

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

2001-2002



**Prepared By The Boreal Toad Recovery Team
Lauren J. Livo and Chuck Loeffler, Editors**



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Colorado Division of Wildlife
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Denver, CO 80216**

January, 2003

Table of Contents

INTRODUCTION AND SUMMARY	1
ACKNOWLEDGMENTS	4
MANAGEMENT STATUS & ADMINISTRATION	5
Legal Status of the Boreal Toad	5
The Recovery Team	5
Recovery and Conservation Plans	6
Recovery Objectives and Status	7
MONITORING & STATUS OF BREEDING POPULATIONS	9
Park Range	16
Elkhead Mountains	17
Medicine Bow Range	17
Front Range	18
Gore Range	25
Mosquito and Ten-Mile Range	27
Sawatch Range	28
White River Plateau	33
Grand Mesa	33
Elk and West Elk Mountains	34
San Juan Mountains	35
BOREAL TOAD SURVEYS	38
PUBLIC INFORMATION & INVOLVEMENT	39
CAPTIVE PROPAGATION & TRANSLOCATIONS	39
Captive Propagation and Rearing	40
Experimental Translocations	42
RESEARCH	45
Studies of the Boreal Toad Population in the Henderson Mine Area	45
Survey of Boreal Toad Populations and Other Colorado Amphibians for the Chytrid Fungus, <i>Batrachochytrium dendrobatidis</i>	47
Developing and Testing a PCR-based Assay for <i>Batrachochytrium dendrobatidis</i> Fungal Infections in Amphibian Samples	49
Boreal Toad Research & Monitoring in Rocky Mountain National Park	51
Boreal Toad Research Summary 2001-2002 for Histology, Pathology, and Treatment	53
Environmental Interactions between the Chytrid Fungus <i>Batrachochytrium dendrobatidis</i> and Amphibians	55
Chaffee County Mark-Recapture Study	57
An Evaluation of Possible Causes of Decline in Two Populations of Boreal Toads in Rocky Mountain National Park: An Information-theoretic Approach.	59
Genetic Analyses of <i>Bufo boreas</i>	61
HABITAT MANAGEMENT	63
REFERENCES AND LITERATURE CITED	65

INTRODUCTION AND SUMMARY

This is the fifth in a series of 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 dendrobatidis*) - 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 was completed in 2001.

For the past five 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 and public involvement in searches for new populations of boreal toads.

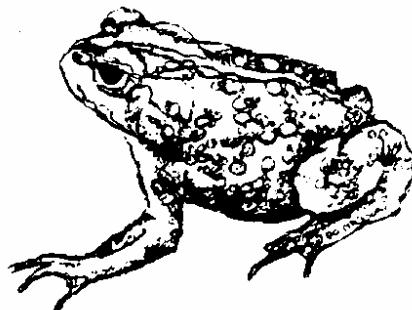
As of August 2002, the boreal toad (SRMP) is known to occur in fourteen counties (Chaffee, Clear Creek, Eagle, Grand, Gunnison, Hinsdale, Jackson, Larimer, Mesa, Mineral, Park, Pitkin, Routt, Summit) in Colorado and two counties (Albany and Carbon) in southern Wyoming. Indications are that boreal toads may also still occur in Boulder, Garfield, Gilpin, Lake, Rio Blanco, Saguache, and Conejos counties in Colorado. No confirmed reports of boreal toads have been obtained during the past two decades from Rio Arriba County, New Mexico, and it may be extirpated from this state. 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 60 known breeding localities - some having more than one breeding site - located in nine of the eleven geographic areas, or "mountain ranges of historic occurrence". The White River Plateau, an historic area of occurrence, has no recent confirmed records of occurrence of boreal toads, although unconfirmed sightings exist. A second historic area of occurrence, the Grand Mesa, had confirmed sightings of adult boreal toads in 2002, but breeding localities were not located. Based on the definition of "Breeding Population" (Loeffler 1998), the 60 breeding localities comprise 32 separate populations, of which only one (1) presently meets the criteria to be considered "viable". (See summary in Table 1). The decline in the number of "viable" populations from 1999 to 2002 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 7). 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 & 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	Tina Jungwirth, Denver, CO
New Mexico Game & Fish Department	Charles Painter, Santa Fe, NM
Wyoming Game & Fish Department	Don Miller, Laramie, WY
US Fish & Wildlife Service	Terry Ireland, Grand Jct., CO
USGS/Biological Resources Division	Erin Muths, Ft. Collins, CO
US Forest Service (Region 2)	Doreen Sumerlin, Granby, CO
US Forest Service (Region 3)	Donna Storch, Taos, NM
NPS/Rocky Mountain National Park	Therese Johnson, Estes Park, CO
Bureau of Land Management	Jay Thompson, Lakewood, CO
Environmental Protection Agency	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 Fetkovich	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	US Fish & Wildlife Service, Cheyenne, 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. Contact with the Recovery Team may be made via Tina Jungwirth as follows:

By Mail: *Tina Jungwirth, Species Conservation Section, Colorado Division of Wildlife, 4255 Sinton Road, Colorado Springs, CO 80907*
By Phone: *719-227-5237*
By E-Mail: *Tina.Jungwirth@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 into a single, comprehensive document. Therefore, in October, 1998, the existing documents were combined in the new *Boreal Toad Conservation Plan and Agreement*. This document was 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 $\frac{1}{2}$ 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 Mountains, 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. obs.). 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 an unconfirmed 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 2002.

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 Figure 1 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 60 breeding localities comprising 30 separate populations, of which only one (1) presently meets the criteria to be considered "viable" (See Table 1 on page 15). This population is the Cottonwood Creek population in Chaffee County. The decline in the number of "viable" populations from 1999 to 2002 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 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 in 2001 of 59 known breeding localites, indicates that 38 of the sites had breeding activity, 19 sites apparently were inactive, and 2 sites are of unknown status due to lack of adequate monitoring. Monitoring in 2002 of 60 known breeding localities, indicates that 38 of the sites had breeding activity, 16 sites apparently were inactive, and 6 sites are of unknown status due to lack of adequate monitoring. Breeding activity was documented in at least 22 of the 32 known populations in 2001. Breeding activity was documented in at least 24 of the 32 known populations in 2002.

Overall, boreal toad populations showed fair to good reproduction. However, in 2002, several

breeding localities remained dry or dried prior to metamorphosis due to the effects of drought. No direct (or indirect) effects of the numerous wildfires in 2002 were reported for any known breeding locality.

Additional information about the presence of chytrid in populations became available in 2002. In addition to chytrid-positive populations at Urad/Henderson (Clear Creek County), the North Fork of the Big Thompson (Rocky Mountain National Park, Larimer County), and Conundrum (Pitkin County), the following populations contained one or more chytrid-positive breeding localities: California Park (Routt County); Pole Creek (Grand County); and South Cache le Poudre (Larimer County).

Year 2001 survey efforts located one previously undocumented breeding *population* with two breeding *localities* in Grand County. The breeding localities are located in the Upper Williams Fork drainage.

Year 2002 survey efforts located one previously undocumented new breeding *locality* within a known population. The new breeding locality is in the Cottonwood Creek population (Chaffee County). In addition, three adult boreal toads were found in the Buzzard Creek drainage of eastern Mesa County, indicating the almost certain presence of a breeding population on Grand Mesa. Boreal toads were also observed in southwestern Jackson County, suggesting a possible breeding population in this area as well. Figure 2 illustrates both current known boreal toad breeding localities as well as miscellaneous recent (1992-2002) boreal toad observations thought to be reliable.

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. In this version of the Status Report, hyphens have been omitted from locality numbers to conform to usage elsewhere.

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.

In this version of the Status Report, the chytrid status from surveys conducted during 2000-2001 is reported to the right of the locality and population name. Chytrid status may be *negative* (at least one individual tested and no chytrid-positive results obtained), *positive* (at least one individual tested positive for chytrid), or *not tested* (no toads from that locality sampled).

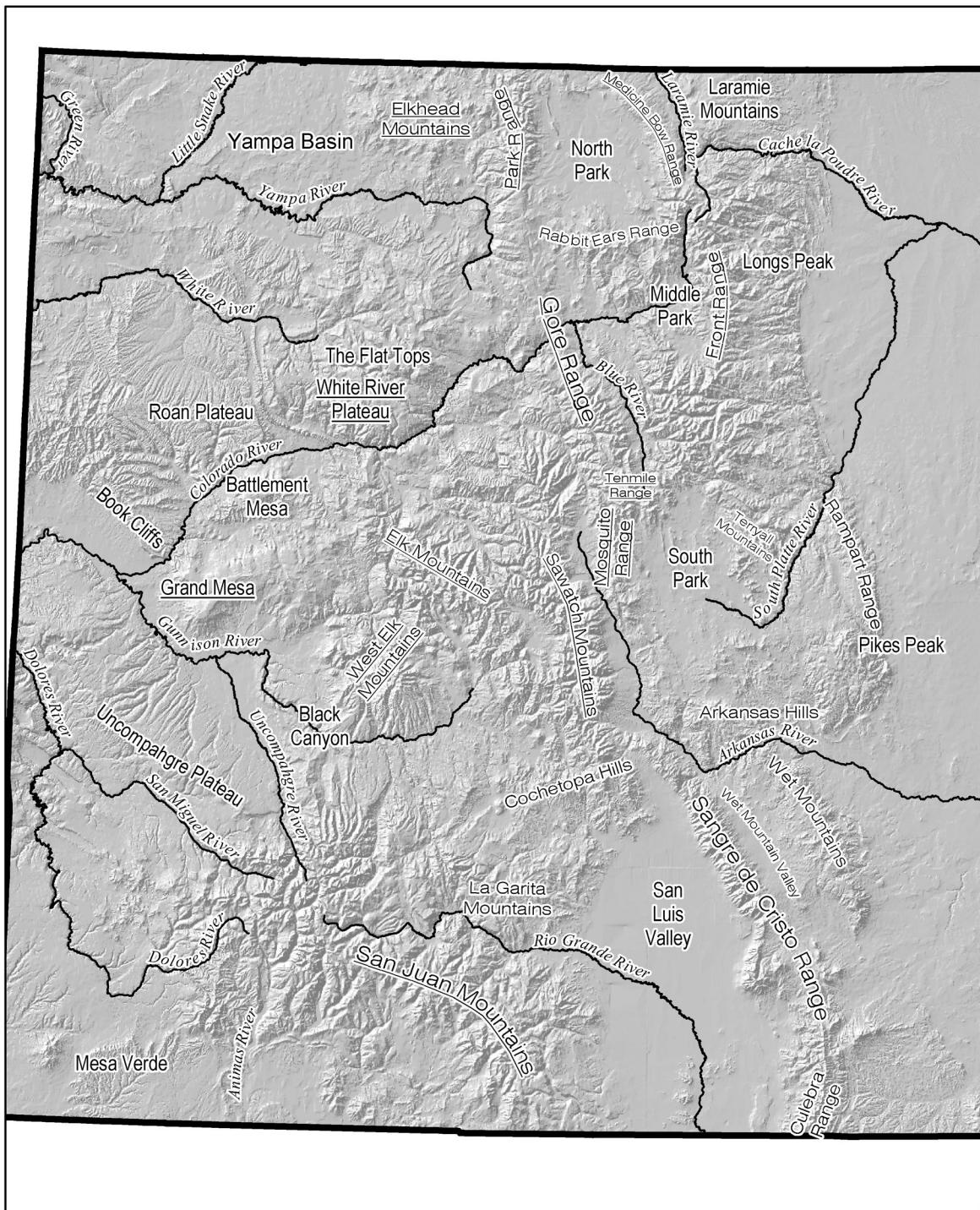
M/F/Egg Masses: This column shows the *minimum* number of breeding-age males (M), females (F), and number of viable egg masses at the locality in each year. These numbers may represent actual counts, or they may be presumed, based on other evidence. For instance, if tadpoles are observed at a locality, 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 Mountain 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 2002, as success can not be determined until the Spring or Summer of 2003, or it is known that there were no metamorphosed toadlets produced at the site in 2002.

