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

1999

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

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Chuck Loeffler, Coordinator/Editor
Colorado Division of Wildlife
6060 Broadway
Denver, CO 80216

March, 2000

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INTRODUCTION AND SUMMARY

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

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

Research in the mid-1990s regarding the genetics of the boreal toad in the southern Rocky Mountains has revealed that this population is a genetically monophyletic lineage, and may warrant classification as a separate subspecies, or even a separate species, within the genus *Bufo*. The recently published "Amphibians and Reptiles in Colorado", by Geoffrey Hammerson, 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 priortity 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. Also, in 1995, the State of Colorado and the US Department of the Interior entered in to a Memorandum of Agreement which committed the State of Colorado and agencies in the Department of the Interior to collaborate and cooperate in management and conservation of declining populations of fish and wildlife, such as the boreal toad, and their habitat. 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. New agreements, signed in 1999, include the Colorado Natural Heritage Program at Colorado State University, and the Carson National Forest, New Mexico.

For the past three years, the recovery team has worked on plans and actions to implement recovery and conservation efforts for the boreal toad. Work to date has involved several state and federal resource management agencies, personnel from universities, the Colorado Natural Heritage Program, and various other interested parties - including local land use planners and private land owners. Management activities to date have included (1) the conducting of surveys of historic and potential suitable habitats for new toad populations, (2) the annual monitoring of known breeding populations, (3) research work to identify and evaluate both biotic and abiotic limiting factors to toad survival, (4) research to better define good boreal toad habitat and boreal toad biology/ecology, (5) development and testing of techniques and protocols for captive breeding and rearing of boreal toads, (6) experimental reintroductions of toads to vacant historic habitat, (7) protection of boreal toads and their habitats via coordination with land management agencies - in particular with the US Forest Service, (8) work with local land use planners and developers aimed at avoiding or minimizing potential impacts of private land development on boreal toads and their habitat, and (9) efforts to increase public awareness of this species and its plight via informationa lucational activities & public involvement in searches for new populations of boreal toads.

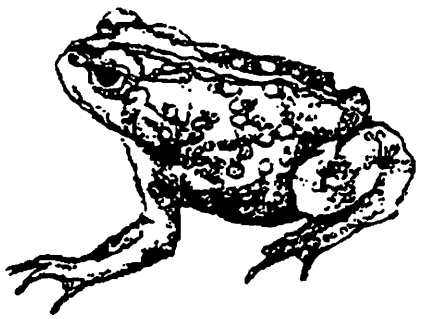
As of the end of 1999, the boreal toad is known, or believed, to still occur in at least 15 counties in Colorado, two counties in Wyoming, and possibly one county in New Mexico. This is based on surveys, monitoring of breeding sites, and on confirmed or reliable observations of individual boreal toads during recent years. Breeding populations have been documented during the past five years in 12 counties in Colorado, and at one location in Wyoming. There are presently 50 known breeding localities - some having more than one breeding site - located in nine of the eleven geographic areas, or "mountain ranges of historic occurrence". Two of the historic areas of occurrence (White River Plateau and Grand Mesa, Colorado) have no recent confirmed records of occurrence of boreal toads. Based on the definition of "Breeding Population" (Loeffler 1998), the 50 breeding localities comprise 29 separate populations, of which only five (5) presently meet the criteria to be considered "viable". (See summary table on page 12).

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. Due to the changes in the criteria, direct comparisons of the level of achievement of recovery goals from 1997 to 1998 & 1999 may not accurately reflect actual progress towards recovery (See "Recovery Objectives and Status", page 5). Significant progress has been made with the boreal toad recovery and conservation effort in the past four 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 solicitation of volunteer help, 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.



MANAGEMENT STATUS AND ADMINISTRATION

Legal Status of the Boreal Toad

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

The Recovery Team

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

Boreal Toad Recovery Team

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

Colorado Division of Wildlife	Chuck Loeffler, Denver, CO
New Mexico Game & Fish Dept.	Charles Painter, Santa Fe, NM
Wyoming Game & Fish Dept.	Don Miller, Cheyenne, WY
US Fish & Wildlife Service	Terry Ireland, Grand Jct., CO
US Forest Service (Region 2)	Dave Winters, Denver, CO
US Forest Service (Region 3)	Donna Storch, Taos, NM
Bureau of Land Management	Jay Thompson, Lakewood, CO
USGS/Bio. Resources Division	Stephen Corn, Missoula, MT
NPS/Rocky Mtn. National Park	Therese Johnson, Estes Park, 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
Anna Goebel	University of Colorado, Boulder, CO
David Felley	US Fish & Wildlife Service, Cheyenne, WY
Mark Jones	Colorado Division of Wildlife, Ft. Collins, CO
Don Kennedy	Denver Water Board, Denver, CO
Lauren Livo	University of Colorado, Boulder, CO
Erin Muths	USGS/Biological Resources Division, Ft. Collins, CO
Jeremy Siemers	Colorado Natural Heritage Program, Ft. Collins, CO
Michelle VanVleet	University of Wyoming, Laramie, WY

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

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

By Mail:	Chuck Loeffler, Species Conservation Section, Colorado Division of Wildlife, 6060 Broadway, Denver, CO 80216.
By Phone:	303-291-7451 (Denver, CO) OR 719-481-1902 (Monument, CO)
By E-Mail:	chuck.loeffler@state.co.us OR LoeffCC@aol.com

Recovery and Conservation Plans

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

In 1998, the Recovery Team agreed that it would be in the best interest of the recovery effort to revise and combine the State Recovery Plan and the draft Conservation Strategy in to a single, comprehensive document. Therefore, in October, 1998, the existing documents were combined in the new, *Boreal Toad Conservation Plan and Agreement.* This document 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 March, 2000, 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).

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.

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

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 two (2) out of the past five (5) years. However, if breeding activity has not been documented in the past three (3) 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 three years.

OR

2. There has been an average total of at least twenty (20) breeding adults at the breeding locality, producing an average of at least four (4) viable egg masses per year, and the number of breeding adults observed at the locality has remained stable or increased over a period of at least five (5) years.

AND

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

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

Breeding population:

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

Breeding Locality:

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

Breeding Site:

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

Recruitment:

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

* * *

MONITORING & STATUS OF BREEDING POPULATIONS

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

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

Since the listing of the boreal toad as a state endangered species in Colorado, in 1993, efforts to survey known historic and potential toad habitats, and to monitor known existing breeding populations, has been intensified. The following is a summary of what is known about boreal toad occurrence, distribution and status as of late 1999.

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), are based on the documentation and/or establishment of a certain number of secure populations within each of the "mountain ranges of its historic distribution". These are presently recognized to include the Park Range, Elkhead Mountains, Medicine Bow Range, Front Range, Gore Range, Mosquito & Ten-Mile Range, Sawatch Range, White River Plateau, Grand Mesa, Elk & West Elk Mountains, and the San Juan Mountains. The "mountain ranges of historic occurrence" are presented in this report in roughly geographic order from north to south. See page 10 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 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 50 breeding localities comprising 29 separate populations, of which 6 presently meet the criteria to be considered "viable" (See summary table on page 12). In most cases, breeding populations are defined such that there is normally no migration of toads between populations. However, due to the continuity of habitat, and the fact that breeding populations can occur in separate drainages which are in close proximity at their headwaters, some populations may be closer to each other than the minimum 5-mile separation, and some toads may occasionally migrate from one to the other by crossing high mountain passes. A case in point would be the Conundrum Creek population in Pitkin County and the White Rock Mtn. (Triangle Pass) population in Gunnison County. In a straight line they are within 5 miles of each other, but they are located in different primary drainages, separated by a 12,500'+ mountain pass. Whereas these localities are in different major drainages, they are considered parts of different populations.

Monitoring of the 50 known breeding localities in 1999 showed that 35 of the sites had breeding activity, 11 sites apparently were inactive, and 4 sites are of unknown status due to lack of adequate monitoring. Overall, boreal toad populations showed fair to good reproduction. However, the first clear evidence of the presence of the pathogenic chytrid fungus was found in Colorado. A die-off occurred at the Urad/Henderson locality in the summer of 1999, and preliminary evidence suggests that the chytrid fungus may be present in other areas. (See reports on pages 35 and 37 for more information).

