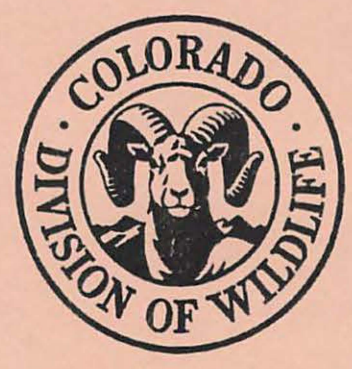
REPORT ON THE STATUS AND CONSERVATION OF THE BOREAL TOAD *Bufo boreas boreas* IN THE SOUTHERN ROCKY MOUNTAINS

1998

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, 1999

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INTRODUCTION AND SUMMARY

This is the second 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.

The boreal toad is presently listed as an endangered species by both Colorado and New Mexico, and is a "Status 2" 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 were signed by eight involved state and federal agencies, outlining and confirming their respective roles in implementing the Conservation Plan. These agreements are appended to the Conservation Plan. Additional agencies and partners in the boreal toad conservation effort are expected to sign Conservation Agreements in 1999.

For the past three years, the recovery team has worked on plans and actions to implement recovery and conservation efforts for the boreal toad. Work to date has involved several state and federal resource management agencies, personnel from universities, the Colorado Natural Heritage Program, and various other interested parties - including local land use planners and private land owners. Management activities to date have included (1) the conducting of surveys of historic and potential suitable habitats for new toad populations, (2) the annual monitoring of known breeding populations, (3) research work to identify and evaluate both biotic and abiotic limiting factors to toad survival, (4) research to better define good boreal toad habitat and boreal toad biology/ecology, (5) development and testing of techniques and protocols for captive breeding and rearing of boreal toads,

(6) experimental reintroductions of toads to vacant historic habitat, (7) protection of boreal toads and their habitats via coordination with land management agencies - in particular with the US Forest Service, (8) work with local land use planners and developers aimed at avoiding or minimizing potential impacts of private land development on boreal toads and their habitat, and (9) efforts to increase public awareness of this species and its plight via informational/educational activities & public involvement in searches for new populations of boreal toads.

As of the end of 1998, 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. Breeding populations have been documented during the past five years in 12 counties in Colorado, and at one location in Wyoming. There are presently 40 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 40 breeding localities comprise 23 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 since 1997, direct comparisons of the level of achievement of recovery goals from 1997 to 1998 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 three to 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 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 a state endangered species in New Mexico since 1976 and in Colorado since November, 1993. It is a "Status 2" species[1] 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
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

[1] This designation recognizes the boreal toad is in need of special attention due to limited and/or declining numbers, but does not indicate any protected status by the state of Wyoming.

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
Mike Wunder	Colorado Natural Heritage Program, Ft. Collins, CO

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, Aquatic Resources 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, 1999, eight state and federal agencies 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 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 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 1998.

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 40 breeding localities comprising 23 separate populations, of which only 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.

Interpretation of Breeding Locality Tables

The breeding locality tables presented in this report have been re-formatted, as compared to the tables in the 1997 report, to better reflect information which is pertinent to the revised recovery criteria and definitions.

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".