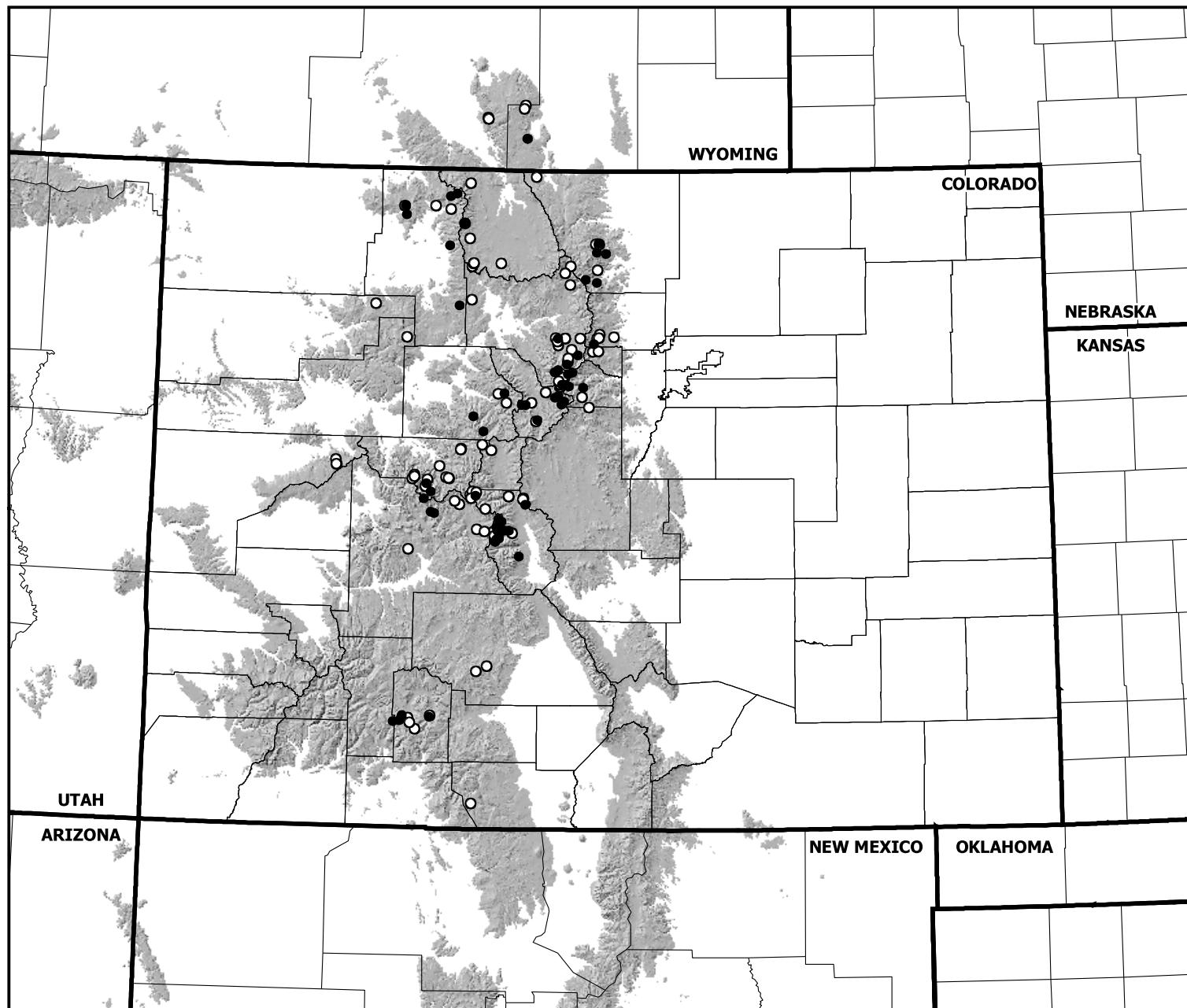
Age Classes: The first number in the entry indicates the minimum number of age classes observed/reported at a specific site. Numbers within parentheses indicate which age classes were observed: M = Metamorphs (young of the year), 1 = one year olds (new "recruits"), S = Subadults (generally two to three 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
1992-2002



Wildlife GIS



Legend

Potential boreal toad range: 8,000' - 12,000'

Observations

- Breeding Site
- Non-Breeding Site

■ State Boundaries

□ County Boundaries



Scale = 1:4,000,000

1 inch = 63.13 miles = 101.6 km

25 0 25 50

Miles

25 0 25 50

Kilometers

January 2003
Status2002.mxd

Five year summary of boreal toad breeding populations in the Southern Rocky Mountains

Jan. 2003

Geographic area (Mtn. range of historic occurrence)	Number of populations	Populations w/ breeding/recruitment					Populations w/ 20+ breeders & 4+ egg masses					"Viable" populations
		1998	1999	2000	2001	2002	1998	1999	2000	2001	2002	
Park Range	3	?/0	1/1	1/1+	2/1	2/?	0	0	0	0	0	0
Elkhead Mountains	1	1/1	0/?	1/1	1/1	1/?	0	0	0	0	0	0
Medicine Bow Range	1	0/0	0/0	0/0	0/0	0/0	0	0	0	0	0	0
Front Range	12	7/1+	6/4	6/6	8/5	8/?	3	2	3	3	3	0
Gore Range	3	1/1	3/2	3/1	3/2	4/?	1	0	1	0	1	0
Mosquito & Ten-mile Range	2	1/?	2/0	0/0	1/1	1/?	1	1	1	0	0	0
Sawatch Range	6	4/2+	5/2	3/1	4/3	5/?	0	0	0	1	2	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	1/?	2/1	2/2	2/1	2/?	1	1	1	1	1	0
San Juan Mountains	2	1/?	1/0	2/1	1/1	1/?	0	0	0	0	0	0
TOTALS	33	16/5+	18/10	18/13	22/15	24/?	6	4	6	5	7	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 the following year: # Before / = Breeding; # After / = Recruitment. NOTE: Recruitment from 2002 production can not be determined until 2003 surveys are done.

Populations w/ 20+ Breeders & 4+ Egg masses: 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 approximately Rabbit Ears Pass. It is located primarily within the Routt and Medicine Bow National Forests.

There are presently four known boreal toad breeding localities in this area. The Soda Creek population has only one known breeding locality, and the North Fork of the Elk River population has two localities as of 2002. In 2001, a breeding locality in Jackson County (deemed the Red Canyon population) was discovered.

ROUTT COUNTY

Locality RO02 - Soda Creek (Soda Creek)				Chytrid Status: Not sampled
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Unk	3 (M,2,A)	Nine metamorphs seen
1997	1/1/1	Yes	2 (M,A)	Numerous Metamorphs
1998	0/0/0	No	1(1)	Inadequate monitoring
1999	1/1/0	Yes	1(A)	One female toad seen.
2000	0/0/0	Unk	1(1)	One yearling toad seen
2001	0/0/0	Unk	None seen	Inadequate monitoring
2002	0/0/0	Unk	None seen	Inadequate monitoring

Locality RO03 - Diamond Park (N. Fork of Elk River)				Chytrid Status: Not sampled
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Yes	2 (M,A)	20 metamorphs seen
1997	1/1/1	Yes	3 (M,1,A)	Few metamorphs seen
1998	0/1/0	No	1 (1,A)	Inadequate monitoring
1999	0/2/0	No	1(A)	Only two toads seen.
2000	0/0/0	Unk	None seen	Site visited three times
2001	0/0/0	Unk	None seen	Inadequate monitoring
2002	0/0/0	Unk	None seen	One site visit

Locality RO06 - Upper Buck Mountain (N. Fork of Elk River)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	9/4/4	Yes	3 (M,S,A)	Est. <50 metamorphs
2001	6/2/2	Yes	4(M,1,S,A)	Est. 100-500 metamorphs
2002	5/2/2	Unk	3(1,S,A)	Metamorphs not observed

JACKSON COUNTY

Locality JA01 – Spike Lake (Red Canyon)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2001	1/1/1	Unk	1(M)	Two visits after discovery
2002	1/1/1?	Unk	?	Site info not provided*

This breeding locality was discovered in 2001; tadpoles and metamorphs, but no adult toads, were observed.

*Tadpoles taken from this site to NASRF in 2002, but monitoring information not submitted.

* * *

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). Although evidence of reproduction has been observed in several locations, a specific breeding site was not found until 2000 near Torso Creek.

ROUTT COUNTY

Locality RO01 - First Creek (California Park)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	0/0/0	Yes	2(2,3)	Numerous sub-adults
1996	1/1/1	Unk	2(S,A)	Larvae seen
1997	1/0/0	Unk	2(S,A)	Toads along Elkhead Cr.
1998	0/0/0	No	1(S)	Inadequate Monitoring
1999	0/0/0	No	None seen	Monitoring adequate
2000	0/0/0	No	None seen	Monitoring adequate
2001	0/0/0	No	None seen	Monitoring inadequate
2002				Not monitored

Locality RO04 - Torso Creek (California Park)				Chytrid Status: Positive
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
2001	2/1/1	Yes	4(M,1,S,A)	>50 metamorphs
2002	1/1/1	Yes	3(1,S,A)	Site dried by August visit

An enclosure was constructed around the breeding area to exclude sheep.

* * *

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, Bird Creek, located in Albany County, Wyoming. Based on historic and recent observations of toads in Carbon and Albany counties, it is likely that other breeding populations will be found in the Medicine Bow Range, given adequate survey effort. A confirmed 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 WY01 - Bird Creek (Albany)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	1/1/1	Yes	1(A)?	No counts of adults/eggs
1994	4/1/1	Yes	3(1,S,A)	
1995	4/1/1	Yes	3(1,S,A)	
1996	2/1/1	Yes	4(M,1,S,A)	17 toadlets collected
1997	3/3/3	Yes	4(M,1,S,A)	Some eggs collected
1998	0/0/0	No	2(1,S)	No reproduction seen
1999	0/0/0	No	None seen	Surveys adequate
2000	0/3/0	No	1(A)	Three & toads seen*
2001	0/1/0	No	1(A)	One female toad seen*
2002	0/1/0	Unk	1(A)	One female toad seen*

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; the female toads seen in 2001 and 2002 were not taken into captivity.