1999 survey efforts located of four previously undocumented breeding *populations*, and five new breeding localities within known populations. The new populations include Vasquez Creek in Grand County, East Vail in Eagle County, Morrison Creek in Routt County, and Texas Creek in Gunnison

County. Four new breeding *localities* were found in the Cottonwood Creek population in Chaffee County, and one new locality was identified in the White Rock Mtn. population in Gunnison County.

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 site for that county. All breeding localities within a specific county may not fall within the same geographic area, or "mountain range of historic occurrence".

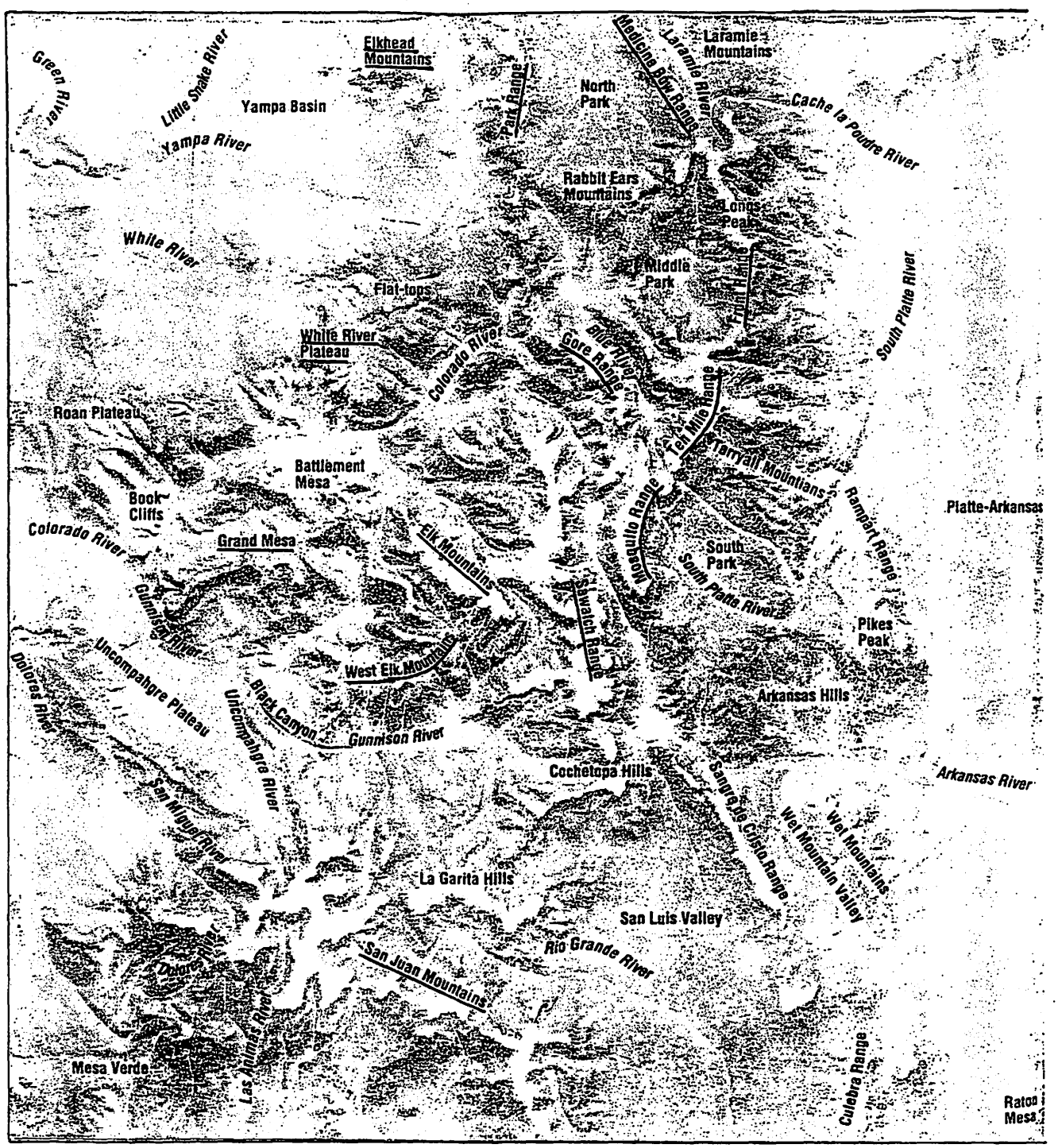
Locality and Population Names: After the locality number will be the name of the locality, followed by the name of the population of which it is considered a part. The population name is in parentheses, and in some cases may be the same as the locality name.

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

Recruitment: A "Yes" entry means that one-year-old toadlets were observed at the site in the Spring of the *following* year. For example; one year old toadlets in June, 1997, would indicate successful recruitment from the 1996 breeding season, and would be so 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 1999, as success can not be determined until the Spring or Summer of 2000, or it is known that there were no metamorph toadlets produced at the site in 1999.

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).

* * *



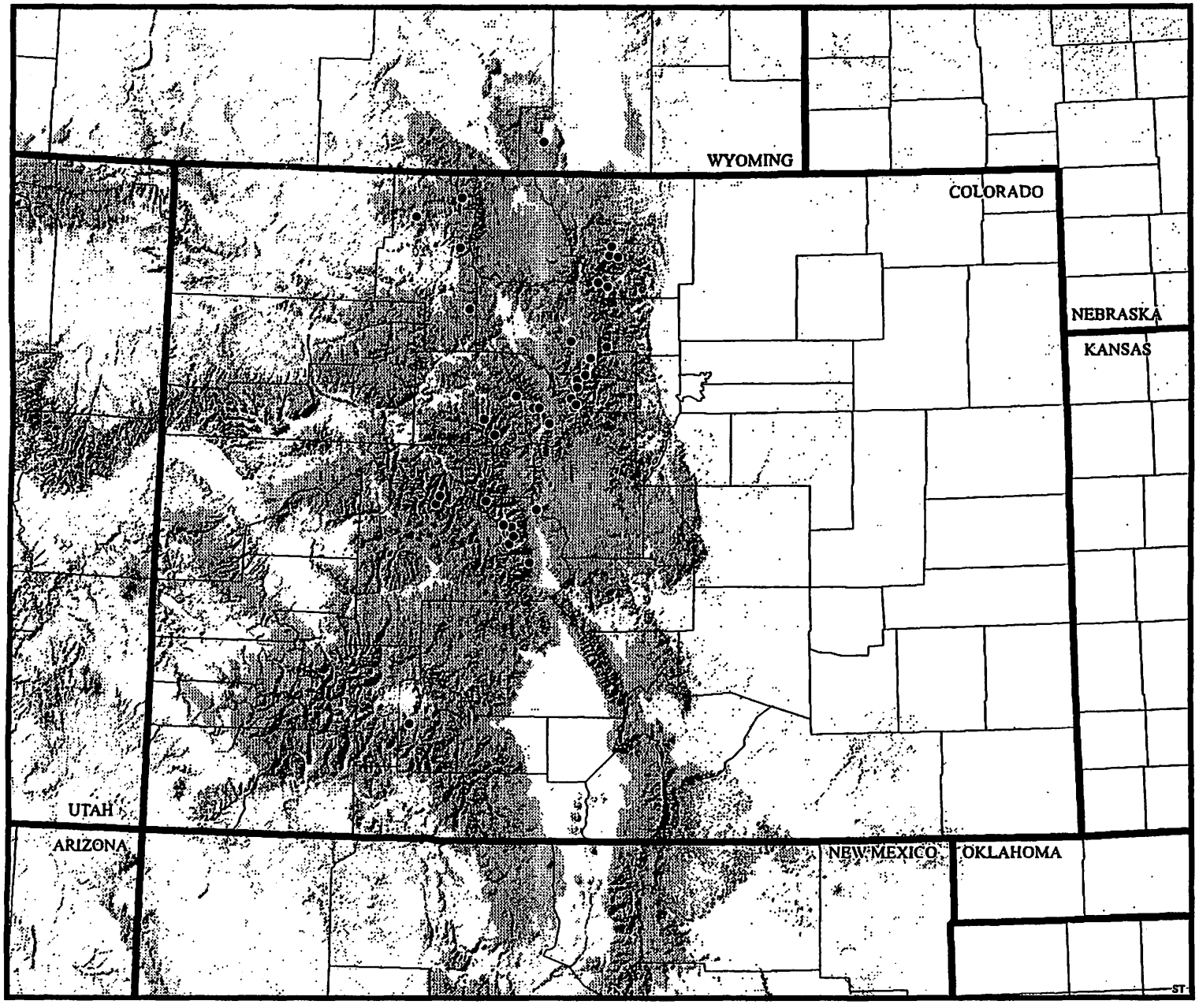
MOUNTAIN RANGES IN WESTERN COLORADO

(Mtn. ranges of historic occurrence of boreal toads shown underlined)

