sub-breeding sized individuals were still present in the area. In 1998, males from the first cohort should have been of breeding size. No surveys were conducted in the area in 1998, and brief surveys in 1999 and 2000 failed to find any toads at the site. Surveys should continue to be conducted in this area for at least two more years.

Glacier Basin, in Rocky Mountain National Park, is the site of an experimental translocation of boreal toads, which began in 1995. It is a cooperative effort between Rocky Mtn. National Park and the USGS/Biological Resources Division. Toadlets (n=800) were released in 1995, and egg masses and 100 captive-reared toads were translocated in 1996. The stock for this transplant came from the Lost Lake breeding site, in Rocky Mtn. National Park. (See Loeffler, ed. 1999 for a complete report). From 1997 through 2000, NPS and USGS/BRD staff continued to monitor the Glacier Basin site. No egg masses or tadpoles have been found to date. Although three adult female toads were observed in 1999, no male toads or breeding activity were seen. Surveys were conducted in the Glacier Basin area in 2000, but no toads or breeding activity were observed.

In 1995, 1996, and 1997, several thousand boreal toad toadlets, and several adult toads, and some tadpoles were released at **Lost Lake, Boulder County**, to determine if translocation of large numbers of young toads is an effective reintroduction method, to monitor the dispersal behavior and habitat use by the reintroduced toadlets, and to assess the survival rates of various age classes of toads. The transplanted animals originated from eggs taken from the Henderson Mine site, in Clear Creek County, and reared at the CDOW's Research Hatchery, in Bellvue, CO. (See Loeffler, ed. 1999 for a complete report). This locality will continue to be monitored for several years to determine the result of the translocation. No toads were observed at Lost Lake in 1999 or 2000.

In Wyoming, an experimental reintroduction at the **Lake Owen** site, in Albany County, was initiated. In 1996, 4000 captive reared tadpoles, which originated from eggs taken at the Bird Creek breeding site, were released at Lake Owen. In 1997, an additional 1500 captive-reared tadpoles were released, and three one-year-old toads were observed, indicating that there was some survival of toadlets from the 1996 release. No additional toads have been released since 1997, but plans are to monitor the

site for the next few years to determine the success of the reintroduction effort. Surveys at the site in 2000 found no toads or sign of breeding activity.

Love Lake, in Mineral County, CO, was the site of a release of approximately 300 newly metamorphosed toadlets in early August, 1996. These were captive reared toadlets from tadpoles collected at the nearby Jumper Creek site in Mineral County. Subsequent searches during late summer of 1996 found some live and some dead toadlets at the site. No toadlets were seen during surveys at the site since 1996. Monitoring at this location should continue, however, due to its relative proximity to the Trout Creek population.

Grand Mesa, in western Colorado, was intensively surveyed from 1997 to 1999, and is a high priority site for an experimental reintroduction of boreal toads. In addition to intensive aquatic habitat mapping, approx. 780 hours of inventory effort was expended in historically occupied habitats on Grand Mesa in 1998. No toads, eggs, or larvae were found. Six potential reintroduction sites were selected from 80 possible sites, using standardized criteria. Administrative groundwork for initiation of an experimental translocation was started in early 1999, but the project was put on hold due to the finding of chytrid fungus at the primary source population in Clear Creek County, and evidence of the presence of chytrid fungus in at least two other populations. The project will not be pursued further until testing for chytrid fungus on Grand Mesa can be done, and the Recovery Team concludes that it is safe and prudent to do the translocation. The earliest that such a translocation could be initiated would be the summer of fall of 2002.

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RESEARCH

Studies of the Boreal Toad Population in the Henderson Mine Area and Related Research on the Chytrid Fungus (*Batrachochytrium dendrobatidis*).

Mark Jones, CDOW, Ft. Collins.

Site Description and Background

The Henderson Mine boreal toad breeding locality consists of numerous ponds and wetlands in an area which is heavily disturbed due to molybdenum mining by the Climax Molybdenum Company. The mine is located west of Empire, Colorado at an elevational range of 10,000 to 10,500 feet. The specific breeding sites at this locality have been designated as follows: 2-pond, Power Alley, Hesbo, Treatment Pond, Donut, Ann's Pond, and Upper Urad. Research in this area has focused on habitat and hibernacula use, toad movements, and population structure and dynamics. (See Jones, ed. 1998, 1999, and 2000 for more details).

Breeding site monitoring

The **Hesbo** site was monitored at night weekly from May 11 to May 30, 2000. The peak of breeding activity occurred on May 11 with 23 adults observed (16 male, 7 female). Ten egg masses were deposited, resulting in approximately 15,000 tadpoles. Metamorphs were observed.