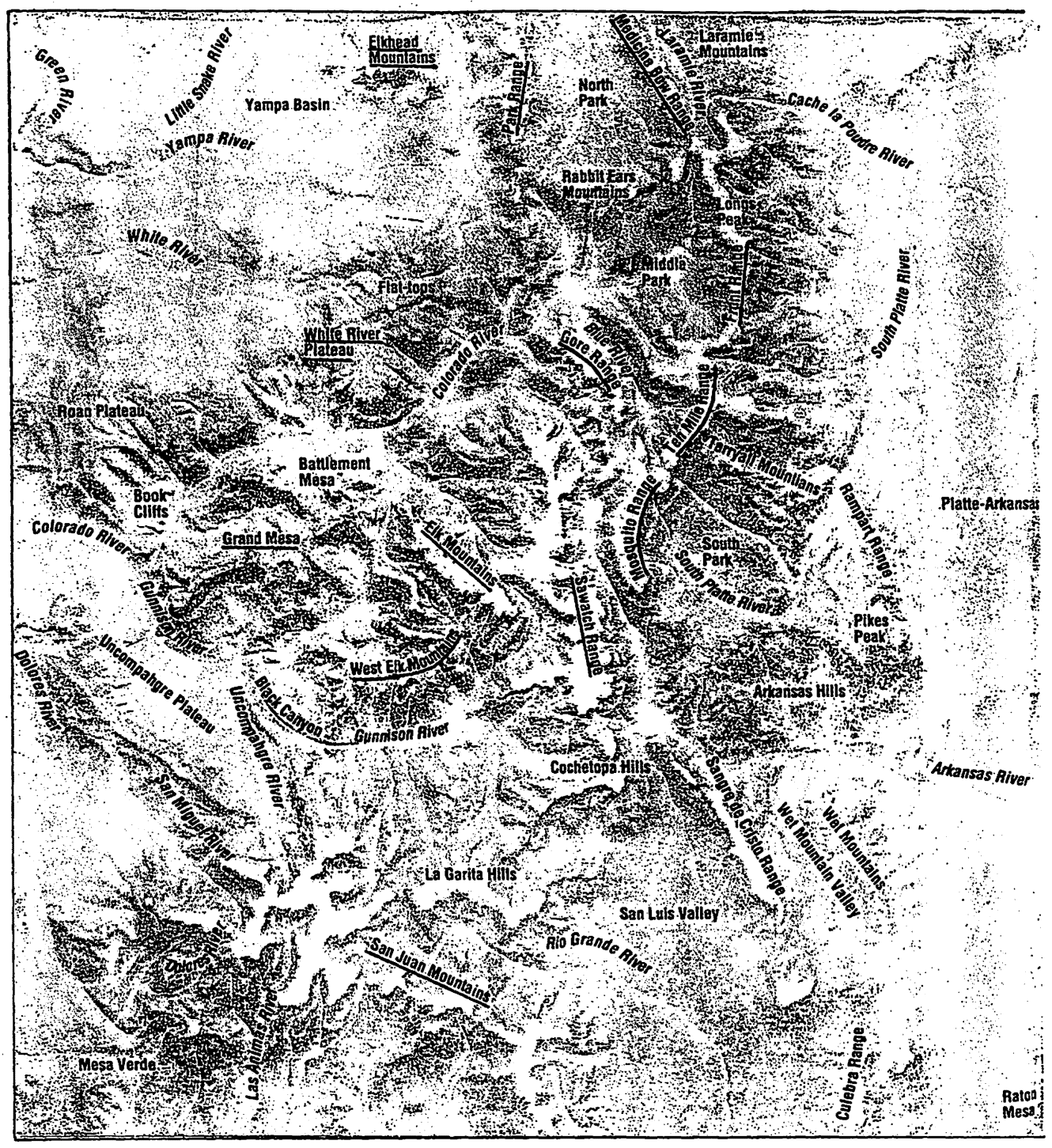
Locality and Population Names: After the locality number will be the name of the locality, followed by the name of the population of which it is considered a part. The population name is in parentheses, and in some cases may be the same as the locality name.

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 1998, as success can not be determined until the Spring or Summer of 1999, or it is known that there were no metamorph toadlets produced at the site in 1998.

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).