Figure 3

BOREAL TOAD BREEDING LOCATIONS

1996 - 1999



COLORADO DIVISION OF WILDLIFE

Legend

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

N

Scale = 1:4,000,000
1 inch = 63.13 miles = 101.6 km

Miles: 25 0 25 50

Kilometers: 25 0 25 50

December 1999

SUMMARY OF BOREAL TOAD BREEDING POPULATIONS IN THE SOUTHERN ROCKY MOUNTAINS **Dec., 1999**

Geographic Area	Number of	Populations w/Breeding/Recruitment					Populations w/20+ Breeders & 4+ Eggm.					"Viable"
(Mtn. Range of Historic Occurence)	Populations	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999	Populations
Park Range	2		2/1	2/2	?/0	0/?		0	0	0	0	0
Elkhead Mountains	1	?/0	1/?	0/0	1/1	0/?	0	0	0	0	0	0
Medicine Bow Range	1	1/1	1/1	1/1	0/0	0/0	0	0	0	0	0	0
Front Range	11	5/1+	6/4	5/1+	7/1+	6/?	3	3	3	3	2	2
Gore Range	3	1/0	1/1	1/0	1/1	3/?	0	1	1	1	0	1
Mosquito & Ten-mile Range	2	1/?	1/1	2/1	1/?	2/?	0	0	0	0	0	1
Sawatch Range	6	2/?	4/1	5/2	4/2+	5/?	1	1	1	1	1	1
White River Plateau	0	0/0	0/0	0/0	0/0	0/0	0	0	0	0	0	0
Grand Mesa	0	0/0	0/0	0/0	0/0	0/0	0	0	0	0	0	0
Elk & West Elk Mountains	2	2/0	2/1	2/1	1/?	1/?	0	0	0	1	1	1
San Juan Mountains	1		1/1	1/1	1/?	1/?		0	0	0	0	0
TOTALS	29	12/2+	20/11	19/9+	16/5+	18/?	4	5	5	6	4	6

Number of Populations: Number of toad populations, based on the definition of "population" in the Boreal Toad Conservation Plan, 1998.

Populations w/Breeding/Recruitment: Populations where any type of breeding activity was documented and/or recruitment of toadlets from that year was observed in following years # Before / = Breeding, # After / = Recruitment
NOTE: Recruitment from 1999 production can not be determined until 2000 suveys are done.

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

Viable" Populations: Represents the number of populations in the historic area of occurence which meet the criteria for "viable populations" as presented in the Boreal Toad Conservation Plan, 1998, and can be counted towards delisting goals.

Park Range

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

There are presently two known boreal toad breeding populations, each with one breeding locality, in the Park Range (N. Fork of the Elk River [Diamond Park] and Soda Creek), although observations of toads in other areas indicate that more breeding sites may exist. Recent (1999) observations show a pattern consistent with a possible die-off of toads due to chytrid fungus. These localities should be closely examined for possible presence of chytrid in 2000.

ROUTT COUNTY

Locality RO-2 - Soda Creek (Soda Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Unk	3 (M,2,A)	Nine metamorphs seen
1997	1/1/1	Yes	2 (M,A)	Numerous Metamorphs
1998	0/0/0	No	1(1)	Inadequate Monitoring
1999	0/1/0	Unk	1(A)	Only one toad seen.

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Yes	2 (M,A)	20 metamorphs seen
1997	1/1/1	Yes	3 (M,1,A)	Few metamorphs seen
1998	0/1/0	No	1 (1,A)	Inadequate Monitoring
1999	0/2/0	Unk	1(A)	Only two toads seen.

* * *

Elkhead Mountains

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

The only known boreal toad breeding population in this area is in California Park. There are two known breeding localities at this time (First Creek and Torso Creek). Evidence of at least one other possible breeding site in the area was found along Elkhead Creek in 1997. Although evidence of reproduction has been observed in several locations, specific breeding sites have not been found. More intensive surveys, early in the breeding season, need to be conducted in this area in order to better identify where breeding is occurring.

ROUTT COUNTY

Locality RO-1 - First Creek (California Park)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	0/0/0	Unk	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	Unk	None seen	Adequately monitored

Locality RO-4 - Torso Creek (California Park)

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

* * *

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 on the Routt and Roosevelt National Forests and on the Colorado State Forest.

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

ALBANY COUNTY, WY

Locality WY-1 - Bird Creek (Albany)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	1/1/1	Yes	1(A)?	No counts of adults/eggs
1994	4/1/1	Yes	3(1,S,A)	
1995	4/1/1	Yes	3(1,S,A)	
1996	2/1/1	Yes	4(M,1,S,A)	17 toadlets collected
1997	3/3/3	Yes	4(M,1,S,A)	Some eggs collected
1998	0/0/0	No	2(1,S)	No reproduction seen
1999	0/0/0	Unk	None seen	Surveys adequate

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

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Front Range

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

There are nineteen (19) known breeding localities within the Front Range area at this time, with several localities having more than one breeding site in close proximity. The breeding localities are located in five counties, as follows:

LARIMER COUNTY

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1990	?/?/22	Unk	1(A)	Incomplete data
1991	206/28/15	Unk	1(A)	No data on sub-adults
1992	143/23/23	Unk	1(A)	No data on sub-adults
1993	77/10/?	Unk	1(A)	Incomplete data
1994	110/35/35	Unk	1(A)	No data on sub-adults
1995	122/32/32	Unk	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

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1990	?/?/13	Unk	1(A)	Incomplete data
1991	21+/23/23	Unk	1(A)	No data on sub-adults
1992	63/18/18	Unk	1(A)	No data on sub-adults
1993	54/25/25	Unk	2(M,A)	
1994	120/21/21	Unk	2(M,A)	
1995	210/24/24	Unk	2(M,A)	
1996	29/13/8	Unk	3(M,2,A)	
1997	15/11/0	No	1(A)	
1998	18/13/10	Unk	1(A)	
1999	~~4/3/2~~ 15/8/2	Unk	1(A)	No metamorphs seen

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	Unk	Yes	Unk	Reproduction presumed
1997	3/1/?	Unk	3(1,S,A)	Limited monitoring
1998	9/3/1	Unk	1(A)	Inadequate monitoring
1999	9/3/1	Unk	2(S,A)	Inadequate monitoring

This site may have a substantial population, but more intensive surveys are needed.