The **Power Alley** site was monitored at night weekly from May 11 to May 23, 2000. Additional daylight surveys were conducted throughout the summer. No adult toads were seen during monitoring. No egg masses were found. There were a few tadpoles in the upper pond and 10 to 12 metamorphs were observed.

The **Upper Urad** site was night monitored from weekly from June 6 to June 14, 2000. Additional daylight surveys were conducted throughout the summer. Two adult toads were observed (1 male, 1 female). Five egg masses were deposited at this site, all fungused and died. No successful reproduction at this site in 2000.

The **Donut** site was monitored at night from May 15 to June 6, 2000. Additional daylight surveys were conducted throughout the summer. The peak of breeding activity occurred on May 23 with 11 adults (4 male, 7 female). Twelve egg masses were observed, resulting in approximately 15,000 tadpoles. Approximately 500 metamorphs observed.

The **Treatment** site was night monitored from May 11 to May 23, 2000. Additional daylight surveys were conducted throughout the summer. Only one male was observed at this site. Two egg masses were deposited and approximately 100 to 200 metamorphs were observed.

The **Anne's Pond** site was night monitored weekly from May 15 to June 6, 2000. Additional daylight surveys were conducted throughout the summer. Five adult toads (2 male, 3 female) were

observed. Three egg masses were deposited, all desiccated. No successful reproduction at this site for 2000.

Other Sites

Hassel Lake- This site is a small lake located just below timberline at the headwaters of the Woods Creek drainage. A survey was conducted on July 21, 2000, one female was observed.

Lower Urad Lake-This site was surveyed on June 14, 2000. Three male toads and one egg mass were observed. No recruitment at this site in 2000.

Twenty-one toads (nineteen males and two females) were radio tagged in May and June 2000 at Hesbo, Donut, and Anne's Pond with Holohil BD-2G radio transmitters weighing 2g each, with an expected battery life of six months. The radios were fixed to the toads using a waist harness constructed of plastic coated fishing leader material fastened with crimp collars inside 2mm vinyl tubing. An additional eight toads (four males and four females) were tagged during the summer as replacements for individuals killed by various predators, disease, or which lost their transmitters. The primary objective of following radio tagged individuals in 2000 was to monitor mortality associated with chytridiomycosis. A total of 21 boreal toad mortalities were confirmed cases of chytridiomycosis, with most of the mortality occurring in June, 2000.

The Chyrid Fungus and Population declines at the Henderson Mine

The boreal toads at the Henderson Mine breeding sites have been pit tagged during the active breeding season since 1995. Capture-recapture methods were used to estimate population numbers of males at each breeding site from 1995 to 2000. Only male boreal toads could be estimated as there was never a recapture of a female in the same year, indicating females breed and immediately leave the breeding site. The computer program Capture (White et al. 1982) was used for the analyses and White et al. 1982 should be referenced for a full description of procedures and model selection. In all cases, the estimate derived from the Capture model was nearly the same as the total number handled at each site indicating we had PIT tagged and handled close to the entire breeding population of males each year at each site. Based on the 1995 estimates, the male breeding population in the Henderson/Urad metapopulation was approximately 173, 227 in 1996, 233 in 1997, 306 in 1998, 188 in 1999, and 38 in 2000. In several instances during the breeding season in May 2000 there were females at a breeding site with no males to breed them. These data obviously indicate a severe decline in the Henderson Mine boreal toad population.

In 1999, the decline in the Henderson/Urad boreal toad population was attributed to a recently described pathogenic fungus *Batrachochytrium dendrobatidis*. Subsequent pathological work by Dr. Allan Pessier has shown that chytrid fungus was present at this locality as early as 1995. Chytrid fungus has now been identified in boreal toads from at least three populations in Colorado: Henderson Mine, Rocky Mountain National Park, and Conundrum Creek. Work in 2000 focused on monitoring the chytrid die-off at the Henderson Mine, getting a draft CCAA written for the Henderson Mine,

collecting samples from as many breeding sites statewide for subsequent PCR testing, collection of various life stages from priority sites for protection at the Native Aquatic Species Restoration Facility (NASRF), testing anti-fungal drugs on chytrid infected boreal toads and tadpoles, and coordinating future work with the IRCEB group.

Pathology work in 2000 was performed by Dr. Allan Pessier, Zoo and Wildlife Pathologist with the University of Illinois Zoological Pathology Program. Specimens were either sent live on ice packs, preserved in formalin, or frozen with dry ice depending on their condition and the anticipated tests/procedures to be done.

* * *

Survey of Boreal Toad Populations for Chytrid Fungus

Lauren J. Livo, University of Colorado and CDOW

Since the chytrid fungus was discovered relatively recently, not very much is known about its ecology. It is important to understand the geographic distribution and prevalence of this amphibian pathogen in Colorado's boreal toad populations. It is not sufficient to depend on just finding dead or sick toads to determine whether a population is affected by chytrid fungus.