* * *

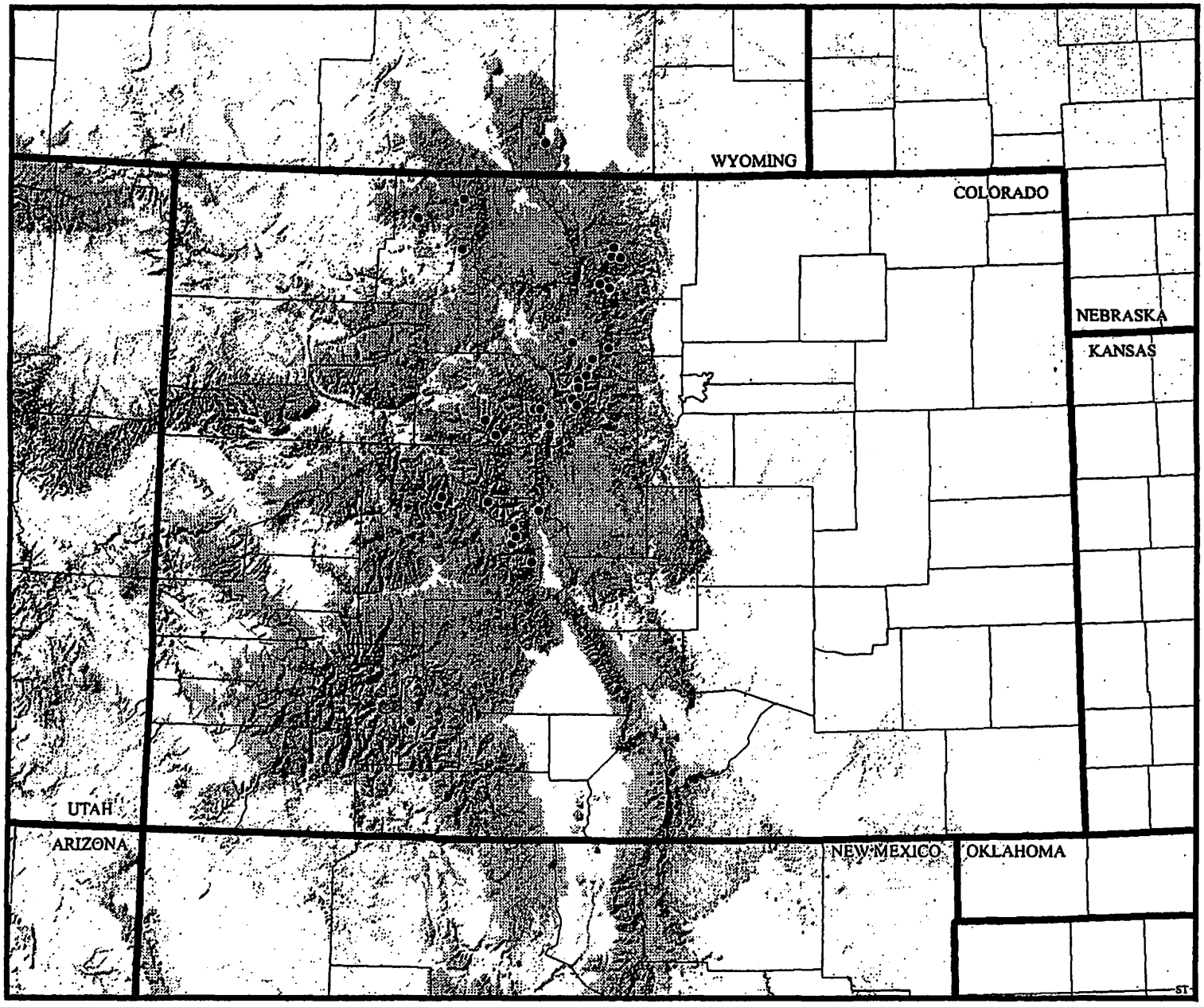


MOUNTAIN RANGES IN WESTERN COLORADO

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

BOREAL TOAD BREEDING LOCATIONS

1996 - 1998



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

August 1998

SUMMARY OF BOREAL TOAD BREEDING POPULATIONS IN THE SOUTHERN ROCKY MOUNTAINS **Dec., 1998**

Geographic Area	Number of	Populations w/Breeding/Recruitment					Populations w/20+ Breeders & 4+ Eggm.					"Viable"
(Mtn. Range of Historic Occurence)	Populations	1994	1995	1996	1997	1998	1994	1995	1996	1997	1998	Populations
Park Range	2			2/1	2/2	?/?			0	0	0	0
Elkhead Mountains	1		?/0	1/?	0/0	?/?		0	0	0	0	0
Medicine Bow Range	1	1/1	1/1	1/1	1/1	0/0	0	0	0	0	0	0
Front Range	10	3/1+	5/1+	6/4	5/1+	6/?	2	3	3	3	3	3
Gore Range	1		1/0	1/1	1/0	1/?		0	1	1	1	0
Mosquito & Ten-mile Range	2		1/?	1/1	2/1	1/?		0	0	0	0	0
Sawatch Range	5	1/?	2/?	4/1	5/2	3/?	0	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/?	0	0	0	0	1	1
San Juan Mountains	2			2/1	1/1	1/?			0	0	0	0
TOTALS	26	5/2+	12/2+	20/11	19/9+	13/?	2	4	5	5	6	5

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 1998 production can not be determined until 1999 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 are likely to exist.

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	Unk	1(1)	Inadequate Monitoring

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	Unk	1 (1,A)	Inadequate Monitoring

* * *

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 is one known breeding site at this time (First Creek), but evidence of at least one other possible breeding site in the area was found along Elkhead Creek in 1997. 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	Unk	1(S)	Inadequate Monitoring

* * *

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.