* * *

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 Mountain 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-one (21) known breeding localities, comprising twelve (12) populations, within the Front Range area as of 2002. Two sites, comprising the Upper Williams Fork population, were discovered in 2001. These breeding populations and localities are located in five counties, as

follows:

LARIMER COUNTY

Locality LR01 - Lost Lake (North Fork of Big Thompson River, RMNP) Chytrid Status: Positive

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1990	?/?/22	Unk	1(A)	Incomplete data
1991	206/28/15	Unk	1(A)	No data on sub-adults
1992	143/23/23	Unk	1(A)	No data on sub-adults
1993	77/10/?	Unk	1(A)	Incomplete data
1994	110/35/35	Unk	1(A)	No data on sub-adults
1995	122/32/32	Yes*	1(A)	No data on sub-adults
1996	43/15/15	No	1(A)	No data on sub-adults
1997	112/15/15+	No	3(M,2*,A)	15 to 20 egg masses
1998	106/12/12	Unk	2(M,A)	150+ Metamorphs seen
1999	10/10/10	Unk	1(A)	Metamorphs possible
2000	3/3/3	Unk	1(A)	Positive for chytrid
2001	0/3/0	Unk	1(A)	Only females observed
2002	0/1/0	Unk	1(A)	One female observed

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

Locality LR02 - Kettle Tarn (North Fork of Big Thompson River, RMNP) Chytrid Status: Positive

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.*
2001	2/4/3	Yes	3(M,S,A)	Metamorphs observed*
2002	2/2/2	Unk	3(M,1,A)	See note**

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

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

Locality LR03 - Spruce Lake (Big Thompson River, RMNP)				Chytrid Status: Negative
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.
2001	10/2/2	Unk	2(S,A)	Larvae observed*
2002	15/3/3	Unk	1(A)	No metamorphs observed

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

Locality LR04 - Glacier Basin (Big Thompson River, RMNP)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	1/1/0	Unk	1(A)	
1996	1/1/1	Yes	1(A)	Transplant site
1997	0/1/0	No	2(1,A)	
1998	3/0/0	Unk	1(A)	No breeding activity seen
1999	3/0/0	Unk	1(A)	No night survey done
2000	0/0/0	Unk	None seen	Monitoring adequate
2001				Not monitored
2002				Not monitored

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

Locality LR05 - Twin Lake (South Cache la Poudre)				Chytrid Status: Positive
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	1/1/1	Unk	1(A)	Tadpoles observed
1999	0/0/0	Unk	None seen	Site disturbed*
2000	0/0/0	Yes	None seen	Low water
2001	3/2/2	Yes	3(1,S,A)	No metamorphs seen
2002	1/1/1	Unk	2(S,A)	No metamorphs seen

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

BOULDER COUNTY

Locality BO01 - Lost Lake (Middle Boulder Creek)				Chytrid Status: Not tested*
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	0/1/0	No	2(M,A)	Toadlets introduced
1997	0/1/1	No	3(M,1,A)	Toadlets introduced**
1998	0/2/0	No	3(1,2,A)	No breeding observed
1999	0/0/0	No	None seen	Minimal surveys done
2000	0/0/0	No	None seen	Monitoring adequate
2001	0/0/0	No	None seen	Monitoring adequate
2002	0/0/0	Unk	None seen	Monitoring adequate

This is an experimental reintroduction site. Monitoring continued through 2002.

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

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

GRAND COUNTY

Locality GR01 - Jim Creek (Winter Park)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	5/1/?	Unk	3+(S,A)	Substantial population
1996	?/?/0	Unk	3+(S,A)	Substantial population
1997	0/0/0	Unk	None observed	Monitoring inadequate
1998	0/0/0	Unk	None observed	Monitoring inadequate
1999	0/0/0	Unk	None observed	No night survey done
2000	0/0/0	Unk	None observed	Monitoring adequate
2001	0/0/0	Unk	None observed	No night survey done
2002				Not monitored

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

Locality GR02 - Pole Creek (Pole Creek)				Chytrid Status: Positive
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	5/3/3	Unk	2(M,A)	Numerous metamorphs
1996	3/3/3	Yes	2(M,A)	Few metamorphs
1997	10/4/2	No	2(1,A)	Few, if any, metamorphs
1998	5/2/2	Yes*	2(M,A)	Monitoring marginal
1999	5/5/5	Unk	2(M,A)	Metamorphs at #4
2000	6/2/2	Yes	3(M,S,A)	One clutch desiccated
2001	9/7/7	Unk	4(M,1,S,A)	>500 metamorphs
2002	14/6/6	Yes	4(M,1,S,A)	Metamorphs present**

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.

**Metamorphs sampled on 9/23/02 were chytrid-positive.

Locality GR03 - Vasquez Creek (Vasquez Creek)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Yes*	1(A)	Found late in season
2000	0/0/0	Unk	None seen	Monitoring adequate
2001	0/0/0	Unk	1(S)	One subadult seen*
2002	0/0/0	Unk	None seen	One site visit

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

Locality GR04 – McQueary Lake (Upper Williams Fork)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2001	2/3/3	Unk	2(1,A)	No metamorphs observed
2002	8/6/6	Unk	2(M,A)	<50 metamorphs seen

This site was discovered in 2001.

Locality GR05 – Upper Williams Fork (Upper Williams Fork)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2001	2/2/2	Yes	3(M,1,A)	Metamorphs observed
2002	1/1/1	Unk	3(1,S,A)	No metamorphs seen

This site was first visited in July 2001.

SUMMIT COUNTY

Locality SU02 - Montezuma (Snake River)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	7/1/1	No	2(S,A)	Breeding unsuccessful
1996	9/?/0	No	1(A)	No breeding observed.
1997	1/1/1	Unk	1(A)	New site, vs. '95 & '96
1998	0/0/0	Unk	None seen	Monitoring inadequate
1999	3/1/1	Unk	1(A)	Tadpoles observed
2000	0/0/0	Unk	None seen	No access to property*
2001				Not monitored
2002	0/0/0	Unk	None seen	2 site visits

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

Locality SU03 - Peru Creek (Snake River)				Chytrid Status: Positive
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Yes	3(M,S,A)	May be > 3 age classes
1997	6/2/2	Unk	4(M,1,S,A)	Good metamorphosis
1998	3/1/1	Unk	2(M,A)	Monitoring inadequate
1999	14/1/1	Unk	1(A)	Monitoring minimal
2000	19/1/1	Yes	1(A)	Tadpoles seen
2001	29/1/1	Unk	2(1,A)	Inadequate monitoring
2002	2/1/1	Unk	2(M,A)	>500 metamorphs

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

Locality SU06 - Upper North Fork of Snake River (Snake River)				Chytrid Status: Positive
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	1/2/1	Unk	3(M,S,A)	1st survey mid-July
1999	1/1/1	Unk	2(S,A)	Some tadpoles seen
2000	1/1/1	Unk	2(M,A)	10-20 metamorphs seen
2001	1/1/1	Yes	2(1,A)	Inadequate monitoring
2002	1/2/1	Unk	2(1,A)	Inadequate monitoring

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

Locality SU07 - Lower North Fork of Snake River (Snake River)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	1/2/1	Unk	3(M,S,A)	1st survey mid-July
1999	1/2/0	Unk	1(A)	No breeding observed
2000	1/1/0	Unk	1(A)	No breeding observed
2001	1/0/0	Unk	1(A)	Inadequate monitoring
2002	0/0/0	Unk	None seen	Three site visits

CLEAR CREEK COUNTY

Locality CC01 - Vintage (Clear Creek West Fork)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	?/?/?	Unk	Multiple	Little data available
1995	3/2/2	Unk	2(M,A)	Prob. few metamorphs
1996	1/1/1	No	1(A)	No production
1997	1/1/1	No	1(A)	Eggs froze
1998	3/0/0	No	1(A)	No breeding observed
1999	3/0/0	No	1(A)	No breeding observed
2000	0/0/0	No	None seen	Minimal monitoring
2001	0/0/0	Unk	None seen	Minimal monitoring
2002				Not monitored

*All site visits in 2001, including night surveys, conducted in May.

Locality CC02 - Urad/Henderson (Clear Creek West Fork)				Chytrid Status: Positive
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)	
2001	14/14/14	Unk	3(M,1,A)	Some egg mortality*
2002	25/22/22	Unk	2(M,A)	Several sites dry**

This locality is comprised of several closely associated breeding sites.

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

Locality CC03 - Herman Gulch (Clear Creek)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	?/?/?	Unk	2(M,A)	Breeding observed
1994	11/11/11	Unk	2(M,A)	
1995	52/12/12	Unk	3(M,S,A)	Good production
1996	20/12/12	No	1(A)	Poor larvae survival
1997	19/10/10	Unk	3(M,S,A)	Many metamorphs
1998	10/10/10	Unk	2(M,A)	Few metamorphs seen
1999	11/11/11	Yes	1(A)	High egg mortality
2000	9/5/5	Unk	3(1,S,A)	No metamorphs seen
2001	2/2/4	Unk	3(M,S,A)	<50 metamorphs
2002	0/1/0	Unk	1(A)	No evidence of breeding

This site typically has poor egg survival, probably due to water quality problems in run-off from I-70.

Locality CC04 - Mount Bethel (Clear Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	Yes	Unk	2(M,A)	Many metamorphs
1994	Yes	Unk	2(M,A)	
1995	4/1/1	No	2(S,A)	Few, if any, metamorphs
1996	3/3/3	Unk	2(M,A)	Few metamorphs
1997	9/1/1	Unk	2(M,A)	
1998	11/3/3	Unk	2(M,A)	36+ metamorphs seen
1999	23/1/1	Yes	2(M,A)	500+ metamorphs seen
2000	29/3/3	Yes	4(M,1,S,A)	Many metamorphs seen
2001	28/6/5	Yes	4(M,1,S,A)	500+ metamorphs seen
2002	16/4/4	Yes	3(M,1,A)	Metamorphosis early

Locality CC05 - Bakerville (Clear Creek)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	1/1/1	Unk	2(M,A)	Limited data
1995	Unk	Unk	Unk	Site not monitored
1996	0/0/0	No	None seen	
1997	Unk	Unk	Unk	Site not monitored
1998	0/0/0	Unk	None seen	Inadequate monitoring
1999	0/1/0	Unk	1(A)	Inadequate monitoring
2000	0/0/0	Unk	None seen	Monitoring adequate
2001	3/0/0	Unk	1(A)	Inadequate monitoring
2002				Site not monitored

Locality CC06 - Silverdale (Clear Creek South)				Chytrid Status: Negative
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
2001	0/0/0	Unk	2(S,A)	65 subadults, 7 adults*
2002				Site not monitored

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

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 2001 or 2002.