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	1/1/0	Unk	1(A)	
1996	1/1/1	Yes	1(A)	Transplant site
1997	0/1/0	No	2(1,A)	
1998	3/0/0	Unk	1(A)	No breeding activity seen
1999	3/0/0	Unk	1(A)	No night survey done

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	1/1/1	Unk	1(A)	Tadpoles observed
1999	0/0/0	Unk	None seen	Site disturbed*

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

BOULDER COUNTY

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	0/1/0	No	2(M,A)	Toadlets introduced
1997	0/1/0	No	3(M,1,A)	Toadlets introduced
1998	0/2/0	Unk	3(1,2,A)	No breeding observed
1999	0/0/0	Unk	None seen	Minimal surveys done

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

GRAND COUNTY

Locality GR-1 - Jim Creek (Winter Park)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	5/1/?	Unk	3+(S,A)	Substantial population
1996	?/?/0	Unk	3+(S,A)	Substantial population
1997	0/0/0	Unk	None observed	Monitoring inadequate
1998	0/0/0	Unk	None observed	Monitoring inadequate
1999	0/0/0	Unk	None observed	No night survey done

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

Locality GR-2 - Pole Creek (Pole Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	5/3/3	Unk	2(M,A)	Numerous metamorphs
1996	3/3/3	Yes	2(M,A)	Few metamorphs
1997	10/4/2	No	2(1,A)	Few, if any, metamorphs
1998	5/2/2	Unk	2(M,A)	Monitoring marginal
1999	5/5/5	Unk	2(M,A)	Metamorphs at #4

On Pole Creek Golf Course, near holes #4 and #15.

Locality GR-3 - Vasquez Creek (Vasquez Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Unk	1(A)	Found late in season

SUMMIT COUNTY

Locality SU-2 - Montezuma (Snake River)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	7/1/1	No	2(S,A)	Breeding unsuccessful
1996	9/?/0	No	1(A)	No breeding observed.
1997	1/1/1	Unk	1(A)	New site, vs. '95 & '96
1998	Unk	Unk	Unk	Monitoring inadequate
1999	3/1/1	Unk	1(A)	Tadpoles observed

Locality SU-3 - Peru Creek (Snake River)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Yes	3(M,S,A)	May be > 3 age classes
1997	6/2/2	Unk	4(M,1,S,A)	Good metamorphosis
1998	3/1/1	Unk	2(M,A)	Monitoring inadequate
1999	14/1/1	Unk	1(A)	Monitoring minimal

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	1/2/1	Unk	3(M,S,A)	1st survey mid-July
1999	1/1/1	Unk	2(S,A)	Some tadpoles seen

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	1/2/1	Unk	3(M,S,A)	1st survey mid-July
1999	1/2/0	Unk	1(A)	No breeding observed

CLEAR CREEK COUNTY

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	?/?/?	Unk	Multiple	Little data available
1994	?/?/?	Unk	Multiple	Little data available
1995	3/2/2	Unk	2(M,A)	Prob. few metamorphs
1996	1/1/1	No	1(A)	No production
1997	1/1/1	No	1(A)	Eggs froze
1998	3/0/0	No	1(A)	No breeding observed
1999	3/0/0	Unk	1(A)	No breeding observed

This locality has also been called "Mizpah".

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	?/?/?	Yes	2(M,A)	1st site survey in August
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

This locality is comprised of several closely associated breeding sites.

Locality CC-3 - Herman Gulch (Clear Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	?/?/?	Unk	2(M,A)	Breeding observed
1994	11/11/11	Unk	2(M,A)	
1995	52/12/12	Unk	3(M,S,A)	Good production
1996	20/12/12	No	1(A)	Poor larvae survival
1997	19/10/10	Unk	3(M,S,A)	Many metamorphs
1998	10/10/10	Unk	2(M,A)	Few metamorphs seen
1999	11/11/11	Unk	1(A)	High egg mortality

Locality CC-4 - Mount Bethel (Clear Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	Yes	Unk	2(M,A)	Many metamorphs
1994	Yes	Unk	2(M,A)	
1995	4/1/1	No	2(S,A)	Few, if any, metamorphs
1996	3/3/3	Unk	2(M,A)	Few metamorphs
1997	9/1/1	Unk	2(M,A)	
1998	11/3/3	Unk	2(M,A)	36+ metamorphs seen
1999	23/1/1	Unk	2(M,A)	500+ metamorphs seen

Locality CC-5 - Bakerville (Clear Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	1/1/1	Unk	2(M,A)	Limited data
1995	Unk	Unk	Unk	Site not monitored.
1996	0/0/0	No	None seen	
1997	Unk	Unk	Unk	Site not monitored
1998	0/0/0	Unk	None seen	Inadequate monitoring
1999	0/1/0	Unk	1(A)	Inadequate monitoring

Locality CC-6 - Silverdale (Clear Creek South)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	?/?/0	Unk	Multiple	First survey of site
1994	?/?/0	Unk	Multiple	No metamorphs
1995	2/0/0	Unk	2(S,A)	No breeding observed
1996	5/0/0	No	1(A)	No breeding observed
1997	0/0/0	No	None observed	Inadequate monitoring
1998	1/1/0	Unk	2(S,A)	Monitoring marginal
1999	0/0/0	Unk	1(S)	41 sub-adults seen

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Gore Range

This is a geographic area extending from west-central Routt County and northwester Grand County south to western Summit County, including the Eagle's Nest Wilderness Area. Much of this area is on 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. The latter may be a substantial population.

ROUTT COUNTY

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	10/2/2	Unk	4(M,1,S,A)	Site found late July.

EAGLE COUNTY

Locality EA-3 - East Vail (Vail)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	3/1/1	Unk	3(M,S,A)	Site found late July.

SUMMIT COUNTY

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	6/6/6	Unk	2(S,A)	Few, if any, metamorphs
1996	17/6/6	Unk	3(M,S,A)	Good production
1997	13/3/3	Unk	2(M,A)	Limited metamorphosis
1998	18/3/1	Yes	2(S,A)	Inadequate monitoring
1999	2/3/3	Unk	4(M,1,S,A)	Inadequate monitoring

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	4/2/2	Yes	2(M,A)	Few metamorphs
1997	1/2/1	Unk	2(1,A)	Little or no reproduction
1998	5/5/5	Unk	3(M,S,A)	Inadequate monitoring
1999	3/2/1	Unk	1(A)	Inadequate monitoring

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 1999 there are only two known boreal toad breeding localities in this geographic area, as follows:

SUMMIT COUNTY

Locality SU-1 - Cucumber Gulch (Breckenridge)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	1/1/1	Unk	3+(M,S,A)	Mult. age classes seen
1996	?/?/0	No	2(S,A)	No breeding observed
1997	2/1/1	Unk	1(A)	Recruitment doubtful
1998	1/0/0	Unk	1(A)	Monitoring minimal
1999	1/1/1	Unk	1(A)	No metamorphs seen

CHAFFEE COUNTY

Locality CF-7 - Fourmile Creek (Buffalo Peaks)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	3/1/0	No	1(A)	No breeding observed
1996	2/2/2	Yes	2(M,A)	Numerous metamorphs
1997	3/3/3	Yes	4(M,1,2,A)	Good production
1998	1/1/1	Unk	4(M,1,S,A)	Late egg clutch
1999	6/3/2	Unk	2(S,A)	Eggs lost to desiccation

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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 on the White River, San Isabel and Gunnison National Forests.

There are sixteen (16) known breeding localities within this area. Thirteen (13) of these are located in the Collegiate Peaks area of Chaffee County, two (2) in southern Eagle County, and one (1) in eastern Gunnison County. The eleven sites in the Cottonwood Creek drainage of Chaffee County compose one of the most substantial remaining metapopulations of boreal toads in the southern Rocky Mountains.