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 aduls/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	Unk	2(1,S)	No reproduction seen

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

* * *

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 seventeen (17) 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

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)	

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

This site appears to 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

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

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

This is an experimental reintroduction site.

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

Population indicates breeding, 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

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

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

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

Locality SU-6 - 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

Egg mass not observed, but assumed due to presence of metamorph toadlet.

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

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

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

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

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

* * *

Gore Range

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

As of 1998, there were only two known breeding localities in the Gore Range - both in east-central Summit County. Each of these have two or more breeding sites. Some additional survey work was conducted in Summit County in 1998, but more is needed in the overall geographic area.

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	Unk	2(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

* * *

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 1998, 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

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

* * *

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 eleven (11) known breeding localities within this area. Nine (9) of these are located in the Collegiate Peaks area of Chaffee County, and two (2) in southern Eagle County.

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	Unk	2(M,A)	1st year of PIT tagging

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	Unk	4(M,1,S,A)	1st year of PIT tagging

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	Unk	3+(M,S,A)	1st year of PIT tagging

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	Unk	4(M,1,S,A)	1st year of PIT tagging

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

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

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	Unk	4(M,1,S,A)	Eggs late season

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

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

Year	M/F/Egg Masses	Recruitment	Age Classes	Comments
1998	2/2/2	Unk	2(M,A)	Excellent production

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

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	Unk	2(1,A)	Inadequate monitoring

Two closely associated breeding sites at this locality.

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 is being done, and should be completed in 1999. If no toads are found, and suitable habitat still exists, this will be a high priority site for an experimental reintroduction.

* * *

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.

There are two known boreal toad breeding sites in this area. One is in southern Pitkin County, and the other in northern Gunnison County. There have been recent, reliable reports of toads from other localities within this area, such as Mt. Crested Butte and the Snowmass Lake area, and 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

Dead toads found in area in 1995 and 1996. *Basidiobilus ranarum* isolated as possible cause of death.

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

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

* * *

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 1998, 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 - notably from the Elk Creek drainage in Conejos County, Miner's Creek in Saguache County, and from near Chama, New Mexico. Additional survey work needs to be conducted in the San Juan Mountain area, and is likely to result in the eventual location of additional breeding populations.

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)	

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	

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

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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 four years include the Park Range, Front Range, Gore Range, and Saguache Range, with initiation of surveys in the San Juan Mountains in 1997. In 1998, considerable survey work was accomplished in Summit County as a result of a cooperative effort between the US Forest Service, Vail Associates, and the Colorado Division of Wildlife. Evidence of a previously undocumented breeding locality was found in the North Snake River drainage in Summit County, and new breeding localities were also found in the Poudre River drainage in Larimer County and in the South Cottonwood Creek drainage in Chaffee County.

Data regarding areas surveyed, where no toads were found, is in the process of being gathered from various sources and compiled, and will be used to plan future survey efforts. In 1999, a cooperative boreal toad survey and monitoring effort between the USFS, CDOW, and Colorado Natural Heritage Program is planned, and recruitment of volunteer help will also continue (see below).

PUBLIC INFORMATION AND INVOLVEMENT

The use of trained volunteers is being pursued as a remedy to 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, volunteer "workshops" were conducted at Ft. Collins, Glenwood Springs, Colorado Springs, and Durango, resulting in the training of nearly 50 volunteers. Although subsequent participation in survey efforts by volunteers was less than hoped for, ten survey forms were completed and submitted by five volunteers in 1998. Aside from the survey information which may be gained from volunteers, there is also a broader benefit in educating members of the public - especially those who frequent the out-of-doors - about the boreal toad and its habitat. Therefore, the effort to train "volunteers" will continue in 1999.

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 in 1996, 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, from now on, 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.

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 has been discontinued as of late 1997, and will only be resumed if and when it is decided that a reintroducion is to be done. Most of the toads which were housed at the CDOW toxicology lab, in Ft. Collins, have been transferred to Dr. Cindy Carey, at the University of Colorado/Boulder, for use in research on immunology.

As of late 1998, there are still approximately 30 boreal toads in captivity in Sybille, Wyoming, which continue to be used for captive breeding and rearing work. There was very little captive production of tadpoles in 1998, primarily because Mr. Mitch Bock, who was overseeing this work, left the Wyoming Game & Fish Department.