ROUTT COUNTY

Locality RO05 - North Fork Morrison Creek (Morrison Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	10/2/2	Yes	4(M,1,S,A)	Site found late July.
2000	7/3/3	Yes	4(M,1,S,A)	<50 metamorphs seen.
2001	29/10/1	Unk	4(M,1,S,A)	Three site visits
2002	15/1/1	Unk	2(S,A)	Three site visits

EAGLE COUNTY

Locality EA03 - East Vail (Vail)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	3/1/1	Yes	3(M,S,A)	Site found late July.
2000	8/2/1	Unk	3(M,1,A)	Many metamorphs.
2001	32/4/3	Yes	3(M,S,A)	15 metamorphs seen
2002	7/1/1	Unk	4(M,1,S,A)	Hundreds of subadults

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

SUMMIT COUNTY

Locality SU04 - Upper North Tenmile (North Tenmile Creek)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	6/6/6	Unk	2(S,A)	Few, if any, metamorphs
1996	17/6/6	Unk	3(M,S,A)	Good production
1997	13/3/3	Unk	2(M,A)	Limited metamorphosis
1998	18/3/1	Yes	2(S,A)	Inadequate monitoring
1999	2/3/3	Unk	4(M,1,S,A)	Inadequate monitoring
2000	7/4/4	Unk	2(S,A)	Metamorphs likely
2001	8/2/2	Yes	1(A)	Larvae disappeared
2002	8/8/8	Unk	4(M,1,S,A)	No night survey

Locality SU05 - Lower North Tenmile (North Tenmile Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	4/2/2	Yes	2(M,A)	Few metamorphs
1997	1/2/1	Unk	2(1,A)	Little or no reproduction
1998	5/5/5	Unk	3(M,S,A)	Inadequate monitoring
1999	3/2/1	Unk	1(A)	Inadequate monitoring
2000	5/3/2	Unk	2(M,A)	Monitoring adequate
2001	3/4/3	Yes	2(M,A)	100 metamorphs seen
2002	2/2/2	Unk	3(M,1,A)	No night survey

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 2002 there are only two known boreal toad breeding localities in this geographic area, as follows:

SUMMIT COUNTY

Locality SU01 - Cucumber Gulch (Breckenridge)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	1/1/1	No	3+(M,S,A)	Mult. age classes seen
1996	?/?/0	No	2(S,A)	No breeding observed
1997	2/1/1	No	1(A)	Recruitment doubtful
1998	1/0/0	Unk	1(A)	Monitoring minimal
1999	1/1/1	Unk	1(A)	No metamorphs seen
2000	0/1/0	Unk	1(A)	Monitoring adequate
2001	0/0/0	Unk	None seen	Monitoring adequate
2002	0/0/0	Unk	None seen	5 site visits by CNHP

Development has occurred around this site.

CHAFFEE COUNTY

Locality CF07 - Fourmile Creek (Buffalo Peaks)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	3/1/0	No	1(A)	No breeding observed
1996	2/2/2	Yes	2(M,A)	Numerous metamorphs
1997	3/3/3	Yes	4(M,1,2,A)	Good production
1998	1/1/1	Unk	4(M,1,S,A)	Late egg clutch
1999	6/3/2	Unk	2(S,A)	Eggs lost to desiccation
2000	1/0/0	Unk	1(A)	Monitoring adequate
2001	10/4/4	Yes	2(M,A)	Ca. 100 metamorphs
2002	1/2/1	Unk	2(1,A)	Tadpoles disappeared

* * *

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 seventeen (17) known breeding localities within this area. Fourteen (14) 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 twelve sites in the Cottonwood Creek drainage of Chaffee County, including a breeding locality discovered in 2002, comprise the most substantial remaining metapopulation of boreal toads in the Southern Rocky Mountains, and presently is the only population which meets the viability criteria in the Conservation Plan.

CHAFFEE COUNTY

Locality CF01 - Collegiate Peaks Camp Ground (Cottonwood Creek)				Chytrid Status: Negative
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
2001	12/6/6	Yes	3(M,S,A)	Numerous metamorphs
2002	21/4/3	Unk	4(M,1,S,A)	About 200 metamorphs

Locality CF02 - Denny Creek (Cottonwood Creek)				Chytrid Status: Negative
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	Yes	4(M,1,S,A)	Good production
2001	52/22/22	Yes	4(M,1,S,A)	Numerous metamorphs
2002	27/13/13	Unk	4(M,1,S,A)	Only 1 metamorph seen

Locality CF03 - Hartenstein Lake (Cottonwood Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	5/?/?	Unk	1(A)	Limited data
1995	29/6/6	Unk	1(M,A)	Few metamorphs seen
1996	10/2/2	Yes	2(M,A)	Metamorphs presumed
1997	12/5/5	Unk	2(M,1,A)	Many metamorphs
1998	31/7/5	Yes	3+(M,S,A)	1st year of PIT tagging
1999	64/10/9	Unk	2(1,A)	Predation by mallards
2000	57/14/14	Yes	2(M,A)	Few metamorphs
2001	69/5/5	Yes	3(1,S,A)	Four yearlings seen
2002	21/4/4	Unk	(M,1,S,A)	Metamorphosis early

Locality CF04 - South Cottonwood Creek (Cottonwood Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	24/3/3	Unk	3(M,S,A)	Numerous metamorphs
1996	12/4/4	Yes	2(M,A)	Good production
1997	26/3/3	Yes	4(M,1,2,A)	Numerous metamorphs
1998	35/7/7	Yes	4(M,1,S,A)	1st year of PIT tagging
1999	45/11/11	Yes	3(M,1,A)	Numerous metamorphs
2000	54/10/10	Yes	4(M,1,S,A)	Numerous metamorphs
2001	51/5/5	Yes	4(M,1,S,A)	Numerous metamorphs
2002	26/5/5	Unk	4(M,1,S,A)	Low water levels*

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

Locality CF05 - Brown's Creek (Brown's Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	2/3/1	Yes	2(S,A)	Metamorphs unlikely
1996	4/4/4	Unk	3(M,S,A)	Few metamorphs
1997	2/2/2	Unk	3(M,2,A)	Fair metamorphosis
1998	0/1/0	Unk	1(A)	No breeding observed
1999	3/2/2	Unk	2(M,A)	Snake predation
2000	0/0/0	Unk	None seen	Monitoring adequate
2001	1/2/1	Unk	2(M,A)	5 metamorphs seen
2002	2/3/1	Unk	1(A)	Tadpoles disappeared

Locality CF06 - Kroenke Lake (Cottonwood Creek)				Chytrid Status: Negative
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 subadult seen
2001	9/1/1	Unk	3(M,S,A)	4 metamorphs, 1 subadult
2002	2/2/2	Unk	2(M,A)	15 metamorphs seen

Locality CF08 - Morgan's Gulch (Cottonwood Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1997	19/6/6	Yes	2(M,A)	Many metamorphs
1998	24/1/1	Yes	4(M,1,S,A)	Eggs late season
1999	40/3/3	Unk	4(M,1,S,A)	One egg mass not viable
2000	17/5/5	Unk	2(S,A)	Few or no metamorphs
2001	12/5/5	Unk	3(M,S,A)	30 metamorphs seen
2002	10/0/0	Unk	2(S,A)	No breeding observed*

*Pond dried by mid-June in 2002.

Locality CF09 - Sayre's Gulch (South Fork Lake Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1997	9/1/1	Unk	1(A)	Site found late in season
1998	34/2/2	Unk	2(S,A)	Metamorphs few, if any
1999	4/4/2	Unk	2(S,A)	Larvae lost to mallards*
2000	8/5/5	Unk	2(S,A)	No early-season survey*
2001	13/5/5	Yes	2(S,A)	Larvae apparently lost**
2002	21/6/6	Unk	4(M,1,S,A)	

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

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

Locality CF10 - South Cottonwood Creek - West (Cottonwood Creek) Chytrid Status: Negative

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	2/2/2	Yes	2(M,A)	Excellent production
1999	9/9/9	Yes	3(M,1,A)	Good production
2000	19/9/9	Yes	3(M,1,A)	Good production
2001	26/7/7	Yes	4(M,1,S,A)	Numerous metamorphs
2002	14/5/5	Unk	4(M,1,S,A)	Numerous metamorphs

Locality CF11 - Rainbow Lake (Cottonwood Creek) Chytrid Status: Not tested

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	4/3/3	Unk	1(A)	Larvae lost to mallards
2000	1/1/1	Unk	2(S,A)	One sub-adult seen
2001	2/1/1	Yes	1(A)	Tadpoles disappeared*
2002	3/2/2	Unk	2(1,A)	Tadpoles disappeared

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

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

Locality CF12 - Middle Cottonwood (Cottonwood Creek) Chytrid Status: Not tested

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	13/1/1	Unk	4(M,1,S,A)	8 one-year olds seen
2000	9/1/1	Unk	3(M,S,A)	Few metamorphs seen
2001	11/4/4	Yes	3(M,S,A)	100 metamorphs seen
2002	14/3/3	Unk	4(M,1,S,A)	15 metamorphs seen

Locality CF13 - Denny Creek West (Cottonwood Creek) Chytrid Status: Not tested

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	5/2/2	Unk	1(M,1,A)	5 metamorphs seen
2000	1/0/0	Unk	1(A)	Minimal monitoring
2001	3/0/0	No	1(A)	Adequate monitoring
2002	3/3/3	Unk	3(1,S,A)	Metamorphosis possible*

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

Locality CF14 - Denny Creek South (Cottonwood Creek) Chytrid Status: Not tested

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Unk	3(M,S,A)	4 sub-adults seen
2000	1/0/0	Unk	1(A)	Dried up mid-summer
2001	2/2/2	No	1(A)	Egg masses desiccated
2002	0/0/0	No	None seen	Site dry

Marginal site, subject to desiccation.

Locality CF15 – Holywater Beaver Ponds (Cottonwood Creek) Chytrid Status: Not tested

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2002	3/3/3	Unk	1(M)	About 50 metamorphs

*Site discovered on July 3, 2002. No adults or subadults observed, and egg count estimated.

EAGLE COUNTY

Locality EA01 - Holy Cross City (Holy Cross City) Chytrid Status: Not tested

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Unk	1(A)	Predation & late season
1997	1/1/1	Unk	1(A)	Recruitment unlikely
1998	2/2/2	Unk	1(A)	Inadequate monitoring
1999	2/0/0	Unk	1(A)	Inadequate monitoring
2000	1/0/0	Unk	1(A)	Inadequate monitoring
2001	1/1/1	Unk	None seen	5 visits to site*
2002	2/1/1	Unk	1(A)	Breeding pond dried**

*Report of boreal toad tadpoles at this site in July 2001 by Bill Andree.

**In 2002, the breeding pond dried, probably before tadpoles could metamorphose.

Locality EA02 - East Lake Creek (East Lake Creek) Chytrid Status: Not tested

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Unk	3(M,S,A)	Site found 8/13/96
1997	Unk	Yes	Unk	Site not monitored
1998	3/0/0	Yes	2(1,A)	Inadequate monitoring
1999	4/4/4	Yes	3(M,1,A)	No night survey done
2000	2/2/2	Unk	3(1,S,A)	Minimal monitoring
2001	1/0/0	Yes	1(A)	Only one adult male seen*
2002	2/2/2	Unk	3(1,S,A)	14 adults seen (not sexed)

Two closely associated breeding sites at this locality.

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

GUNNISON COUNTY

Locality GU03 - Magdalene Gulch (Texas Creek)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Unk	2(M,A)	Site found late in season
2000	2/1/0	Unk	1(A)	Adequate monitoring
2001	0/0/0	Unk	None seen	Inadequate monitoring
2002	0/0/0	Unk	None seen	One site visit

* * *

White River Plateau

This geographic area includes southwestern Routt County, eastern Rio Blanco County, northeastern Garfield, and northwestern 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 likely that one or more breeding sites may 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.