Currently, a genetic (PCR) test is under development (see next page), that should provide a method to determine whether small tissue samples from toads contain any chytrid fungus. During the 2000 field season, samples were collected from toads, which are then released. As of the end of 2000, samples have been collected from 123 toads at 26 sites throughout Colorado. Three samples were taken from each individual. First each toad was soaked for two hours in 10 ml of distilled water in an attempt to collect the flagellated *Batrachochytrium* zoospores. The second sample was a ventral skin scraping using a wood sample stick. The third sample was a toe clip. Toe clips and wood sticks were put into screw cap cryogenic tubes containing 1 ml of 0.25M EDTA pH 8 saturated with NaCl. The soak water sample was poured into a tube containing 1 ml 0.1M Tris, 0.1M NaCl, 0.1M EDTA, and 10% lauryl sarcosine, pH 7.5. In addition to the samples taken from boreal toads, samples from 64 individual animals from seven other amphibian species were obtained.

These samples can be compared to an undeveloped roll of film in a camera. When the PCR test becomes available, the samples can be "developed", providing a "snapshot" showing which boreal toad populations are affected by the chytrid fungus. It is anticipated that the testing of the samples collected in 2000 can be completed by May or June, 2001, and further sampling, depending on the results of these tests, will likely need to be done during the summer of 2001.

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PCR assay to detect *Batrachochytrium dendrobatidis*

Seanna Annis, Farahad Dastoor and Joyce Longcore, University of Maine, Peter Daszak, University of Georgia, in cooperation with Mark Jones, Colorado Division of Wildlife and Erin Muths, Midcontinent Ecological Science Center, USGS-BRD.

We are developing an assay which will detect a piece of DNA unique to *B. dendrobatidis*. This will allow us to detect *B. dendrobatidis* in various samples and will prevent false positives from other chytrids or other fungi. We are using the polymerase chain reaction (PCR) which can theoretically amplify one copy of a small piece of DNA into million of copies. The PCR method uses small pieces of DNA called primers that bind to DNA sequences flanking the piece of DNA to be amplified and then uses those primers as starting points for copying the DNA. This method should allow us to identify small quantities of *B. dendrobatidis* by amplifying up a small fragment of DNA unique to this fungus to a level we can detect it.

We are using a region of nuclear DNA containing highly conserved ribosomal genes (their DNA sequences tend to remain unchanged over time) that flank highly variable internal transcribed spacer (ITS) regions. There are typically 100s of copies of this region of DNA in the fungal genome because these genes encode for RNAs used in protein synthesis. The ITS2 region is flanked by the 5.8S and the 28S ribosomal genes on either side. This ITS2 region typically varies between species within a genus and sometimes within species of fungi.

We have amplified the ITS2 region and a portion of the 5.8S and 28S ribosomal genes flanking it using the PCR method with primers that bind to the highly conserved ribosomal genes. We have amplified and sequenced this ITS2 region from *B. dendrobatidis* isolates from Australia, Africa and from around North America, including Colorado. We have also amplified and sequenced this region from chytrids closely related to *Batrachochytrium* and other taxonomic orders of chytrids. PCR amplification from all of the *B. dendrobatidis* isolates produced similar sized DNA fragments. Fragments amplified from the other chytrid orders were all larger than those of *B. dendrobatidis* suggesting a large difference in DNA sequence between them. We aligned the sequences of the ITS2 region from the isolates of *B. dendrobatidis* to look for regions common to all isolates. It was important to compare the sequence from many *B. dendrobatidis* isolates to find a sequence of DNA common to most isolates so we increase our chances of detecting all isolates of *Batrachochytrium*. The sequences from the other chytrid orders were too different to align directly to the *B. dendrobatidis* sequences. We found a sequence of DNA within the ITS2 region that is common to all *B. dendrobatidis* isolates and not found in the other chytrid orders or other sequences published in Genbank. We have designed a *Batrachochytrium* specific primer from this sequence. We have used this specific primer and a primer for the conserved 28S ribosomal gene to amplify up a piece of DNA of the predicted size from different isolates of *B. dendrobatidis*. This set of primers does not amplify up any DNA fragments from the other orders of chytrids. This is evidence that we have a specific assay for *B. dendrobatidis*. We have a detection limit of 100pg of DNA or 100 zoospores using 1 PCR amplification. To lower the detection limit, we have used a 2-step PCR procedure, where we do two PCR amplifications, one after the other, to increase our amplification of the specific piece of DNA. We have lowered our detection limit to 1pg of DNA and 1 to 10 zoospores using the 2-step procedure. We are in the process of checking that with the 2-step PCR, our primers only

amplify up DNA from *Batrachochytrium* and not from other fungi. Our next step is to develop protocols for detecting *B. dendrobatidis* in samples from amphibian skin and samples from scraping of the ventral surface of toads, toe clips and water from soaking of toads to release zoospores.