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.

Although there are no immediate plans for continued captive breeding and/or rearing of boreal toads in Colorado, the CDOW is planning to begin construction of a native aquatic species hatchery in the near future. This facility, to be located in the San Luis Valley, will be primarily geared towards propagation and rearing of native fish species, but will also be designed to accommodate rearing of amphibians, should there be a need to do so.

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, but should be done in 1999, if personnel and time are available to do so.

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 full report on page 38).

In 1997 and 1998, NPS and USGS-BRD staff continued to monitor the Glacier Basin site. No egg masses or tadpoles have been found to date. Although there appeared to be good short-term survival with release of adult toads, thus far none have returned to breed, and none were observed in 1998. Monitoring will continue in 1999 and coming years.

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 full report on page 33). This site will continue to be monitored for several years to determine the result of the translocation.

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, 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 and 1998. Monitoring at this location will continue, however.

Grand Mesa, in western Colorado, has been intensively surveyed during the past three years, and is being considered for an experimental reintroduction of boreal toads, provided no toads are found in 1999 surveys and other criteria, as outlined in the Conservation Plan, are met. In addition to intensive aquatic habitat mapping, approx. 780 hours of inventory effort was made 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.

* * *

RESEARCH

Various areas of research are being pursued in order to achieve recovery goals outlined in the Boreal Toad Recovery Plan. These are being addressed to the extent that time and available resources allow. The following is a summary of research work through 1998.

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, 1995-1997" for more details).

Breeding Site Monitoring

1998 was a banner year for breeding in the Henderson Mine area. The number of sites with successful breeding activity went from 6 in 1997 to 11 in 1998 with a total of 55 egg masses. A couple of the new sites exhibited tremendous production. Other historic sites, however, such as Upper Urad and Treatment had reduced production.

Hesbo: Breeding activity was observed from May 12 to May 26 with a maximum of 10 females noted on May 14 (62 total) and maximum of 96 males (98 total) on May 26. A total of 16 egg masses were observed. The estimated number of tadpoles was 20,000. Many toadlets from 1997 were observed. Survival through metamorphosis at this site was good in 1998. The Hesbo breeding site was "improved" in October will the help of a trackhoe from the mine. A channel was dug down the center to expand storage capacity and to keep tadpoles from being stranded in pools as the water level drops. The dam was significantly enlarged and a water control structure was added.

Hesbo Ditch: There was one egg mass deposited in the ditch to the west of Hesbo. Toadlets were observed in August.

Treatment: The maximum number of adults observed during night surveys at this site was 4 but 4-5 egg masses were deposited. Approximately 10,000 tadpoles were observed on August 5th but no toadlets were subsequently observed.

Lower Urad Reservoir: This site was not monitored at night as it was never a breeding site in previous years. On August 18, several hundred tadpoles were noted in the NW corner and also numerous toadlets. There was probably one egg mass at this site.

Power Alley: Breeding activity was noted from May 12 to June 11 at this site. Three egg masses were observed which later desiccated. Two egg masses were later relocated from less desirable locations to the upper pool, these resulted in approximately 1000 tadpoles. Predation by raccoons on adults was documented at this site as well as at Hesbo and Donut.

Anne's Pond: Breeding activity and success at this site has been greatly enhanced since we started piping in water from Ruby Creek last year. In 1996 and 1997 we typically observed 3-4 adults during night surveys. In 1998 we saw 24 adults on May 26 and again on June 2, with a total of 12 egg masses deposited. Approximately 25,000 tadpoles were observed at this site with good survival through metamorphosis and dispersal. This site was also "improved" by adding a channel down the center to increase volume and prevent tadpoles from becoming stranded in pools and desiccating.

1-Pond: New breeding site. Large tadpoles from at least 2 egg masses were observed on July 29 (approx. 8,000); excellent survival and dispersal of toadlets.

Donut: Breeding observed during night surveys from May 26 to June 23 with a maximum of 22 adults observed in one night. A total of 13 egg masses were deposited. Unlike other years, the tadpoles seemed to utilize the entire pond and metamorphosed onto the islands, which we felt would probably result in greater survival than in previous years.

Upper Urad: This site was monitored four times at night from May 2 to May 23. The greatest number of adults observed was 10, with 4 being females. No egg masses were deposited at this site.