CHAFFEE COUNTY

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	1/1/1	Yes	1(A)	Reproduction presumed
1994	1/1/1	Unk	4(1,2,3,A)	Larvae observed
1995	11/5/5	Unk	3+(M,S,A)	Subadults not aged.
1996	13/5/5	Unk	3(M,S,A)	Few metamorphs.
1997	10/8/6	Unk	2(M,A)	Numerous metamorphs
1998	38/7/7	Yes	2(M,A)	1st year of PIT tagging
1999	24/3/3	Unk	4(M,1,S,A)	4 one-year olds seen

Locality CF-2 - Denny Creek (Cottonwood Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	5/5/5	Unk	2(S,A)	Probably metamorphs
1995	16/10/3	Unk	3(M,S,A)	Sub-adults not aged
1996	4/4/4	Yes	3(M,S,A)	Metamorphs present
1997	10/4/4	Yes	3(1,2,A)	Few, if any, metamorphs
1998	55/22/22	Yes	4(M,1,S,A)	1st year of PIT tagging
1999	63/18/16	Unk	4(M,1,S,A)	Good production

Locality CF-3 - Hartenstein Lake (Cottonwood Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	5/?/?	Unk	1(A)	Limited data
1995	29/6/6	Unk	1(M,A)	Few metamorphs seen
1996	10/2/2	Yes	2(M,A)	Metamorphs presumed
1997	12/5/5	Unk	2(M,1,A)	Many metamorphs
1998	31/7/5	Yes	3+(M,S,A)	1st year of PIT tagging
1999	64/10/9	Unk	2(1,A)	Predation by mallards

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	24/3/3	Unk	3(M,S,A)	Numerous metamorphs
1996	12/4/4	Yes	2(M,A)	Good production
1997	26/3/3	Unk	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	Unk	3(M,1,A)	Numerous metamorphs

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	2/3/1	Unk	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

Locality CF-6 - Kroenke Lake (Cottonwood Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	3/2/2	Unk	1(A)	Metamorphs unlikely
1996	2/2/2	Unk	2(M,A)	Fair metamorphosis
1997	9/2/2	Unk	1(A)	Metamorphs unlikely
1998	3/3/3	Unk	1(A)	Metamorphs unlikely
1999	6/3/3	Unk	1(A)	No night surveys

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1997	19/6/6	Yes	2(M,A)	Many metamorphs
1998	24/1/1	Yes	4(M,1,S,A)	Eggs late season
1999	40/3/3	Unk	4(M,1,S,A)	One egg mass not viable

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1997	9/1/1	Unk	1(A)	Site found late in season
1998	34/2/2	Unk	2(S,A)	Metamorphs few, if any
1999	4/4/2	Unk	2(S,A)	Larvae lost to mallards

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	2/2/2	Yes	2(M,A)	Excellent production
1999	9/9/9	Unk	3(M,1,A)	Good production

Locality CF-11 - Rainbow Lake (Cottonwood Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	4/3/3	Unk	1(A)	Larvae lost to mallards

Locality CF-12 - Middle Cottonwood (Cottonwood Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	13/1/1	Unk	4(M,1,S,A)	8 one-year olds seen

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	5/2/2	Unk	1(M,1,A)	5 metamorphs seen

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Unk	3(M,S,A)	4 sub-adults seen

EAGLE COUNTY

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Unk	1(A)	Predation & late season
1997	1/1/1	Unk	1(A)	Recruitment unlikely
1998	2/2/2	Unk	1(A)	Inadequate monitoring
1999	2/0/0	Unk	1(A)	Inadequate monitoring

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1	Unk	3(M,S,A)	Site found 8/13/96
1997	Unk	Yes	Unk	Site not monitored
1998	3/0/0	Yes	2(1,A)	Inadequate monitoring
1999	4/4/4	Unk	3(M,1,A)	No night survey done

Two closely associated breeding sites at this locality.

GUNNISON COUNTY

Locality GU-3 - Magdalene Gulch (Texas Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Unk	2(M,A)	Site found late in season

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White River Plateau

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

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

* * *

Grand Mesa

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

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

* * *

Elk and West Elk Mountains

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

Prior to 1999 there were two known boreal toad breeding sites in this area - one in southern Pitkin County, and the other in northern Gunnison County. In 1999, an additional site on West Brush Creek in Gunnison County, where adult toads had previously been seen, was confirmed as having reproduction. There have also been recent, reliable reports of toads from other localities within this area, such as Mt. Crested Butte, the Snowmass Lake area, and East Maroon Creek. With additional survey effort it is likely that more breeding populations will be located - especially in the Elk Mountains.

PITKIN COUNTY

Locality PI-1 - Conundrum Creek (Conundrum Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1995	3/1/1	Unk	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	?/?/?	Unk	?	Site not monitored

Verified report in 1999 of toad observations in nearby East Maroon Creek.

GUNNISON COUNTY

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1993	3/3/3	Unk	1(A)	Metamorphs unlikely
1994	Unk	Unk	Unk	No data
1995	1/1/1	Unk	2(S,A)	Metamorphs unlikely
1996	Unk	Yes	Unk	No monitoring
1997	2/2/2	Yes	4(M,1,S,A)	Many metamorphs
1998	17/5/5+	Unk	4(M,1,2,A)	Many metamorphs
1999	19/5/4	Unk	2(M,A)	No night survey done

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

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1999	1/1/1	Unk	2(M,A)	<50 metamorphs seen

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San Juan Mountains

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

As of 1999, there are two breeding sites known in this area. Both are in Mineral County, CO. One of the two sites (Trout Creek) is questionable, as the tadpoles observed there in 1996 may have been the result of an unauthorized translocation from the Jumper Creek site, rather than natural breeding at that location.

There have been several good reports of observations of boreal toads from other localities in the San Juan Mtn. area - most notably from the Elk Creek drainage in Conejos County, Miner's Creek in Saguache County, and from near Chama, New Mexico. Additional survey work was done in the San Juan Mountains in 1999, but did not result in the location of any new breeding localities. Survey efforts will continue.

MINERAL COUNTY

Locality MI-1 - Jumper Creek (Trout Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1994	3/0/?	Unk	1(A)	1st toad observation
1995	Unk	Unk	Unk	Breeding likely
1996	4/2/1+	Yes	2(M,A)	Breeding observed
1997	8/3/3	Yes	3(M,1,A)	Many metamorphs
1998	7/1/2	Unk	4(M,1,S,A)	
1999	3/2/2	Unk	3(M,S,A)	<50 metamorphs seen

Locality MI-2 - Trout Creek (Trout Creek)

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1996	1/1/1(See note)	No	None seen	Tadpoles observed
1997	0/0/0	No	None seen	
1998	0/0/0	Unk	None seen	
1999	0/0/0	Unk	None seen	Only one site visit

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

* * *

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 is constrained by the availability of qualified personnel to conduct and supervise the work. Areas where surveys have concentrated over the past five years include the Park Range, Front Range, Gore Range, Saguache Range, and the San Juan Mountains. 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 in 1999 resulted in the location of four previously unknown breeding populations located in Routt, Eagle, Grand, and Gunnison counties, and five new breeding localities within known populations in Chaffee and Gunnison counties.

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 plan future survey efforts. In 2000, ongoing survey efforts will continue, with a focus on southeastern Routt County, Pitkin County, the San Juan Mountain area, and several other specific locations from where reliable reports of boreal toad observations have been received in the past two years. An effort will also be made in 2000 to sample as many of the known populations as possible for the presence of the recently discovered chytrid fungus, which has been implicated in the 1999 die-off of toads at a site in Clear Creek County.

PUBLIC INFORMATION AND INVOLVEMENT

The use of trained volunteers has been pursued as a remedy for the lack of time and personnel for survey and monitoring work. In 1996, an initial effort was made to recruit and train volunteers, but the level of participation in surveys was minimal. Approximately 30 individuals attended the workshops, but only 3 subsequently did survey work and submitted data forms. In the Spring of 1998 and 1999, volunteer "workshops" were conducted at Ft. Collins, Glenwood Springs, Steamboat Springs, Denver, Colorado Springs, and Durango, resulting in the training of nearly 100 volunteers. Subsequent participation in survey efforts by volunteers has been considerably less than hoped for. Therefore, active recruitment and training of volunteers will be discontinued in 2000, although potential volunteers will still be welcome to attend training workshops which will continue to be conducted for US Forest Service and Division of Wildlife field personnel.

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

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

CAPTIVE PROPAGATION AND TRANSLOCATIONS

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

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

In light of the discovery of the presence of the chytrid fungus in Colorado in 1999, these guidelines will be reviewed, and may be revised in 2000, 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 Sybille, 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 below), and numerous toads were reared in captivity by the Colorado

Division of Wildlife, at its Fish Research Hatchery in Bellvue, CO, from 1995 through 1997. The Division of Wildlife effort resulted in the development of standard practices for rearing of boreal toads, and the "Hatchery Manual for the Rearing and Propagation of Captive Boreal Toads", March, 1997. Captive propagation and rearing of toads in Colorado was discontinued in late 1997, with the intent of reinstating it only if it is needed for a future reintroduction. After the recent discovery of chytrid fungus in Colorado, and the associated die-off of boreal toads in Clear Creek County in 1999, the Recovery Team decided it would be prudent to establish disease-free captive stocks of boreal toads from several key populations in the southern Rocky Mountains. Plans are being made to accomplish this in 2000. The primary location for housing of such captive stock will be the Colorado Division of Wildlife's new Native Aquatic Species Hatchery, near Alamosa, CO. The possibility of placing some southern Rocky Mountain boreal toads with qualified, AAZPA accredited zoos in the future will also be considered. 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.