Advantages to the PCR method:

- ▶ Specific for one fungus.
- ▶ Requires a relatively small amount of DNA and the region being amplified is in 100s of copies in genome which improves chance of detection.
- ▶ Rapid method to check many samples and can work on a relatively crude preparation of DNA

Concerns

- ▶ Need the DNA to be concentrated in a small volume (about 5 ul).
- ▶ Environmental samples (animal?, definitely soil) will need to be cleaned up to remove inhibitors of PCR.
- ▶ Water samples may be problematic since they will need to be greatly concentrated.

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Boreal Toad Research & Monitoring in Rocky Mountain National Park

Erin Muths, USGS/BRD, Ft. Collins, CO

In 2000 we continued our mark-recapture efforts at Kettle Tarn and Lost Lake in the North Fork of the Big Thompson drainage. We visited Kettle Tarn over 20 times and Lost Lake 12 times. The number of captures was disappointing at both locations although toads at both locations produced 3 egg masses. We observed tadpoles in July at Kettle Tarn and as late as September at Lost Lake. Due to very low sample numbers, we were unable to estimate toad populations in the North Fork.

Our studies of boreal toads in the North Fork drainage have been complicated by the emergence of chytrid fungus (*Batrachochytrium dendrobatidis*) as an important disease of boreal toads. Since 1998, 12 toads (11 dead and one sick, but alive) have been sent to either Allan Pessier, DVM, currently at Loyola University, or David Green, USGS-NWHC, and at least eight of the specimens have been diagnosed as positive for chytrid fungus or had symptoms characteristic of chytridiomycosis. Three toads (2 females, 1 male) from the Northfork drainage were collected and sent to the Colorado Division of Wildlife's captive rearing facility in Alamosa, as per agreement with RMNP and members of the Boreal Toad Recovery Team, in March 2000.

We fitted radio collars and radio tracked toads only when we felt that they were healthy. A cursory health evaluation was based on weight, activity and whether or not the toad exhibited symptoms characteristic of chytrid infection, such as excessive skin sloughing. The 2000 season resulted in information on 3 toads; 2 females and 1 male. All tracking data for 2000 was collected after mid summer. The toads we found in the spring were either dead, too small to collar or appeared unhealthy. As a complement to the toad location information generated by radio tracking, we are looking at different scales in the landscape using information gathered when the animal is located and also data that are remotely sensed. We are using satellite imagery to examine habitat use by boreal toads. Thus far, we have collected over 40 random points to assist in ground truthing the imagery. At a finer scale, we have collected data on 16 random quadrats and transects to use in the analysis of habitat use data collected when each toad is located.

Spruce Lake, in the Spruce Creek drainage, has a small population of boreal toads. This population has been monitored casually (e.g. no mark – recapture studies) by RMNP staff and by MESC. Spruce Lake was visited 18 times during the spring / summer. We found at least 2 egg masses and observed tadpoles and 3 sub adult toads. One metamorph was sighted on 15 August, presumably from one of this year's egg masses. We observed a minimum of 10 males, 4 females and 2 unknown sex toads. At this time, we believe toads at Spruce Lake to be free of amphibian chytridiomycosis although the population is certainly at risk. Approximately 200 tadpoles were removed and taken to the CDOW facility in Alamosa as per conversations with RMNP and members of the Boreal Toad Recovery Team in March 2000. Unfortunately, 150 tadpoles died in transit. 50 tadpoles survived and are doing well in Alamosa.

The population viability analysis (PVA) project for boreal toads in the Northfork officially received funding this fall. Mr. Rick Scherer has started a Master's degree program at Colorado State

University and will be working on the PVA. He will be using our historical data from 1991 as well as continuing to collect data in the Northfork. We will commence mark – recapture efforts at Spruce Lake in 2001.

An amphibian health evaluation in Rocky Mountain National Park and vicinity will be initiated in 2001 in collaboration with David Green, DVM and Dr. P.S. Corn. A detailed project proposal, "Health Evaluations of Declining Boreal Toads and Other Amphibians in Rocky Mountain National Park", was submitted to RMNP in May 2000.

Recent relative publications:

Corn, P.S., E. Muths, and W. Iko. 2000. A comparison of three methods of monitoring breeding amphibians. *Northwestern Naturalist*. 81: 22-30.

Muths, E., P.S. Corn and T.R. Stanley. 2000. Use of oxytetracycline in batch-marking post-metamorphic boreal toads (*Bufo boreas*). *Herpetological Review* 31(1): 28-31.