John's Sewer Pond: This was a new breeding site this year. This pond produced approximately 4,000 very large tadpoles; the enhanced growth probably a result of warm water and nutrient enrichment. Survival and dispersal was good. Some of these tadpoles were moved to Power Alley.

Flume House: This was a new breeding site which was brought to out attention by one of the mine workers. There were approximately 2,000 tadpoles present, but because we felt they had nowhere to disperse to, we relocated them to Power Alley.

Research Activities

All adult toads which were handled during surveys at breeding sites were weighed, measured and checked for pit tags. A total of 374 individual toads were handled (some multiple times). Of these, 228 were recaptures from previous years and 146 were first time breeders. The pit tag data will be used to generate population and over-winter survival estimates. The pit tag data is also being used to determine site fidelity and breeding frequency. Of 79 females pit tagged since 1995, there have been only four recaptures in subsequent years. This indicates that most females do not breed every year and may only breed once every four to five years. Thirty-three toads were fitted with radio transmitters and their locations and habitat use recorded each week. All locational data was imported into ARC/INFO for spatial analysis. Habitat selection and movement data is being analyzed. As with

last years data, the telemetered toads selected for rocky areas, ie. they used rocky areas far out of proportion to their availability in the study areas. Also of note was their selection for higher gradient slopes after breeding season. The toads move to upland habitats after breeding and do not remain in the riparian areas surrounding the breeding site. The maximum distance moved by a telemetered toad in one week was 1,538 m, and the minimum distance 0.5 m. The average distance moved per week was 70 m for males (SD=62 m) and 46 m for females (SD=32 m). In both the habitat and movement analyses there was high variability between individuals, particularly males. Home range estimates are being calculated for all telemetered toads using both the minimum convex polygon and adaptive kernel methods.

Plans for the 1999 field season

A fairly good, long-term data set is being developed on toads in the Henderson breeding locality. Plans are to continue to monitor these sites during breeding, collecting pit tag information, and radio tagging as many adults as possible, particularly females. Information collected on the Henderson Mine boreal toad population - especially that leading to a better understanding the life history of female boreal toads - may be critical to successfully establishing the new populations which may be required to meet recovery criteria. This locality will continue to be closely monitored and studied over the next few years.

* * *

Reintroduction of Various Age Classes of Boreal Toads to Lost Lake, Boulder County, Colorado - Kirsta L. Scherff-Norris (CDOW/CSU)

Introduction

One of the research needs identified by the Boreal Toad Recovery Team is experimental reintroduction (Goettl 1997). This study investigates an experimental reintroduction of boreal toads of various ages raised by different husbandry methods. Toads were reintroduced in the summers of 1996 and 1997 and an area surrounding the reintroduction site was intensively monitored from June 1997 to August 1998. The primary goal of this study was to determine whether various age classes of reintroduced boreal toads had different survival probabilities. This information will aid in determining the most efficient method for toad reintroductions to establish self-sustaining populations in areas historically occupied by the boreal toad, as outlined in the *Boreal Toad Recovery Plan* (Goettl 1997). The following age classes of boreal toads were reared and reintroduced to Lost Lake: tadpoles (two groups), 1-4 week old toadlets (three groups), 9-10 month old toadlets (three groups), 22 month old toadlets (one group), and adult toads (one group). Hereafter, 9-10 month old toadlets will be referred to as "1 year old" toadlets and 22 month old toadlets will be referred to as "2 year old" toadlets.

Monitoring of Reintroduced Toads

Censuses were conducted from 3 June 1997 to 18 August 1997 and from 22 June 1998 to 19 August 1998. However, data presented here for the 1997 sampling periods include only those sampling periods between 30 June and 18 August, because the initial sampling period from 3 June to 27 June was considered a pilot period and did not have adequate area coverage. A sampling period was defined by the how many days it took to search the entire census area for toads once.

Tadpole metamorphosis

Tadpoles reared at Lost Lake did not have a high rate of metamorphosis. Of the three non-fed enclosures (NF1, NF2, NF3), only one (NF3) produced toadlets (n=13). Tadpoles that were supplementally fed metamorphosed into toadlets in all three enclosures (n=98 total; F1=23, F2=33, F3=42). Survival percentages for the enclosures were as follows: NF1: 0 % (0/192); NF2: 0 % (0/191); NF3: 7 % (13/187); F1: 17 % (23/133); F2: 21 % (33/159); F3: 27 % (42/154).