As of late 1999, there are still approximately 30 boreal toads in captivity at the Sybille Wildlife Research Center in Wyoming, which continue to be used for captive breeding and rearing work. Few toads have been successfully captive bred and reared at Sybille during the past two years, and no further releases of captive reared stock to the Lake Owen site were done in 1999. There is some concern about limited genetic diversity in the captive Wyoming stock, and consideration is being given to supplementing it with additional animals from the wild, and splitting remaining animals between Sybille and the Saratoga National Fish Hatchery to reduce the chances of loosing all captive toads to a disease outbreak or other disaster.

In 1993 and 1996, respectively, the Cheyenne Mtn. Zoo, in Colorado Springs, and the Henry Doorly Zoo, in Omaha, NB, obtained boreal toads for experimental propagation projects. The Cheyenne Mtn. Zoo collected three yearling toadlets and 17 tadpoles from the Denny Creek site, in Chaffee County, Colorado. These tadpoles were reared to metamorphs at the zoo, and some were over-wintered in a Percival Environmental Chamber. As of late 1997, all boreal toads at the Cheyenne Mtn. Zoo had died due to unknown causes. The Henry Doorly Zoo received 40 toadlets, originating from Mineral County, CO. 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. Due to the limited number of known breeding boreal toads remaining in the San Juan Mtn. area, it was thought advisable to attempt to establish a captive brood stock of boreal toads from that geographic area. As of late 1999, nine of these ten toads were still alive, and being hibernated at the Henry Doorly Zoo.

Experimental Translocations

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

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

Glacier Basin, in Rocky Mountain National Park, is the site of an experimental translocation of boreal toads, which began in 1995. It is a cooperative effort between Rocky Mtn. National Park and the USGS/Biological Resources Division. Toadlets (n=800) were released in 1995, and egg masses and 100 captive-reared toads were translocated in 1996. The stock for this transplant came from the Lost Lake breeding site, in Rocky Mtn. National Park. (See the 1998 Report on the Status and Conservation of the Boreal Toad in the Southern Rocky Mountains for a complete report).

In 1997, 1998, and 1999 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. 1999 was the last year of monitoring of this experimental translocation site.

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 the 1998 Report on the Status and Conservation of the Boreal Toad in the Southern Rocky Mountains for a complete report). This site will continue to be monitored for several years to determine the result of the translocation. No toads were observed at Lost Lake in 1999.

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 were released in 1998 or 1999, but plans are to monitor the site for the next few years to determine the success of the reintroduction effort.

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 in 1997, 1998, or 1999. Monitoring at this location should continue, however, due to its relative proximity to the Jumper Creek breeding site.

Grand Mesa, in western Colorado, has been intensively surveyed during the past four years, and is a high priority site for an experimental reintroduction of boreal toads. In addition to intensive aquatic habitat mapping, approx. 780 hours of inventory effort was expended in historically occupied habitats on Grand Mesa in 1998. No toads, eggs, or larvae were found. Six potential reintroduction sites were selected from 80 possible sites, using standardized criteria. Administrative groundwork for initiation of an experimental translocation was started in early 1999, but the project was put on hold due to the finding of chytrid fungus at the primary source population in Clear Creek County. If a "clean" and adequate brood stock of toads can be established in 2000, and other concerns about possible disease transmission can be resolved to the satisfaction of the Recovery Team, this project will continue to be pursued in the near future.

* * *

RESEARCH

Studies of the Boreal Toad Population in the Henderson Mine Area - Mark Jones, 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 is focusing on habitat and hibernacula use, toad movements, and population structure and dynamics. (See "Colorado Division of Wildlife Boreal Toad Research Progress Report, 1998" for more details).

Breeding site monitoring

Hesbo- Hesbo was monitored at night weekly from May 18 to June 15, 1999. Additional biweekly daylight surveys were conducted throughout the summer. The peak of breeding activity occurred on May 25 with 72 adults observed (65 male, 7 female). Night surveys were discontinued because all of the adults handled had been previously handled in 1999. Twenty-three egg masses were laid, resulting in approximately 20,000 tadpoles. During 1999, Lauren Livo continued dytiscid beetle larvae predation studies at this site.

Power Alley- Power Alley was night monitored weekly from May 18 to June 15, 1999. The most adults observed at this site was 33 males, no females were seen during monitoring. One egg mass was laid at this site which later desiccated.

Upper Urad- Upper Urad was night monitored weekly from June 22 to June 29, 1999. Seven adults including one gravid female was the highest number of toads observed on any occasion. One egg mass was deposited which became infected with fungus and died. No successful reproduction in 1999 at this site.

Donut- Donut was night monitored weekly from May 31 to June 22, 1999. Seventeen egg masses were deposited at this site, but several died from fungus. Lauren Livo conducted tadpole ecology experiments at this site. Although some toadlets died from desiccation and exposure at this site, we believe survival was better than in previous years because many metamorphosed onto the islands, which are thickly vegetated and have suitable hibernaculum close to the edge of the water.

Treatment- Treatment was night monitored from June 15 to June 29, 1999. The greatest number of adults observed in one night was four. No egg masses were observed, but based on the groups of tadpoles observed on June 23, we suspect two egg masses were present. Monitoring was continued at this site throughout the summer with good survival to metamorphosis. It is still not

known whether many survive the winter at this site as there are few suitable hibernacula and juveniles are not typically seen the following spring .

Anne's Pond- Anne's Pond was monitored from May 25 to June 29, 1999. The most adults observed in one night was 21, we checked a total of 7 females during the course of the active breeding period. Nineteen egg masses were laid, all of which desiccated because of our inability to keep water levels stable.

1- Pond- Boreal toads were first observed breeding in 1-Pond in 1998. Many juveniles were observed in June, 1999, indicating good over-winter survival. In 1999, tadpoles were again observed at this site, probably from two egg masses. Most of the tadpoles metamorphosed and dispersed by September 29.

John's Pond- John's Pond is a small catch basin by the domestic water treatment plant on the Henderson side of the mine. Breeding was first observed at this site in 1998. In 1999, tadpoles from one egg mass were observed on June 30. Most metamorphosed and dispersed by September 29.

Lower Urad Lake- This was the second year we observed breeding in Lower Urad Lake. On June 23, two egg masses were observed in the north west cove. On subsequent visits it appeared that one of these disappeared and the other produced approximately 100 tadpoles. These tadpoles gradually disappeared and it is believed that none survived to metamorphosis.

Other 1999 Field Work and Plans for 2000

In 1999, boreal toads in the Henderson/Urad area were weighed, measured, and PIT tags monitored during breeding site surveys. A total of 152 unique adult toads were handled at nine breeding sites, most of these more than once. Breeding resulted in a total of 68 egg masses; some of these died or were destroyed prior to hatching. The pittag databases from 1995 to 1999 have been combined into one database for analyses such as site fidelity, population estimates, survival, and growth. Twenty four adults were radio tagged during breeding site surveys for habitat use and movement studies.

On June 29, 1999 four radio telemetered boreal toads in the Hesbo breeding site area were found dead with no outward signs of the cause of death. This occurrence was alarming since we had experienced minimal mortality of radio telemetered toads in the previous three years of radio tracking, and when we did lose a toad, the cause of death was usually apparent, such as predation by a raccoon. Subsequent to finding the first mortalities, more extensive searches were conducted. Eight more toads were found dead during the week of July 5th, two of which were not telemetered, which indicated the mortality was not associated with the radio tracking activities. Observed toad mortality seemed to spread from the Hesbo breeding site up the valley to Treatment and then Donut and Anne's Pond. This sequence of mortality may be temperature related and more research will be conducted in 2000 to investigate this potential relationship.