Historically, boreal toads were abundant on the Grand Mesa. Extensive surveys have been conducted on Grand Mesa, but despite this effort, no confirmed observations of boreal toads were made for approximately 25 years. In 2002, two field crews working in the Buzzard Creek drainage of Mesa County observed a total of three adult boreal toads. Photographs were taken of two of the toads, confirming the identification. In addition, tadpoles were observed along the same reach of stream as two of the toads. However, the identification of the tadpoles as boreal toad tadpoles was not confirmed. Intensive surveys in the Buzzard Creek drainage should be a high priority activity for the 2003 field season. Such surveys should be conducted early enough in the season to maximize the opportunity to find breeding sites. Samples should be taken from any boreal toad egg masses for rearing at NASRF. Further, blood samples should be taken from any toads encountered for genetic analysis.

Grand Mesa is a high priority site for a possible experimental translocation of boreal toads. An area along Kanah Creek in Mesa County has been identified as a possible translocation site. This area is approximately 24 miles southwest of the toad locations along Buzzard Creek. In addition to the straight-line distance, several drainages occur between these two sites that would impede movement

of boreal toads and prevent contact between natural and translocated populations.

* * *

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. However, no additional breeding localities were found during the 2001-2002 field seasons.

PITKIN COUNTY

Locality PI01 - Conundrum Creek (Conundrum Creek)				Chytrid Status: Positive
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	3/1/1	Yes	2+(S,A)	Minimal monitoring
1996	1/1/1	Unk	2+(S,A)	Many metamorphs
1997	2/2/2	Unk	2(2,A)	Poor production
1998	2/2/0	Unk	1(A)	Inadequate monitoring
1999	0/0/0	Unk	Unk	Site not monitored
2000	2/2/2	Unk	2(M,A)	Adequate monitoring
2001	3/9/3	Yes	2(M,A)	100 metamorphs seen
2002	1/1/1	Unk	2(M,1)	Many metamorphs*

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

Locality PI02 - East Maroon Creek (Conundrum Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	3/3/3	Yes	4(M,1,S,A)	Several ponds at site
2001	3/3/3	Yes	3(1,S,M)	Adults not observed
2002	3/3/3	Unk	4(1,M,S,A)	Breeding in 2 ponds

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

GUNNISON COUNTY

Locality GU01 - Triangle Pass (White Rock Mountain)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	3/3/3	Unk	1(A)	Metamorphs unlikely
1994	Unk	Unk	Unk	No data
1995	1/1/1	Unk	2(S,A)	Metamorphs unlikely
1996	Unk	Yes	Unk	No monitoring
1997	2/2/2	Yes	4(M,1,S,A)	Many metamorphs
1998	17/5/5+	Unk	4(M,1,2,A)	Many metamorphs
1999	19/5/4	Unk	2(M,A)	No night survey done
2000	13/13/13	Unk	3(M,S,A)	One subadult seen.
2001	18/14/11	Yes	2(M,A)	No night survey done
2002	16/17/16	Unk	3(1,S,A)	No visits after 7/25/02

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

Locality GU02 - West Brush Creek (White Rock Mountain)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Unk	2(M,A)	<50 metamorphs seen
2000	0/0/0	Unk	None seen	Inadequate monitoring
2001	0/1/0	Unk	1(A)	Inadequate monitoring
2002	0/0/0	Unk	None seen	One site visit

Locality GU04 - Brush Creek (White Rock Mountain)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	3/3/3	Yes	4(1,2,S,A)	Minimal monitoring
2001	6/1/1	Unk	3(1,S,A)	Minimal monitoring
2002	23/5/1	Unk	2(S,A)	Minimal monitoring

* * *

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 into 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) was 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. However, breeding at the West Trout Creek site (in Hinsdale County) supports the legitimacy of the Trout Creek observations.

There have been several good reports of observations of boreal toads from other localities in the San Juan Mountains, 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 MI01 - Jumper Creek (Trout Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	3/0/?	Unk	1(A)	1st toad observation
1995	Unk	Unk	Unk	Breeding likely
1996	4/2/1+	Yes	2(M,A)	Breeding observed
1997	8/3/3	Yes	3(M,1,A)	Many metamorphs
1998	7/1/2	Unk	4(M,1,S,A)	
1999	3/2/2	Unk	3(M,S,A)	<50 metamorphs seen
2000	4/2/2	Yes	1(A)	Site dessicated
2001	4/1/1	Unk	3(M,1,A)	<50 metamorphs seen
2002	0/0/0	Yes	1(1)	Site dry; 3 1-yr-olds seen

Locality MI02 - Trout Creek (Trout Creek)				Chytrid Status: Not tested
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1(See note)	No	None seen	Tadpoles observed
1997	0/0/0	No	None seen	
1998	0/0/0	No	None seen	
1999	0/0/0	No	None seen	Only one site visit
2000	0/0/0	Unk	None seen	Minimal monitoring
2001	0/0/0	Unk	None seen	Minimal monitoring
2002	0/0/0	Unk	None seen	Minimal monitoring

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

Locality MI03 – Roaring Fork Pond (Goose Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	1/1/1	Unk	2(M,A)	Site found late season
2001	3/0/0	Unk	1(A)	Minimal monitoring
2002	1/1/1	Unk	None seen	One egg mass; 2 visits

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

HINSDALE COUNTY

Locality HI01 - West Trout Creek (Trout Creek)				Chytrid Status: Negative
Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
2000	2/2/2	Unk	2(M,A)	Site found mid-season
2001	4/4/4	Yes	4(M,1,S,A)	Minimal monitoring
2002	1/1/1	Unk	2(1,A)	1 visit, 6 1-yr-olds seen

* * *

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, Sawatch Mountains, 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 seven previously unknown breeding populations located in Routt, Eagle, Jackson, Grand, Gunnison, and Mineral counties, and twelve new breeding localities within known populations in Routt, Chaffee, Grand, Gunnison, Jackson, Mineral, and Hinsdale counties.

In both 2001 and 2002, one female boreal toad was observed at Bird Creek, Albany County, Wyoming. No boreal toads were observed at Rock Creek Park in 2002. However, five juvenile toads were located in Ryan Park. Four juvenile toads were observed along the North Fork of the Little Laramie River. In 2002, personnel reported 430 hours of amphibian survey work at approximately 50 localities in southeastern Wyoming. Extensive surveys also were conducted in western Wyoming in 2002, yielding numerous toad and breeding site observations. Samples were collected for analysis to determine the relationships of these toads with those in the Southern Rocky Mountain population.

Surveys done in 2001 and 2002 in the Lagunitas Lake, Canjilon Lake, Middle Trout Lakes, and Upper Trout Lakes, in New Mexico, by personnel from the Carson National Forest, resulted in no observations of boreal toads.

In 2001, CNHP crews surveyed 98 sites in 11 Colorado counties (Chaffee, Eagle, Garfield, Gunnison, Jackson, Lake, Moffat, Park, Pitkin, Routt, and Saguache counties). Eight of the surveys resulted in observations of one or more boreal toads. In 2002, CNHP crews surveyed 73 sites in nine counties (Boulder, Chaffee, Eagle, Gunnison, Lake, Larimer, Park, Pitkin, and Summit counties). Four of the 2002 surveys yielded observations of boreal toads. Of particular note are toads observed in 2001 at Buffalo Meadows (Park County), in 2001 and 2002 near Taggart's Lake (Pitkin County), in 2001 near Clear Creek Reservoir (Chaffee County), and in 2002 along Sanford Creek (Gunnison County). Survey work by CDOW personnel in 2001 resulted in observations of a toad along Mill Creek (Gunnison County).

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. Ongoing survey efforts will continue, with a focus on locations from which 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 & 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 and 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 & 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 chance 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 are in the process of revision 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 43), 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" was produced in 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 (NASRF), near Alamosa, CO. In order to minimize risk of losing 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 Saratoga National Fish in Wyoming, and at various AZA certified zoos, including, as of January 2003, the Henry Doorly Zoo (Omaha, NE), the Cheyenne Mountain Zoo (Colorado Springs, CO), the Cincinnati Zoo (Cincinnati, OH), Morrison Museum of Natural History (Morrison, CO), Ocean Journey (Denver, CO), and the Toledo Zoo (Dayton, Ohio). The primary purpose of establishment of captive stocks is to preserve genetic diversity in the event of catastrophic die-offs. Secondarily, 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. In December 2002, revised husbandry methods for NASRF were summarized in the "Native Aquatic Species Restoration Facility boreal toad husbandry manual."

Colorado Native Aquatic Species Restoration Facility (NASRF)

Currently 611 toads are at NASRF, of which 363 are being hibernated during the winter of 2002-2003. NASRF houses representatives from 18 different boreal toad breeding localities throughout the state. In the spring of 2002 NASRF succeeded in getting two year old toads that had emerged from hibernation to reproduce in captivity with the use of hormones. The progeny were used to aid researchers in studying chytrid fungus.

Sybille Wildlife Research Center

On December 18, 2000, Saratoga National Fish Hatchery (SNFH) received official notification of approval from the Director, U.S. Fish and Wildlife Service, to house in refugia and breed Boreal toads (*Bufo boreas boreas*). Due to the increased loss of boreal toads housed at Sybille Wildlife Research Center (Sybille), the Wyoming Game and Fish Department, along with the Boreal Toad Recovery Team, made a decision to move all remaining captive populations from Wyoming of the Southern population Boreal toads to SNFH. The Hatchery received 1 male and 3 female Bird Creek boreal toads on December 12, 2001.

On July 28, 2001, at the direction of the Wyoming Game and Fish Department, a private landowner from Ryan Park delivered a female boreal toad to SNFH. In July 2002, U.S. Forest Service employees delivered 3 juvenile boreal toads to SNFH, sex unknown.

Due to the low numbers of boreal toads remaining in the Southern population, it has been directed by the Boreal Toad Recovery Team, along with the Wyoming Game and Fish Department, to capture all located toads in southern Wyoming, and deliver them to SNFH for refugia.

Boreal toads at Saratoga National Fish Hatchery (as of January 2003)

	Male	Female	Unknown
Bird Creek boreal toads	1	3	0
Ryan Park boreal toads	0	1	3

Cheyenne Mountain Zoo

In 1993, personnel from the Cheyenne Mountain 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 Mountain Zoo had died due to unknown causes.

In 2000, the Cheyenne Mountain 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 Mountain Zoo for captive rearing and propagation work. As of September, 2002, all these toads remained alive.

Henry Doorly Zoo

Due to the limited number of known breeding boreal toads remaining in the San Juan Mountain 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. Ten additional toadlets from 2000 egg masses were sent to Henry Doorly Zoo. As of September 2002, a total of eleven toads were still alive.

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 September 2002, thirteen 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) Colorado's Ocean Journey, in Denver, (2) Colorado Division of Wildlife, in Ft. Collins, (3) Colorado Division of Wildlife, in Durango, (4) the Morrison Natural History Museum, in Morrison, and (5) the Cincinnati Zoo, in Cincinnati, Ohio. 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. It is anticipated that a studbook will be established by mid-2003.

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 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.

Glacier Basin, in Rocky Mountain National Park, was the site of an experimental translocation of boreal toads, which began in 1995. It is a cooperative effort between Rocky Mountain 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 Mountain National Park (See Muths et al., 2001).

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 have been observed at Lost Lake since 1999, although some monitoring has continued through 2002.