Muths, E., T.L. Johnson, and P.S. Corn. In press. Experimental translocation of boreal toad (*Bufo boreas*) embryos, toadlets and adults in Rocky Mountain National Park. *The Southwestern Naturalist*.

Muths, E., P.S. Corn, A.P. Pessier and D.E. Green. Evidence for disease related amphibian decline in Colorado. In prep.

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Chytrid Fungus Research: Immunology and Toxicology

Cynthia Carey and Lauren J. Livo, University of Colorado, Boulder

The relationship between chytrid fungi and boreal toads is being tested on several fronts. Antimicrobial peptides, the only likely immune defense in the skin against this fungus, have been extracted from boreal toad skin and tested against the fungus for activity. At least several were found to be effective and they are being purified and sequenced at this time to identify them. Assuming the purified peptides are also effective at killing the fungus, the next step is to determine why they are not working in the field.

Laboratory research is ongoing and planned that will test effects of cold, pH, and trace metals on the immune system of boreal toads and other amphibians. Combinations of cold and pH, and low pH and trace metals will also be tested. Immunological responses to the above may be tested by injecting bacteria into toads and by testing egg jelly for antibacterial and antifungal properties then exposing egg masses to different regimens of cold, pH, trace metals, and UV-radiation.

Antimicrobial peptides

The best, and possibly only, defense against the chytrid fungus are small peptides produced by skin glands that have the ability to kill fungi and bacteria. A number of these peptides have been discovered in amphibians, and most differ so greatly from one another that many are named after the individual species of frog in which they were found. We have established a collaboration with Dr. Mike Conlon of the Creighton University Medical School in Omaha, NB. He extracted skin secretions from 3 boreal toads, and we tested the fractions against the chytrid fungus originally obtained from boreal toads in Clear Creek County by Joyce Longcore. We found significant activity in three fractions, and Dr. Conlon is purifying and sequencing them to determine their structure. Efforts will be made in 2001 to determine if secretions can be obtained from boreal toads in the field non-invasively (i.e. without killing them).

How the Fungus Kills

We spent the fall developing the technique for extracting any toxin that might be produced in broth by cultured chytrids. The technique, which we are testing on *Rana pipiens*, is that a 21-day culture of chytrids is filtered with a 45 u filter to remove the chytrid and large debris, then dialyzed against phosphate buffer (pH 6.7) in order to remove small chemicals that could affect our ability to totally dry the broth, then freeze-dried to remove all water. We do this to be able to concentrate the broth/toxin extract to much higher concentrations than if we didn't do this. We've tested various concentrations of control broth and have settled on a 1:10 dilution of chytrid, broth to be injected into frogs to determine if a toxin exists. We will do multiple injections 5 days apart in case the toxin cannot kill the frog outright with the first injection. If evidence of a toxin exists from these tests, we will send the material to Seanna Annis at the University of Main to determine the nature of the toxin.

Experimental Exposures

We need to know what sort of dosage of chytrid zoospores is necessary to cause infection of a boreal toadlet. We tried 20,000 zoospores per toadlet for 24 hrs and then monitored them for over 6 weeks.

Some died, and some of these exhibited moderate to small infection (histologically evaluated). A planned, subsequent study will involve exposure of toadlets to a concentration of up to 1 million zoospores/toadlet for 3 days. Samples for EM, histology, and PCR will be sent to Allan Pessier (Loyola University), Seanna Annis (University of Maine), and Peter Dazcak (University of Georgia).

Environmental Factors that may/may not be involved in the ability of chytrids to infect boreal toadlets.

We know that the Colorado chytrid isolate grows much more slowly than the type isolate (from tropical frogs) at 24 C. We are going to look at comparative growth rates of the Colorado and type isolates at a variety of temperatures, testing the hypothesis that the Colorado isolate may have a lower thermal preference.

We also tested the effect of cadmium exposure on growth rate of the Colorado isolate. All concentrations turned out to be too low and did not inhibit growth.

We plan to test combinations of the following: temperature, pH, and metals on the chytrid growth rate alone, the chytrid and antimicrobial peptide together, and chytrid and boreal toadlets.

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Modeling Boreal Toad Breeding Habitat

A. Andrew Holland, CDOW/CSU, Ft. Collins

This project involves modeling boreal toad breeding habitat requirements. My objective is to provide the Colorado Division of Wildlife (CDOW) with appropriate habitat variables, and levels of these variables, that can be used to evaluate lakes and ponds as potential boreal toad breeding sites and translocation sites. Breeding site selection, both between and within site, was the focus of my field efforts in 1999. In 2000, I continued to address breeding site selection but focused more on measuring and modeling conditions within breeding sites that allow tadpoles to achieve rapid growth and metamorphose at a large size.