The cause of death of the previously mentioned toads was attributed to chytridiomycosis, due to *Batrachochytrium dendrobatidis,* by Dr. David Green (USGS National Wildlife Heath Center) on July 14, 1999. This diagnosis confirmed that this pathogenic fungal species was present at the Henderson/Urad location. Since the first diagnosis of chytridiomycosis at the Henderson Mine, there have been a total of 24 toad deaths at this site which were confirmed cases of chytrid infection. The radio tracking project allowed early detection of the die-off and enabled us to collect specimens which were useful for histology, isolation, and culture of the fungus. During our radio tracking activities in previous years it was common to observe six to eight non-telemetered toads per day. Toward the end of the 1999 field season, non-telemetered toads were rarely seen, which is a good indication that the die-off may be extensive in this metapopulation. We will be not able to assess the extent of the mortality until we conduct breeding site surveys in the Spring of 2000, and calculate subsequent population estimates from this data.

It appears that this chytrid fungus has been in Colorado for quite a few years, but its origin is still unknown. All of the histologic samples collected in 1995 from boreal toad mortalities in the Urad valley as well as captive specimens which were reared at the Fort Collins Research Hatchery were reexamined by Dr. Allan Pessier (San Diego Zoological Society) and chytrid was found to be present. Dr. Pessier also reexamined specimens collected in Rocky Mountain National Park in 1998, and chytridiomycosis was determined to be the cause of death. At this time there is little doubt that chytridiomycosis may have been the primary cause of declines experienced by the boreal toad in Colorado in the late 1970's and early 1980's. Although all of the evidence is circumstantial, the earlier reports of die-offs are consistent with mortality associated with the chytrid fungus, *B. dendrobatitis*.

Work during the 2000 field season will concentrate on evaluating the extent of the die-off in the Henderson/Urad population and screening all other known breeding sites in the state for the chytrid fungus. We are in the process of working with the University of Maine at Orono to develop a PCR genetic testing procedure which should assist us in evaluating the extent of the chytrid problem in boreal toads statewide.

* * *

Kettle Tarn

This site was monitored from 24 May through mid October, 1 to 2 times per week. Monitoring of 3 radio collared toads will continue monthly through spring. USGS field personnel monitored the site.

Breeding activity was observed at Kettle Tarn II, a small wetland adjoining Kettle Tarn. We saw no pairs in amplexus at Kettle Tarn II, but did find 2 egg masses. These egg masses hatched by 24 June. Tadpoles (a couple 100) were observed throughout the summer until late August but no metamorphs were observed; thick vegetation may have hindered our observations. Kettle Tarn II remained wet with shallow to deep water all summer and fall.

We caught 24 individuals at Kettle Tarn, 8 new and 8 recaptured males; 8 new and 0 recaptured females. Many of the males appeared to be small, perhaps young adults.

We feel that Kettle Tarn is still a viable breeding site and may have recruited this year. We have expanded our search area around Kettle Tarn and have found a number of females late in the summer in the nearby marshy areas. These females were all unmarked. Whether these toads have moved into the area recently or are residents that have not bred in the last 8 years is open for speculation. Most males found in this area have been small and unmarked. Diving beetle larvae were again present in Kettle Tarn II.

Two dead toads from Kettle Tarn (1998) were sent to the Vet Path Lab at the University of Wyoming, their reports indicated Basidiobolus infection and mycotic dermatitis as the cause of death. Subsequent examination of the same toads by Allan Pessier (DVM, San Diego Zoo) found strong evidence of chytrid fungus infection including the diagnostic septa in the cells and discharge papillae. Two extremely desiccated toad carcasses were sent to David Green (DVM, USGS-NWHC) this year. Both specimens showed hyperkeratosis of the skin, a lesion characteristic of chytrid infections. Given this evidence, we think that the chytrid fungus is present in the Northfork and has been for at least 2 years. One of the 1999 specimens was from Lost Lake and one from Kettle Tarn.

Lost Lake

This site was monitored from 9 June through mid October, once per week during the breeding season and at least once every two weeks during the summer and fall by USGS field personnel.

We caught 8 individuals at Lost Lake, 0 new and 1 recaptured male; 5 new and 2 recaptured females. One of the recaptured females looked ill and was subsequently found dead. This was one of the individuals examined at NWHC.

Very little breeding activity was actually observed at Lost Lake, although we saw 8 –11 egg masses. Two egg masses were completely dead. 7 – 10 masses had hatched by 20 July There was an additional center of activity on the west side of Lost Lake, similar to 1998, that contributed to the

egg mass count. We monitored tadpoles through October. On September 30, Ryan Monello (RMNP) observed 25 live tadpoles with front and back legs at the west end of the breeding area and 50-100 tadpoles at the north end as well as some dead tadpoles. On October 6, we saw about 170 tadpoles, some very close to metamorphosis and 11 dead. Most all of these had well developed hind legs and at least front limb buds. The dead ones had front limb stubs. These late season observations suggest that there might have been some minor recruitment at Lost this year, but the numbers would have been very small.

Glacier Basin

Glacier Basin was searched 2 – 3 days per week, using personnel from USGS and from RMNP through June 1999. We found 3 female toads on 2 occasions, one at 53g and one at 40g on 11 June and one over 100g on 21 May. These animals did not have PIT tags and no others were found. This is the last year of monitoring this site and completes the translocation experiment begun in 1995. There was no indication of breeding-no egg masses, tadpoles or amplexing adults.

Spruce Lake

This site was monitored on 11 June and 22 June by Steve King (RMNP). He located several (number unknown) adult toads and one egg mass (22 June).

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Modeling Boreal Toad Breeding Habitat - Andy Holland, CDOW/CSU

The objective of this project is to use a habitat-based modeling approach to evaluate boreal toad breeding habitat requirements. Breeding site suitability was chosen as the focus for this study because of its influence on recruitment and population growth. Two sets of models will be used to evaluate breeding habitat suitability. The number of egg masses deposited in a breeding site will be used as a response variable to model habitat selection by breeding adults. Habitat variables will be measured for breeding sites and nonbreeding sites. Nonbreeding sites used in this study are usually adjacent to breeding sites and are required to be available to breeding adults. Tadpole development will serve as the response variable for the second class of models. These models will be used to investigate what habitat conditions result in successful metamorphosis. Tadpole development will be evaluated by developmental stage, tadpole size, and mass at metamorphosis. Independent variables consist of habitat attributes such as degree days (cumulative water temperature for the breeding and developmental period), bank slope, water level consistency, productivity, and area. The number and proximity of other suitable breeding sites, type of site, and estimated tadpole density will also be considered as explanatory variables.

In most cases sites were visited at least monthly. Variables were measured for 24 breeding sites and 14 nonbreeding sites in 1999. These sites were located in Chaffee County, Summit County, Clear Creek County, and Rocky Mountain National Park. The Chaffee County breeding locations that I included in my study were Collegiate Peaks, Denny Creek, Hartenstein Lake, South Cottonwood Creek, South Cottonwood Creek West, Morgan's Gulch, Brown's Creek, Four Mile Creek, and Sayer's Gulch. I included Peru creek, Cucumber Gulch, and North Tenmile Creek in Summit County. In addition to all the sites associated with the Henderson Mine, I also sampled at Mt. Bethel and Herman Gulch in Clear Creek County. Only Lost Lake and Kettle Tarn were visited in Rocky Mountain National Park.

Better understanding about boreal toad breeding habitat requirements will allow the ranking of occupied and unoccupied sites according to their respective suitability and provide insights into the influences on successful metamorphosis in the wild. This modeling approach will ultimately improve habitat quality assessments which should be useful for future surveys, translocations, and when mitigating for habitat degradation.

* * *

A better understanding of ecological factors and processes related to larval development and survival is important towards understanding possible limiting factors in boreal toad populations and developing strategies for the recovery and conservation of this species. Work described below is a continuation of work done over the past few years (See the *1998 Report on the Status and Conservation of the Boreal Toad in the Southern Rocky Mountains* for description of previous work).