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 2000-2002 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, approximately 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 in Clear Creek County, and evidence of the presence of chytrid fungus in at least two other populations. Some initial testing of resident amphibians has been conducted at the Kanah Creek drainage (Mesa County), with no chytrid positive specimens of tiger salamanders or chorus frogs to date. During a January, 2003 meeting of a subgroup of the Boreal Toad Recovery Team and Technical Advisory Group, it was determined that an effort would be made to experimentally translocate eggs and/or tadpoles derived from Hartenstein Lake (Chaffee County) in 2003. A specific protocol for this translocation effort is under development.

* * *

RESEARCH

Studies of the Boreal Toad Population in the Henderson Mine Area

Lauren J. Livo, University of Colorado and CDOW

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

Lack of snowfall during the winter of 2001-2002 resulted in open water appearing at breeding sites as early as late April. In addition, some sites (Power Alley, Hesbo, and Anne's Pond) that normally hold water either were dry during the breeding season or became dry well before tadpoles could complete development.

The **Hesbo** site was monitored at night weekly from May 3 to June 4, 2002. The peak of breeding activity occurred on May 20 with 16 adults observed (10 male, 6 female). Seven egg masses were deposited, however water levels declined rapidly. Before the site dried completely, approximately 3000 tadpoles were transferred to the Upper Urad site; no tadpoles survived at Hesbo.

The **Power Alley** site was not monitored because it remained dry throughout the season.

The **Upper Urad** site was monitored at night on May 20, 2002, and frequently visited throughout the remainder of the summer, but no toads or egg masses were observed. A few of the transferred tadpoles were seen in July but had disappeared by early August. No metamorphs were observed.

The **Donut** site was monitored at night from May 3 to June 4, 2002. Additional daylight surveys were conducted throughout the summer. The peak of breeding activity occurred on May 20 with 8 adults (6 male, 2 female). Eleven egg masses were observed, resulting in approximately 15,000 tadpoles. Metamorphosis began by August 1, when 150 metamorphs were 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. In September, newly metamorphosed toadlets were observed under several rocks surrounding the pond. We placed

flagging at these rocks to use in early 2003 to determine whether toadlets could overwinter successfully in these locations.

The **Anne's Pond** site was visited weekly throughout May. However, it began with very low water levels and then became dry. No toads or evidence of reproduction was observed at this site in 2002.

Radio Telemetry

Fifteen toads (all males) were radio tagged in May and June 2002 at Hesbo and Donut with Holohil BD-2G radio transmitters weighing 2g each. 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. The primary objective of following radio tagged individuals in 2000 was to monitor mortality associated with chytridiomycosis. Toads were followed weekly, but the short life remaining on the radios for the 2002 season resulted in toads being followed a mean of only 8.6 days (S.E. = \pm 2.2 days, range 1 – 23 days, N = 15) before radio failure or toad death.

Sentinel Tadpoles

Sentinel tadpoles were placed at several sites to determine whether they could be used to detect chytrid in the environment. In 2001-2002, tadpoles were placed at known chytrid-positive sites in the Urad Valley. In addition, tadpoles were placed at Lost Lake (Boulder County; a former translocation site); on the Grand Mesa (Mesa and Delta counties; areas that may be future translocation sites); and at the Henderson Mill Site (Grand County).

Tadpoles or toadlets were maintained in field enclosures for one to two weeks. After euthanization, the specimens and samples were stored in 70 percent ethanol. Each tadpole sample submitted for PCR testing consisted of mouthparts pooled from five individuals, while each toadlet sample consisted of a small piece of the pelvic patch pooled from five individuals.

Of 68 samples submitted to date (19 pooled pelvic patch samples and 49 pooled mouthpart samples), all but three have tested chytrid negative, despite 38 samples deriving from sites in the Urad Valley, a chytrid positive area. These preliminary results indicate that this method of sampling does not reliably detect chytrid even from chytrid-positive localities.

* * *

Survey of Boreal Toad Populations and Other Colorado Amphibians for the Chytrid Fungus, *Batrachochytrium dendrobatidis*

Lauren J. Livo, University of Colorado and CDOW

Little is known about the distribution and prevalence of the chytrid fungus, *Batrachochytrium dendrobatidis*, in Colorado amphibian populations. During the 2000 and 2001 field seasons, I collected samples for PCR testing from 538 amphibians from 75 localities. Emphasis was on obtaining samples from boreal toad populations, of which 213 samples were collected from 34 sites.

I obtained water samples from each amphibian by soaking it for two hours in 10 ml of distilled water in an attempt to collect the *Batrachochytrium* zoospores. A skin scrape sample was obtained by gently scraping a sharpened wooden stick on the ventral and pelvic patch regions. A toe clip was obtained by removing the rear, right toe of the amphibian with a pair of fine scissors. Toe clips and wood sticks were placed in 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. Samples were submitted to Pisces Molecular for PCR testing.

Initially, all samples were tested at 35 cycles of amplification (see following research summary by John Wood, Pisces Molecular). Results presented here represent 45 cycle test results. Although skin scrape and toe samples were approximately equal in their likelihood of producing a positive result, water samples were much less sensitive in detecting chytrid in a chytrid-positive amphibian.

Chytrid-positive PCR tests were obtained from boreal toads in the following populations: Torso Creek (Routt County); Twin Lake (Larimer County); Kettle Tarn (Larimer County); Pole Creek (Grand County); Urad/Henderson (Clear Creek County); North Fork of the Snake (Summit County); Peru Creek (Summit County); and Conundrum (Pitkin County). To date, 12 percent of the sampled boreal toads tested chytrid-positive. At present, no Chaffee County populations appear to be affected by chytrid.

Eight of 10 other amphibian species sampled in Colorado had at least one chytrid positive individual. Chytrid positive species include: tiger salamander (*Ambystoma tigrinum*), Woodhouse's toad (*B. woodhousii*), Great Plains toad (*B. cognatus*), chorus frog (*Pseudacris triseriata*), bullfrog (*Rana catesbeiana*), wood frog (*R. sylvatica*), northern leopard frog (*R. pipiens*), and Plains leopard frog (*R. blairi*). Chytrid-negative species include: Plains spadefoot (*Spea bombifrons*; 21 samples from five localities) and canyon treefrog (*Hyla arenicolor*; 1 sample). A group of hybrids between northern leopard frogs and Plains leopard frogs also yielded chytrid-negative results. Chytrid was geographically widespread in the sampled populations.

In some areas, chytrid-positive amphibian populations were present within a relatively short distance of an apparently chytrid-negative population. For example, four miles separate the chytrid-positive Urad Valley boreal toads and chytrid-negative Mount Bethel boreal toads in Clear Creek County. In Boulder County, approximately two miles separate the chytrid-positive bullfrogs at the Cherryvale

Pond site from chytrid-negative northern leopard frogs at a South Boulder Creek site. Where these situations exist, the chytrid-negative sites are either higher in the drainage or separated by a barrier such as a ridge.

Because chytrid-negative and chytrid-positive amphibian populations may exist in proximity to one another, decontamination and survey policies may need to be revised. At present, sites lower in a drainage usually are surveyed first, followed by surveys of sites higher in the same drainage. However, within a drainage, it may be prudent to survey the uppermost sites first, and move down the drainage to conduct subsequent surveys. This modification of survey procedures may help limit the likelihood of surveyors bringing the chytrid fungus to new sites.

* * *

Developing and Testing a PCR-based Assay for *Batrachochytrium dendrobatidis* Fungal Infections in Amphibian Samples

John Wood, Pisces Molecular, Boulder, CO.

Using an initial PCR protocol and primer sequences developed by Dr. Seanna Annis at the University of Maine, we have further developed and tested the PCR protocol for specificity and sensitivity in detecting the presence of *B. dendrobatidis* in a variety of amphibian sample types.

The target *B. dendrobatidis* DNA sequence used in the PCR test was initially determined by Dr. Annis and is in the ribosomal RNA gene cluster. Utilizing the primer sequences chosen by Dr. Annis, we amplify and detect an approximately 290 bp fragment of *B. dendrobatidis* genomic sequence, beginning in the Intervening Transcribed Sequence 1 (ITS-1) region, spanning the 5.8S rRNA gene, and ending in the ITS-2 region. As shown in Table 1, using DNA preparations from cultures provided by Dr. Joyce Longcore, we have completed experiments which confirm lack of cross-reactivity of the *B.d.* specific primers with a broad range of fungal species across the Chytridiomycota phylum.

Table 1: Testing specificity of PCR protocol and primers

Organism tested	Order	Amplification with <i>B. d.</i> specific primers?
<i>B. dendrobatidis</i> (JEL-197, JEL-270 & JEL-275)	<i>Chytridiales</i>	yes
JEL-72 - <i>Nowakowskia clade</i>	<i>Chytridiales</i>	no
JEL-93 - <i>Karlingiomyces</i> sp.	<i>Chytridiales</i>	no
JEL-142, JEL-150, JEL-151, JEL-291 - <i>Rhizophydiump</i> sps.	<i>Chytridiales</i>	no
JEL-183 - <i>Gonapodya</i> sp.	<i>Monoblepharidales</i>	no
JEL-204	<i>Blastocladiiales</i>	no
JEL-205	<i>Spizellomycetales</i>	no
JEL-301 - <i>Chytridium</i> clade	<i>Chytridiales</i>	no

We have tested the sensitivity of the PCR protocol with *B. dendrobatidis* zoospore dilutions from Lauren Livo and Cindy Carey. As shown in Table 2, the sensitivity of the test is markedly improved using 45 cycles of amplification instead of the more commonly used 35 cycles, and with 45 cycles, the sensitivity of the procedure is approximately 10 zoospores in a 5 ml sample.

We have tested the PCR protocol with a variety of types of samples from amphibians, including different tissue parts or fragments, as well as “toad wash” solutions from Lauren Livo as shown in Table 3. Initial data with triplicate skin scrape, toe, and toad wash samples from the same animals indicated that the toad wash samples were not as sensitive for detecting the presence of *B. dendrobatidis*.

We have successfully detected *B.d.* in samples preserved in 70% ethanol as well as in the buffers recommended by Dr. Annis (tissue samples: 0.25M EDTA, pH8, saturated NaCl; water samples:

0.1M Tris, 0.1 M NaCl, 0.1 EDTA, 10% lauryl sarcosine, pH7.5); however we do not have sufficient data yet to determine if these buffers are adequate to prevent sample degradation during long term storage. Additionally, reactions between these buffers and the subsequent DNA extraction chemistry (primarily precipitate formation), has led us to suggest for the moment that samples should be preserved either by freezing or in 70% ethanol at room temperature.

Table 2: Testing sensitivity of PCR protocol

# zoospores/5 ml	# samples tested	PCR results	
		35 cycles	45 cycles
1,000,000	2	1 +++, 1 ++	all +++
100,000	2	1 +++, 1 ++	all +++
10,000	3	2 +, 1 w+	all +++
1,000	4	all w+	2 +++, 2 ++
100	4	all -	1 +++, 3 +++
10	4	all -	2 +, 2 -
1	4	all -	all -
0	4	all -	all -

scoring: +++ = very strong positive, ++ = strong positive, + = positive,
w+ = weak positive, - = negative/not detected

Table 3: PCR Testing different type of samples

Sample type	PCR Results
Skin scrapings	Good
Toes	Good
Washes	Less sensitive
Pelvic patch	Good
Tadpole mouthparts	Good
Sentinel tadpoles	In progress
Pond water	In progress

The results of PCR testing “sentinel” tadpole samples have not been encouraging so far. Most samples tested have been negative, which doesn’t yet allow a determination of whether there is a problem with the DNA extraction procedures, or with the tadpole exposure procedures. Initial experiments filtering pond water suggest that it is possible to filter, extract, and PCR amplify *B.d.* DNA from pond water samples. More comprehensive experiments are being planned to determine what volume of water can be reasonably filtered and what sensitivity level (zoospores per liter) can be attained.