With the help of several people I was able to place, at the time of breeding, an Onset Computer Corporation Optic stowaway® temperature logger in almost all of the known, active breeding sites in the state of Colorado. It was from these sites that I selected my 2000 study sites. To select my study sites I first identified all the breeding sites in the state of Colorado that had at least 1 egg mass deposited in them for the last 3 consecutive years. On 5 June 2000, 33 breeding sites, meeting those criteria, had at least 1 egg mass deposited in them. I randomly selected 18 sites from these 33 sites for more intensive study. The randomly selected study sites included: Mt. Bethel, Hesbo, Upper Urad Reservoir, Herman Gulch, and Donut in Clear Creek County; Lower North Tenmile Cr. and Upper North Fork of the Snake River in Summit County; East Vail in Eagle County; Morrison Cr. (Stairway site) in Routt County; East Lake Creek in Eagle County; Triangle Pass in Gunnison County; and Hartenstein Lake, Hartenstein Lake outlet pond, Denny Cr. (number 3), South Cottonwood, South Cottonwood West (pond 6), Collegiate Peaks East, and Collegiate Peaks West in Chaffee County. The eggs did not hatch in Upper Urad Reservoir and Herman Gulch. I visited the remaining 16 sites on a regular schedule, usually every other or every 3rd week, through metamorphosis.

At each site visit I estimated growth and development rates by measuring the individual Gosner stage, length to nearest .5 mm, and mass to nearest hundredth of a gram (wet weight) for between 30 and 100 randomly selected tadpoles. This is an estimate of the growth rate of the tadpoles within the site and not an individual growth rate as I did not measure the same individuals between site visits. I also measured air temperature, depth and water temperature at the temperature loggers, depth and water temperature of 2 tadpole aggregations, DO, and took water samples for pH and conductivity at each visit. I estimated a categorical larval density (low, med, or high) at each visit. I also measured the pond area, total length of shoreline that had water less than 10 cm deep at 30 cm from the shore, and bank slope in areas where eggs were deposited.

In 2000, boreal toad eggs were brought in from the field by others and raised in captivity to conserve genetic stock from evolutionary significant units throughout Colorado. The CDOW brought eggs into captivity from 5 of my 18 randomly selected study sites. Tadpoles were reared to metamorphosis in several labs and hatcheries. When clutches were split into several tanks I randomly selected which tanks I would use for my study. I measured the water temperature associated with these tanks with temperature loggers. With the help of other CDOW employees, I estimated numerical density for the captively reared tadpoles and measured tadpoles with the same methods employed in the wild sites

from which they came. Although not an experiment, this allowed me to look at tadpole growth and development rates with respect to known temperature and density while assuming unlimited food availability.

I was able to obtain masses of Gosner stage 45 metamorphs from all field (except Collegiate Peaks West) and lab sites to estimate mass at metamorphosis. In almost all cases these were measured at the beginning of metamorphosis which also allows me to precisely estimate the length of larval period. Mass at metamorphosis, tadpole growth rates between Gosner stage 25 and 40, length of larval period, and development rates in Gosner stages per day are the response variables that are currently being modeled. Independent variables include degree days (sum of daily mean water temperatures), mean temperature, mean of daily maximum temperatures, larval density, pond level stability, pond area, area by stability interaction, and conductivity. Wild sites are being modeled with random effects models and captively reared tadpoles are being modeled as fixed effects only. Random effects modeling allows inference to the population of breeding sites from which the randomly selected sites came.

An additional component of my 2000 data collection included addressing breeding site selection but from a different angle than in 1999. I wanted to evaluate the suitability of nonbreeding sites that are adjacent, and therefore available, to breeding sites in a more rigorous manner than simply comparing breeding and nonbreeding sites. I attempted to “second guess” breeding site selection by boreal toads by translocating eggs from breeding to nonbreeding ponds. Several criteria were established *a priori*. These included that the nonbreeding site be within 100m of the breeding site and thus available and the nonbreeding site contained habitat suitable for breeding and larval rearing. Also, the breeding site had to have at least 6 egg masses prior to being considered as a “donor” site. Upon meeting these criteria, approximately 500 eggs from each of 2-3 of the egg masses would be moved from the breeding site to the adjacent nonbreeding site. In 1999, through habitat measurements, temperature monitoring of nonbreeding sites, and visual inspection I identified approximately 8 breeding locations in the state that I thought would meet these criteria. In 2000, however, only 4 met the criteria. Several did not have the required 6 egg masses deposited in them and I did not want to jeopardize a breeding sites production for the year. In several other cases boreal toads bred in the “nonbreeding” sites that I was intending on moving eggs into.