Chemical cues are an important source of information for many aquatic animals, including tadpoles. Tadpoles can respond to chemical cues from predators in many ways. Because movement often increases the vulnerability of tadpoles to predators, tadpoles often decrease foraging and other activity when they detect predators. Recent studies have shown that some tadpoles respond to predator cues by developing a different body shape than tadpoles not exposed to predator cues. The different body shape usually allows the tadpoles to swim faster, therefore improving the tadpoles' ability to survive encounters with the predators. Predators can also influence shifts in life history characteristics such as timing of metamorphosis. I conducted experiments with boreal toad (*Bufo boreas*) tadpoles to determine how this endangered species responds to predaceous diving beetle (*Dytiscus* sp.) larvae, an important predator that is common at some breeding sites along the Front Range of Colorado.

I reared boreal toad tadpoles in three different predator conditions using *Dytiscus* larvae. Small cages were present in all pools used to rear boreal toad tadpoles. For the control group tadpoles, the cages were empty. The cages for the "low-cue" tadpole group contained *Dytiscus* larvae that were maintained on a diet of invertebrates. The cages for the "high-cue" tadpole group contained *Dytiscus* larvae that were fed boreal toad tadpoles from a nearby pond. This high-cue group of tadpoles was exposed to chemical cues both from the *Dytiscus* larvae and from any chemicals produced by the tadpoles used to maintain the insect larvae.

Initially tadpoles did not differ in swimming speeds. However, by August, the tadpoles in the high-cue group swam faster than tadpoles in the low-cue or control groups. The ability to swim fast helps tadpoles escape predators. The morphologies of the tadpoles also differed, with the high-cue tadpoles significantly smaller than the control or low-cue tadpoles. When the effects of body size were removed statistically, the high-cue tadpoles had wider bodies in proportion to their body lengths. Comparisons of activity levels indicated that high-cue tadpoles were less active than control tadpoles. There were no consistent differences in the degree of aggregation exhibited by tadpoles in the three treatment groups.

The control tadpoles metamorphosed earlier and had larger size at metamorphosis than the high-cue tadpoles. Additionally, after metamorphosis the toadlets from the control group were more likely than the high-cue toadlets to strike at or capture pinhead crickets during a test of predatory ability and to move more quickly across a test arena. The low-cue tadpoles had intermediate scores for most measures.

Size at metamorphosis is an important component of fitness for amphibians. Consequently, although the altered tadpole morphology may increase the likelihood of survival during the larval peri the smaller size at metamorphosis probably has negative long-term consequences for the toadlets.

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Population Study in the Cottonwood Creek Drainage - **Craig Fetkavich, CNHP**
(Reported by C. Loeffler, CDOW)

In 1998, an effort to PIT-tag adult and large sub-adult boreal toads was initiated at breeding localities in the Cottonwood Creek population in Chaffee County, CO. It is believed that this effort will yield valuable comparative data which can compliment data which has been collected in Rocky Mountain National Park (RMNP) and the Urad/Henderson (U/H) area. The breeding localities in this area are more numerous than those in RMNP, and more widely dispersed than those at U/H. Also, the habitat in the Cottonwood Creek area is less disturbed than at U/H.

In 1998, a total of 183 male and 25 female toads were PIT tagged at five of the six breeding localities in this population. In 1999, an additional 220 males and 67 females were marked. and a total of 344 recaptures were recorded. 1999 data are still being analyzed, but preliminary examination of the data revealed that there were only 5 recaptures of female toads which were marked in 1998, and all of those were marked *and* recaptured at the Denny Creek site. PIT tagging and intensive monitoring will be continued in this area in 2000 and beyond.

* * *

Possible Role of Weather Pattern Changes in Amphibian Population Declines

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The questions that were addressed in this study concern whether unusual temperature and/or moisture patterns occur just prior to or simultaneously with amphibian population declines at specific sites. If so, these correlations would merit further study to determine if weather patterns have either been sufficiently severe to directly cause amphibian deaths or have contributed indirectly to amphibian declines by fostering changes in pathogen movement, pathogen virulence, or susceptibility of amphibians to pathogens.

It would have been ideal if the mass amphibian declines in the United States, Australia, and Costa Rica/Panama had happened adjacent to weather stations. Unfortunately, they occurred in remote, mountainous areas in which weather stations don't exist. Furthermore, studies at montane weather stations about 30 miles apart show little correlation in measurements. Therefore, we used two data sets that provided estimates of temperature and precipitation patterns from the earliest dates available through 1999. "Reanalysis", a sophisticated combination of model and observations that uses data from a variety of sources, including satellites, ships, etc. provides estimates from 1948 for approximately 2 geographical grids. A "station" model uses weather station data from 1900 to 1999 to specify weather patterns averaged over a 2.5 x 2.5 grid. Both models have advantages and disadvantages that affect the accuracy of the data. Average temperatures and precipitation were calculated on a yearly or monthly basis. Since weather data rarely fall on the mean, we looked for distinctive departures from "normal" just prior to or simultaneously with the onset of amphibian declines.

Three geographical localities (Queensland, Australia, Costa Rica and Panama, and Colorado were selected for analysis because the dates and locations of amphibian die-offs are well established. Declines of many species and probable extinctions of a few species began in tropical mountains of Australia and Costa Rica/ Panama in the late 1980s-early 1990s. The direct cause of death appears to be a chytrid fungus (*Batrachochytrium dendrobatidis*). During the times of the die-offs, these regions were warmer and drier than normal, but not exceptionally so. Similar weather patterns existed in these locations over the past 40-60 years, but it is unknown if they were associated with amphibian declines.

Mass die-offs of boreal toad (*Bufo boreas*) and leopard frog (*Rana pipiens*) populations began in 1973 and continued through about 1982 in the mountains of Colorado. Most populations of boreal toads were extirpated and high elevation populations of leopard frogs appear to be completely extinct. The likely cause of death was also a fungus similar to or identical to Batrachochytrium. Mass mortalities in the few remaining boreal toad populations in Colorado began again in 1997 and are almost certainly caused by this fungus. During the 1973-1982 die-offs of boreal toads, the central mountains of Colorado experienced near normal, but slightly colder and drier, conditions. During the 1997-1999 episodes of mass mortality, the mountains were slightly colder and wetter than normal. May of 1973 and 1997 were wetter than normal, but precipitation in May in years not associated with die-offs was even higher. Two extremely cold winters in 1978 and 1999 occurred after the episodes

of mass mortalities of boreal toads had already started in 1973 and 1997. Therefore, no distinctively abnormal weather conditions were associated with the die-offs of boreal toads in Colorado, either in the 1970s or 1990s.

Although these data sets cannot provide exact temperature and moisture at the precise locations of each decline, the data do not support the possibility that weather events were sufficiently extreme to kill amphibians directly. We feel that the lack of obvious correlations of extreme weather events with the onset of mass mortality events in these three locations make it unlikely that temperature and moisture made a significant contribution to outbreaks of fungal skin infections.

Amphibians have survived a number of climate changes over the last 250 million years of their existence. Future studies of the interaction between fungal skin diseases and amphibians should point to which environmental factors, if any, have likely played a role in tipping the balance in favor of the fungus.

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HABITAT MANAGEMENT

Overview

Boreal toad habitat consists of areas with suitable breeding habitat in lodgepole pine, spruce-fir forests, and alpine meadows. Breeding habitat consists of shallow, quiet water in lakes, marshes, bogs, ponds, and wet meadows, often with egg placement optimizing thermal effects of the summer sun. Young toads are restricted in distribution and movement by available moist habitat, while adults can move several miles and reside in marshes, wet meadows, or upland forested areas. Protection of such habitats, and the preservation of reliable and stable water levels in breeding habitat is essential to the long-term survival of the toads.

Public Lands

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

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

Private Lands

There are some boreal toad populations and habitats located on private lands, particularly in the vicinities of ski resorts. In Colorado, the Colorado Division of Wildlife has worked with private land owners and developers, mainly in Summit 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.

Although the boreal toad populations on private lands represent a very 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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