* * *

Boreal Toad Research & Monitoring in Rocky Mountain National Park

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

Boreal toads have been monitored in the North Fork Drainage of the Big Thompson River since the early 1990s (Corn et al. 1997). The populations in this drainage (Kettle Tarn and Lost Lake, possibly one metapopulation) crashed between 1995 and 1998 (Muths et. al. in press). We have continued to monitor these populations and began intensive monitoring at Spruce Lake, the only other known breeding site for boreal toads in the Park, in 2000. Two of three boreal toad populations are in severe decline (Muths et al. in press) and the third is very small. Efforts are directed at site protection, monitoring and the completion of the amphibian health evaluation project.

Lost Lake was visited 4 times and only 1 female boreal toad was detected. Kettle Tarn was visited 13 times; boreal toads were detected on 6 of 13 visits. 2 – 5 individuals were found at Kettle Tarn (Table 1). The number is ambiguous because on 2 occasions, 2 individuals were in amplexus and on 1 occasion we found 1 female. We were unable to get a PIT tag reading (individual identification) on any of the amplexing animals. This means that there could be only 1 female that we have seen 3 times and 1 male that we have seen twice, or 3 different females and 2 different males. One pair of toads produced an egg mass. About 2/3 of the egg mass appeared infertile, but some eggs hatched and several thousand tadpoles survived.

The Colorado Division of Wildlife released approximately 1100 boreal toad tadpoles at Kettle Tarn on 13 June 2002. The tadpoles were hatched at the CDOW Native Aquatic Species Restoration Facility in Alamosa, CO. The eggs came from clutches produced by 2 separate pairings of 4 boreal toads (2 males and 2 females) taken from Kettle Tarn in 2000 as per recommendations from the boreal toad recovery team as part of an effort to maintain the various genetic lineages from Southern Rocky Mountain boreal toads in captivity. These tadpoles were larger than the tadpoles from the local egg mass and were easy to distinguish. It is important to note that this release was not discussed by the boreal toad recovery team and was approved by the Native Aquatic Species Restoration Facility. It should be clear that this “project” was not a scientifically designed program and was without clear objectives or protocols.

On 31 July, we located < 100 metamorphic boreal toads in crevices and mud cracks at the edge of the water. These individuals had absorbed their tail and were metamorphosed completely. We were not able to determine whether they were from the released cohort or the local cohort. On that date, Kettle Tarn was < 0.5 acre in size, 0.5 m deep at the center and < 15 cm deep along most of the shoreline. There was an expanse of mud flat between the water and usual shoreline (during non-drought years) and there was no emergent vegetation. By 28 September, Kettle Tarn was reduced to a puddle (approximately 1 m²) with less than 10 cm of water (Fig. 1) and was dried completely by early October. It is unknown whether any of the metamorphs observed in July survived to the fall or were able to find suitable hibernacula.

Spruce Lake was visited 9 times and boreal toads were detected on 5 visits. There are too few capture – recapture data to derive estimates of the population size with any confidence. Based on observations

and the number of toads we have recaptured, the population at Spruce Lake appears to be relatively small. To date, there is no evidence of chytrid fungus at Spruce Lake (D.E. Green, DVM, pers. comm.). We recommend maintaining the early season (15 May – 15 July), partial closure of Spruce to protect nursery habitat and to continue to encourage anglers to bleach their waders and other equipment before visiting Spruce Lake.

* * *

Boreal Toad Research Summary 2001-2002 for Histology, Pathology, and Treatment

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A. Histologic Examination of "Death Kit" Amphibians

Carcasses of selected wild boreal toads and other amphibians occupying boreal toad habitat found dead by biologists were collected into "death kits". Samples in formalin were forwarded to my laboratory in Illinois for histologic examination. These allow for surveillance for chytridiomycosis and other amphibian diseases as they occur at various sites throughout the state. For instance, in 2000 histologic evaluation of death kit samples identified an animal with chytridiomycosis at the Conundrum breeding pond in Pitkin County, a site in which this disease was not previously recognized. Nineteen animals were submitted in 2001 and consisted of 13 *Bufo boreas*, 3 *Rana pipiens*, 2 *Ambystoma tigrinum*, and 1 *Pseudacris* sp. Five *Bufo boreas* were submitted in 2002. In 2001, 2 animals with chytridiomycosis were identified. The first was a *Rana pipiens* (initially identified as *Rana blairi*) from the Alamosa blanca wetlands; to my knowledge, this is the first finding of this disease from this site. The second was an adult *Bufo boreas* from the Henderson Mine, Hesbo Pond site and this confirms continued occurrence of chytridiomycosis at this location. All 5 animals from 2002 were histologically negative for chytridiomycosis.

B. Diagnostic Pathology of Selected Captive Boreal Toads

Carcasses of captive boreal toads are periodically submitted for necropsy evaluation in order to monitor disease trends within the captive population kept for display, education, and maintenance of genetic diversity. In 2002, 3 carcasses were evaluated; 1 each from the CDOW office in Fort Collins, the Alamosa Hatchery and Colorado's Ocean Journey in Denver. Squamous metaplasia of the tongue (in which the normal sticky mucous-producing epithelium of the tongue is replaced by squamous epithelial cells) was identified in the CDOW office animal. This finding is significant because microscopic changes in the tongue strongly resemble those observed in captive Wyoming toads with "short tongue syndrome" which is thought to be caused by a vitamin A deficiency. Vitamin A deficiency within populations can be related to immunodeficiency and poor reproductive success. Additional research on captive boreal toad diets and determination of liver levels of vitamin A (retinol) in both captive and wild boreal toads may be necessary as the captive breeding program is developed. Hepatic (liver) retinol levels from a single wild boreal toad provided by L. Livo and submitted to the Nutrition Laboratory of the Wildlife Conservation Society demonstrated retinol levels of 62.96 ug/g. This is interpreted as being within the range of normal as based on results from wild Wyoming, American and Southern toads. For comparison, captive Wyoming toads with suspected vitamin A deficiency had mean hepatic retinol levels of approximately 2 ug/g (Pessier AP et al: "Short Tongue Syndrome", Lingual Squamous Metaplasia and Suspected Hypovitaminosis A in Captive Wyoming Toads. Proceedings Association of Reptilian and Amphibian Veterinarians, 2002, pp 151-153. Retinol analysis of captive boreal toads has not been performed to date. The animal submitted for necropsy from the Alamosa hatchery had an intestinal impaction likely caused by ingestion of a large piece of the polyacrylamide polymer used for providing water to the crickets used for food. While this

may have been a freak occurrence, measures should be taken in the future to avoid placement of this material within toad enclosures. Finally, the toad from Colorado's Ocean journey was submitted following suspicion that it may represent a case of chronic epimyocarditis syndrome observed in other toads from that institution in 1999 and 2000. The cause of the epimyocarditis (inflammation of the tissues surrounding the heart, resulting in heart failure) has not been determined to date, with suspect organisms including *Mycoplasma* sp., and *Chlamydophila* sp. The animal submitted in 2002, did not appear to have epimyocarditis on gross necropsy examination, however, histopathology is pending. Surveillance for epimyocarditis in dead animals from other institutions housing boreal toads may be necessary to determine the significance of this disease entity.

C. Evaluation of Treatment Methods for Chytridiomycosis

An experimental study was conducted in the fall of 2002 to evaluate the efficacy of the commonly used 0.01 % itraconazole bath treatment protocol for elimination of the amphibian chytrid fungus *Batrachochytrium dendrobatidis* from the skin of infected toads. A smaller subset of toads were also treated with the chitin synthesis inhibitor lufenuron for activity against *B. dendrobatidis*. Experimentally-infected boreal toads will be evaluated using histology and the newly-developed PCR assay for evidence of chytrid infection following treatment with itraconazole and lufenuron. Untreated animals will serve as controls. The conclusion and results of this study are pending performance of the PCR assay and evaluation of the histologic sections. Results will help to determine if itraconazole treatment can reliably eliminate chytrid infections from captive animals or wild animals brought into captivity.

Environmental Interactions between the Chytrid Fungus *Batrachochytrium dendrobatidis* and Amphibians

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

Recent laboratory experiments have examined the environmental interactions between chytrid fungus (*Batrachochytrium dendrobatidis*) and amphibians, especially boreal toads. We studied:

- Effects of the chytrid zoospore dose used to expose animals
- Chytrid zoospore ability to be transmitted in the water
- Effects of boreal toad body size on survival after exposure to chytrid zoospores

In addition, studies were conducted to determine how chytrid kills amphibians, pH and temperature effects related to chytrid, and effects of antimicrobial peptides on amphibian resistance to chytrid infection.

With respect to differing levels of zoospore dosage, while even a small number of zoospores resulted in infection, small dosages took longer to kill exposed toads compared to large doses. Further, multiple exposures killed faster than single exposures. Toads became infected by chytrid after being placed in water used by infected toads. Survival time of infected toads was not affected by whether the toads were maintained at 12C or 23C. Smaller infected animals survived a shorter time compared to larger animals.

In culture, chytrid grows well at pH levels between 5 and 8, with maximum growth rates at about pH 6.5. However, mortality rates of infected toads did not differ regardless of the pH at which they were held.

In nature, boreal toads thermoregulate to temperatures between 25 and 30C on sunny days, but their body temperatures fall close to freezing at night. A series of experiments examined the effect of fluctuating temperatures on toad survival after chytrid exposure. In culture, chytrid grows well at 12C, but best at about 23C. Growth is slow at 4C, and no growth is observed at 30C. When exposed to fluctuating temperatures, chytrid grew best at 12 and 23C, but little growth occurred with temperature fluctuations between 4 and 30C. Toads were exposed to chytrid, then experimental groups of toads were maintained at either constant temperatures or at fluctuating temperatures in which the cooler temperatures were experienced at night and the warmer temperatures during the day. When temperatures involved spending the days at 30C, the survival of infected toads was better, often approaching that of the non-infected control toads. However, when chytrid-exposed toads were moved out of the 30C regime, mortality occurred.

All strains of the chytrid that infect amphibians are considered members of a single species, *Batrachochytrium dendrobatidis*. Boreal toads were exposed to the type strain as well as to strains isolated from amphibians in Colorado, Arizona, and Panama. Toads exposed to the type and Colorado isolates had the shortest survival time. Other isolates also killed exposed toads, but took a longer time. Tiger salamanders and chorus frogs can occupy the same sites as boreal toads, so

can act as reservoirs for this pathogen.

Tadpole studies addressed a series of questions, including whether vulnerability differed by developmental stage, whether exposure affected growth and development, whether tadpoles could carry a chytrid infection through metamorphosis, and whether infected tadpoles could be a source of infection for metamorphosed toads. All the samples for boreal toad tadpoles exposed to a single dose of chytrid fungus and submitted for PCR testing have come back chytrid negative, but future experiments will vary exposure conditions. One observation is that up to 10% of control tadpoles had mouthpart abnormalities, so mouthpart abnormalities by themselves are not sufficient to indicate chytrid infection.