I moved eggs at 3 breeding locations: Hartenstein Lake, South Cottonwood, and Denny Cr. The eggs being moved were photographed to estimate their number, a sample preserved to evaluate development stage and viability, and tempered to avoid temperature shock. I was intending on comparing growth rates and, if metamorphosis was achieved, mass at metamorphosis between breeding and nonbreeding sites. At Denny Cr. natural breeding occurred in the “nonbreeding” pond shortly after I moved eggs into it. The Hartenstein Lake nonbreeding pond’s water level receded presumably before the eggs hatched. This pond was very stable in 1999. The translocated eggs hatched at South Cottonwood and I measured the tadpoles once but could not locate them again as there were only a couple hundred in a very large pond with a lot of vegetation. They were last seen by Brad Lambert (CNHP) on 22 June, 2000. A few metamorphs were seen in the margins of the South Cottonwood nonbreeding transplant pond but they could have moved from the breeding pond after they metamorphosed. This type of study shows promise at evaluating whether breeding sites are selected for habitat, sociality, or simply

the reuse of natal ponds. To be successful it would have to be conducted on a much larger scale however. Also, I found that it was difficult to find breeding locations where I could not tell why they were selecting the sites they did.

The data from this study should provide valuable information for both rearing boreal toad larvae in captivity and for selecting translocation sites in which to put eggs or tadpoles from captive individuals. Information gained will also be useful for mitigation by determining the habitat suitability of wetlands proposed for development. This research will become even more valuable if additional boreal toad populations are lost and are no longer available for habitat relationships studies in the wild.

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Chaffee County Mark-Recapture Study

Brad Lambert, CNHP, Ft. Collins

For the third consecutive year, a mark-recapture study was conducted in the South Cottonwood Creek and Middle Cottonwood Creek drainages in Chaffee County. The study took place at the following breeding sites: Collegiate Peaks Campground, Denny Creek, South Cottonwood, South Cottonwood West, Morgans Gulch, Rainbow Lake, Hartenstein Lake and Middle Cottonwood. The purpose of the mark-recapture study was to collect baseline data for evaluating population size and trends. The data collected are also useful for detecting movement between breeding sites and determining population parameters, such as survival estimates. At the present time, the mark-recapture data collected from the last three years is being analyzed by Mark Jones and Andy Holland at the Colorado Division of Wildlife. For the upcoming years, the plan is to continue the mark and recapture study in the Cottonwood Creek drainage.

The majority of adult toads were captured early in the spring during the breeding season. This year females and males in amplexus were not tagged or scanned for recapture data. Avid PIT (Passive Integrated Transponders) tags were used to individually mark toads. The protocol outlined in the *Boreal Toad Conservation Plan and Agreement* was followed for marking toads (Loeffler 1998). The 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 with dial calipers. The toads were released at or near the point of capture.

<u>Year</u>	<u>Males Tagged</u>	<u>Females Tagged</u>	<u>Total # Tagged</u>
1998	188	26	214
1999	219	67	286
2000	77	10	87
<u>Total number of tagged toads in the Cottonwood Drainage - 587</u>			

A preliminary examination of the mark-recapture data showed a high level of breeding site fidelity by adult males. The breeding sites in the Cottonwood Creek drainage are closely situated, with many sites being within a mile of each other. Fifty males were caught at least once each year for three consecutive years -1998, 1999, and 2000. Forty nine out of the 50 toads were found at the same breeding site all three years. There have been 10 recaptures of female toads in consecutive years and all but one toad were recaptured at the same breeding site. In 1999 a female toad was tagged at Mineral Basin (approximately 2 miles north of Morgans Gulch) and recaptured this year at the Morgans Gulch breeding site.

Recapture History

214 individual toads tagged in 1998

Number of individual toads tagged in 1998 and recaptured only in 1999: 79

Number of individual toads tagged in 1998 and recaptured only in 2000: 8

Number of individual toads tagged in 1998 and recaptured in both 1999 and 2000: 50

286 individual toads tagged in 1999

Number of individual toads tagged in 1999 and recaptured in 2000: 58

Several improvements to the mark and recapture study design are needed in the future. Consistency in search effort is necessary for statistically meaningful population studies. Also, a useful addition to the study would be to record breeding activity (amplexus or egg deposition) by individual females so that, over time, breeding cycles could be examined.

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Late Metamorphosis of Toad Larvae may be due to UV-B's Impacts on Alpine Ecosystems.