In a follow-up study, boreal toad tadpoles were exposed to daily doses of chytrid fungus for one to two weeks. In these experiments, exposed tadpoles yielded chytrid positive PCR test results and had higher rates of mouthpart abnormalities than control tadpoles. Histology of mouthparts by Allan Pessier is pending.

An experiment to determine whether chytrid cultured in broth produced a toxin did not result in excess mortality in northern leopard frogs. However, it did change the ion balance in the frogs. Another remaining question is whether chytrid infection stimulates skin growth or whether skin growth is an attempt by the amphibian to eliminate the infection.

Ambystoma tigrinum virus (ATV) has been documented from several localities in the United States and Canada, including sites in the mountains of Colorado. We conducted an experiment to determine whether ATV could cause illness or mortality in amphibians other than tiger salamanders. Boreal toads, northern leopard frogs, and tiger salamander larvae were exposed to two strains of ATV isolated from tiger salamanders in Colorado. Although the virus caused mortality in the tiger salamanders, there was no evidence of transmission to boreal toads or northern leopard frogs.

* * *

Chaffee County Mark-Recapture Study

Brad Lambert, CNHP, Ft. Collins

In 2002 we continued our mark-recapture study in the Cottonwood Creek drainage in Chaffee County. This project began in 1998 and has continued through 2002. The study took place at the following breeding sites: Collegiate Peaks Campground, Denny Creek, Denny Creek West, South Cottonwood Creek, South Cottonwood West, Morgan's Gulch, Rainbow Lake, Hartenstein Lake and Middle Cottonwood Creek. The purpose of the mark-recapture study is to collect baseline data for evaluating population size, trends and survival rates. The data collected are also useful for detecting toad movement between breeding sites and examining breeding site fidelity by adult toads.

At each site adult toads within the study area were collected in buckets or mesh bags and were processed on site after the area was surveyed. The majority of adult toads were captured early in the spring during the breeding season. Avid PIT (Passive Integrated Transponders) tags were used to individually mark toads. Only toads weighing more than 20g were marked. The protocol outlined in the *Boreal Toad Conservation Plan and Agreement* was followed for marking toads (Loeffler 2001). An incision was made with sterile scissors and the PIT-tag was inserted on the dorsal side, horizontal to the toad's mid-dorsal line. The entry wound was sealed with New Skin Liquid Antiseptic Bandage. The toads were weighed with an Acculab 0-250g electronic scale and measured snout to vent with dial calipers. The toads were then released near the point of capture.

Year	Males Tagged	Females Tagged	Total # Tagged
1998	188	26	214
1999	219	67	286
2000	77	10	87
2001	123	43	166
2002	99	28	127

Total number of adult toads tagged 1998-2002 in the Cottonwood Creek drainage - 880

The mark-recapture data have shown a high level of breeding site fidelity by adult males and females. Most of the breeding sites in the Cottonwood Creek drainage are closely situated, several being with 1-2 km of each other. Despite their ability to cover relatively large distances, only seven recaptured toads out of the 1124 total recaptures were captured at different breeding sites. The data reveals that, although rare, there is movement by toads between the Denny Creek and Hartenstein Lake breeding sites and the South Cottonwood Creek and South Cottonwood Creek West sites. One notable adult male was tagged at Collegiate Peaks Campground in 1999 and was recaptured in 2002 at the South Cottonwood Creek site approximately 8 km away. This is the first time there has been any evidence that there is movement between the population in the Middle Cottonwood Creek drainage and the population in the South Cottonwood Creek drainage.

As a result of the mark-recapture study, breeding cycles in females have also been examined. There have been 22 recaptures of adult females in separate years; 55% were captured in consecutive years,

50% were captured in alternate years, and 5% were recaptured after a two year absence. The data indicates a varied pattern of female breeding cycles, assuming that an adult female captured at a breeding site during the breeding season indicates a breeding attempt.

Several parameters are currently being examined from the data set. Population estimates using a closed-population model should be available from several of the breeding sites and an open population model is being considered to look at population estimates and survival rates from the pooled data. Another parameter that will be examined is overall recapture rates. The goal is to continue the mark-recapture study in the Cottonwood Creek drainage in future years to better understand the demography of one of the largest known metapopulations of boreal toads left in Colorado.

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An Evaluation of Possible Causes of Decline in Two Populations of Boreal Toads in Rocky Mountain National Park: An Information-theoretic Approach.

Rick D. Scherer, Colorado State University

Two populations of boreal toads (*Bufo boreas*) in Rocky Mountain National Park, Colorado have been annually sampled since 1991 using capture-recapture techniques. These populations were once among the largest in the state (Hammerson 1999). However, both populations have experienced recent declines in abundance and appear to be approaching extinction (Muths et al. in press). *Batrachochytrium dendrobatidis* (chytrid fungus) was identified on live and dead boreal toads from these populations suggesting that fungal infection is the cause of death in examined toads and a proximate cause of the decline (Muths et al. in press). However, other hypotheses have not yet been evaluated. This project used the information-theoretic approach (Burnham and Anderson 1998) and the existing capture-recapture data sets from these populations to evaluate climate change and introduced disease as causes of the declines. Based on the literature on amphibian declines and the ecology of the boreal toad and chytrid fungus, *a priori* hypotheses were developed that related annual apparent survival rate and recruitment rates of adult males to various climatic variables. These hypotheses were expressed as mathematical models. In addition, models that reflect the expected behavior of annual apparent survival and recruitment rates in the presence of an introduced, highly virulent pathogen were developed. Then, both sets of models were fit to the available data. Model selection based a version of Akaike's information criterion for overdispersed count data (QAIC_c) was used to determine which model or set of models most parsimoniously represented the information contained in the data. The analysis was conducted using Program MARK.

There were three important results from this analysis. First, models that reflected an introduced pathogen scenario had strong support in the data. There was little evidence that climate change has played a role in the declines of boreal toads at Kettle Tarn and Lost Lake, either through effects on survival or recruitment rates of adult males. Second, estimates of both parameters showed large declines in the year the pathogen was introduced into the populations. The top model in the analysis of survival rates showed a decrease in annual apparent survival probability from 0.82 to 0.008 in the year the pathogen was introduced into the populations. The most highly ranked climate model had a $\Delta\text{QAIC}_c = 5.67$. The top model in the analysis of recruitment rates showed a decrease in annual recruitment rate of adult males from 0.29 to 0.008 once the pathogen was introduced into the populations. The most highly ranked climate model had a $\Delta\text{QAIC}_c = 11.27$. Finally, this analysis suggests that the PIT tagging procedure used to mark individual toads may have problems. Survival rates for individuals that were tagged at the beginning of a year are much lower than survival rates for individuals that were tagged at least a year previous. There are several possible reasons for this result, but evidence suggests it is due to PIT tag loss.

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Genetic Analyses of *Bufo boreas*

Anna Goebel, University of Colorado Museum

All *Bufo boreas* in the Southern Rocky Mountain (SRM) group (Colorado and south central Wyoming) are very closely related as indicated by their mitochondrial DNA (mtDNA) and nuclear DNA profiles. They belong to the divergent eastern mitochondrial DNA clade that includes toads from Utah, southeast Idaho, Colorado and southern Wyoming. However, geographic barriers do not seem to parallel genetic divergence to the north of the SRM group, in west central Wyoming. The dry deserts of western Wyoming appear to be a geographic barrier between toads in the SRM and those from Sawmill Creek, Sublette Co., Wyoming (west central Wyoming), but toads in these regions are not genetically distinct. In contrast, toads from Yellowstone National Park in northwest Wyoming are highly divergent in their mtDNA (belong to the divergent northwestern mtDNA clade), yet geographic barriers between Sublette and Yellowstone Counties are not apparent.

Eight samples, from Buck and Chall Creeks, west central Wyoming, were collected in 2001. Both nuclear DNA amplified fragment length polymorphisms (AFLPs) and mtDNA control region sequences were collected in 2002. These data were analyzed together with all previously collected mtDNA and nuclear AFLP data from toads of the SRM group as well as others from the eastern portion of the toad's distribution.

The mtDNA control region sequences of all eight samples from Buck and Chall Creeks were identical. Parsimony analysis of the control region sequences identified these toads as belonging to the northwest mtDNA clade. In contrast, toads from Sawmill Creek, Sublette Co., WY, and Albany Co., WY, were in the SRM group of the eastern mtDNA clade. The profile of nuclear AFLP fragments collected from Buck and Chall Creeks, WY, was nearly identical to the profile of fragments from Sawmill Creek, WY. The profile was very similar to a number of samples from the SRM group, and was easily distinguishable from toads from southeastern Idaho (Caribou, Co.), the sister group to the SRMs. Unlike the toads from Sawmill Creek, which had both mtDNA and nuclear DNA profiles closely related to the SRM group, the mtDNA and nuclear profiles from toads from Buck and Chall Creeks differed and each showed a close relationships to different divergent groups. The mtDNA inferred a relationship to the northwest mtDNA clade, but the nuclear data inferred a close relationship to the eastern, specifically the SRM, group.

Although toads from the northwest and southwest mtDNA clades occur together in central California, a region of overlap between the northwest and eastern mtDNA clades has not been identified. The new data did not identify overlap between the mtDNA clades, although the geographic proximity of Sawmill Creek (with mtDNA from the SRM group) and Buck and Chall Creeks (with mtDNA from the northwest group) suggest that overlap may occur in this region. The new data did identify individual animals with conflicting mtDNA and nuclear DNA group identity. However, a clear pattern of nuclear DNA divergence in the region is not yet evident; although nuclear DNA data from toads in Oregon clearly are highly divergent and belong the northwest group, nuclear DNA data from Yellowstone and regions further north are lacking.

Two kinds of data are needed to understand the evolutionary history of toads in this region. First, both mitochondrial and nuclear DNA need to be examined from toads in western and central Wyoming in order to identify the pattern of genetic divergence and possible geographic migration routes between west central Wyoming and the SRM group. Second, nuclear DNA needs to be examined from toads in Yellowstone and surrounding regions to the north in order to determine if nuclear divergence parallels the high mtDNA divergence.

Genetic analyses of toads within the captive-breeding group are ongoing. Nuclear DNA profiles have been generated from all breeding adults and from three known siblings sets. This data will be combined with previously collected data, to estimate three levels of divergence: divergence between known siblings, divergence within populations, and divergence between populations within the SRM group. These estimates will assist mate choice within the captive-breeding program. For the best interpretation of the nuclear data, it is important to combine the AFLP data previously collected by manual methods (about 130 samples of the SRM group and portions of the eastern clade), with the data currently being collected by automated methods (about 60 samples from the same regions).

I am grateful to the very large number of people that collected samples for this analysis; the work could not be done without them. Mark Jones, Colorado Division of Wildlife, provided the funding for this analysis. The work was completed in the Biotechnology Department of the Community College of Aurora (Todd Bergren, Biotechnology Department Chair).

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 Mountain 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. However, a Candidate Conservation Agreement with the US Fish & Wildlife Service is still pending for this property as of January 2003.

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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