Karel Rogers, Grand Valley State University, Allendale, MI

Among the variety of factors causing the decline of boreal toads, it appears that the nutritional quality of tadpole food may be an important contributor. Field experiments using mylar shielding were conducted at four boreal toad tadpole ponds to determine the impacts of UV-B radiation on algal biochemical and species composition. Samples of tadpoles were taken at three sites to determine if boreal toad tadpoles are selective feeders. Although not all members of taxonomic groups reacted the same, the density of Chlorophyta and Xanthophyceae increased and the density of Diatomaceae and Cyanophyta decreased under mylar shielding. Protein content decreased with increased UV-B exposure. Other authors have found that the biochemical composition of algae, including photosynthetic pigments, proteins, fatty acids, and carbohydrates, respond to UV-B in a species-specific manner and some respond to increased UV-B by adding protective molecules or protective coats. Because boreal toad tadpoles non-selectively eat whatever algae are present, biochemical changes in the algae are important to successful completion of their lifecycle. From the literature we know that tadpoles fed diets high in protein grow and develop quickly because some aspects of thyroid function are proportional to availability of dietary protein. Thus, slow development and late metamorphosis resulting in poor recruitment to adult populations appear to be a result of increased UV-B incidence.

This work is in press with the *Journal of Freshwater Ecology* and is titled, "Effects of incident UV-B radiation on periphyton in four alpine freshwater ecosystems in central Colorado: impacts on boreal toad tadpoles (*Bufo boreas*)". Karel Rogers, Department of Biology, Grand Valley State University, Allendale, MI, 49401-9403.

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HABITAT MANAGEMENT

Overview

Boreal toad habitat consists of areas with suitable breeding habitat in lodgepole pine, spruce-fir forests, and alpine meadows. Breeding habitat consists of shallow, quiet water in lakes, marshes, bogs, ponds, and wet meadows, often with egg placement optimizing thermal effects of the summer sun. Young toads are restricted in distribution and movement by available moist habitat, while adults can move several miles and reside in marshes, wet meadows, or upland forested areas. Although availability of adequate suitable habitat does not appear to be a significant factor in the decline of boreal toad populations, protection of such habitats, and the preservation of reliable and stable water levels in breeding habitat, are essential to the long-term viability of toad populations.

Public Lands

The large majority of known existing and potential boreal toad populations and habitats in the southern Rocky Mountains are located on US Forest Service lands and in Rocky Mountain National Park (see summary by geographic areas, earlier in this publication). Therefore, efforts to protect and enhance habitat for boreal toads are focused mainly on these lands.

At this time, protection and consideration of boreal toad habitats on US Forest Service lands is achieved via management guidance provided in various USFS documents, such as the Watershed Conservation Practices Handbook and the Region 2 Sensitive Species List. A significant number of known breeding populations are located within USFS Wilderness Areas and within Rocky Mtn. National Park, which provides additional protection of habitats from potential disturbance by disruptive land uses. In addition, cooperative efforts with individual forests are pursued in localities where boreal toad breeding populations exist. These efforts are focused at informing recreationists about boreal toads & habitats, making land managers aware of the toads' habitat needs, and incorporating considerations for boreal toad habitat protection in land use decisions on forests. It is anticipated that specific direction for boreal toad habitat conservation measures will be incorporated in individual forest management plans after review under the National Environmental Policy Act (NEPA).

Private Lands

There are a few boreal toad populations and habitats located on private lands. In Colorado, the Colorado Division of Wildlife has worked with private land owners and developers, mainly in Summit, Clear Creek, and Grand counties, on cooperative efforts to protect existing toad populations and habitats. At the Cucumber Gulch site, in Summit County, cooperative work with the town of Breckenridge and a local land developer has resulted in the adoption of a number of conditions and criteria which will help to minimize any potential impacts on boreal toads at that site. This effort will help to set a precedent for consideration of boreal toad habitats in other pending land developments in Summit County. In 1998, Vail Associates helped fund boreal toad survey work in Summit County in cooperation with the USFS and CDOW, and is working closely with several local, state, and federal

agencies to minimize potential negative impacts of planned development at the Breckenridge Ski Resort on the Cucumber Gulch wetlands, and boreal toads.

In Grand County, cooperative efforts with managers of the Pole Creek Golf Course have helped to gain consideration for boreal toads on that property, and managers of the golf course have agreed to pursue cooperative work to preserve and enhance the habitat at the two known breeding sites.

In Clear Creek County, the Climax Molybdenum Company has worked in cooperation with the Colorado Division of Wildlife at the Henderson/Urad Mine, since 1995, to help facilitate research work on boreal toads and to protect and enhance toad breeding habitat on their property. A Candidate Conservation Agreement with the US Fish & Wildlife Service is expected to be completed and approved in 2001 on this property.

Although the boreal toad populations on private lands represent a relatively small portion of the total toad population and habitat, efforts will continue to protect such sites and to minimize and mitigate impacts of land development and land use changes.

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