Relative proportions of toadlets recaptured

The numbers of recaptures of toadlets in each sampling period for 1997 and 1998 are listed in Table 1. Recaptures represent total sightings, not necessarily sightings of unique toadlets. This is because toadlets were marked with batch marks, not individual marks. Also shown in Table 1 are the statistical significant of differences in proportions of toadlets recaptured within a sampling period. We used the χ^2 test of homogeneity of proportion; if sample size was small, we used Fisher's Exact test. Toadlets reintroduced as tadpoles were not included in the analysis because none were recaptured. For all comparisons, the letter (a-g) representing the group of toadlets with the *higher* proportion of recaptures is listed next to the statistical significance level of the difference in recapture proportion.

As evidenced by these data, numbers of recaptures of toadlets declined rapidly in the summer following toadlet reintroduction. Of the groups that were monitored for two summers after reintroduction, toadlets reintroduced as 2 year olds, 1 year olds (intensively hibernated), and 1 year olds (not hibernated), were not captured at Lost Lake or surrounding search areas in 1998. No toadlets reintroduced from tadpoles reared at Lost Lake were ever recaptured. In 1998 there was only one recapture of toadlets reintroduced as 1-4 week olds (in 1996), and only four recaptures of toadlets reintroduced as 1 year olds (extensively hibernated). Because of this, recapture was only analyzed for these groups based upon 1997, not 1998, recaptures. While there were individuals recaptured in 1998 that were reintroduced as 1-4 weeks olds (in late 1997) from captive and wild stock, the numbers rapidly declined through the summer, and none were recaptured in the last two sampling periods of 1998.

Dispersal of toadlets

There were marked toadlets found on the trail below Lost Lake in 1997 and 1998. These toadlets were not included in the recapture analysis. Due to the low numbers of toadlets captured at Lost Lake and the surrounding search areas in 1998 (142 recaptures in seven sampling periods in 1998 vs. 1 698 recaptures in three sampling periods in 1997), several searches for reintroduced toadlets were conducted outside of the described search area, in drainages surrounding Lost Lake. These surveys were conducted in 1998 on: 3 July, 14 July, 15 July, 22 July, 10 August, and 21 August. Only three of these surveys resulted in discovery of toadlets. The survey on 15 July revealed 12 reintroduced toadlets approximately 0.3 km from Lost Lake in a meadow near a stream. The survey on 22 July revealed six reintroduced toadlets approximately 0.4 km from Lost Lake in a wet meadow. Upon searching the same areas on 10 and 21 August, only one reintroduced toadlet was found, on 10 August.

Adult movements

Of the five adult toads reintroduced to Lost Lake in 1997, only one was tracked through the entire summer. He was last found in 1997 on 17 October and his temperature sensitive radio indicated that he was in a location with a temperature of 1.3 °C. In 1998, he was found dead after snowmelt on 29 May. Because he was not in a hole or other protected area and appeared "mummified," he apparently froze to death in the fall of 1997 without finding a hibernacula. Two other adults slipped out of their radio harnesses in 1997. Another toad presumably went out of radio range or his radio quit working, as no signal was received 12 days after the toad's release in 1997. Finally, one toad was severely cut by his radio harness and was found dead on 18 September 1997.

We determined average daily distance traveled, as well as maximum distance traveled from Lost Lake for the two toads that were tracked for the entire summer following release. The first toad was the one that apparently froze to death before winter 1997. The average daily distance traveled by this toad was 76.8 m (80.4 SD; range: 2.6-264.2 m) and the farthest distance traveled from Lost Lake was 1 790.6 m. The second toad for which distances traveled were figured was the one that died on 18 September 1997. The average daily distance traveled by this toad was 33.4 m (30.6 SD; range: 1.8-91.7 m) and the farthest distance traveled from Lost Lake was 459.3 m.

Discussion

In our study, there was a statistically significant difference in masses between toadlets given supplemental food as tadpoles and those not. While there was also a difference among fed enclosures, given the magnitude of the difference of masses of toadlets from the fed enclosures (0.30-0.37 g) versus those from the unfed enclosures (0.13 g), we concluded that the difference in mass between fed and unfed toadlets can most likely be attributed to the supplemental feeding. Supplemental feeding did appear to benefit boreal toad tadpoles in our study.

Table 1. Numbers of recaptures of toadlets 1997-1998 and differences in proportions of toadlets recaptured. Group with higher proportion recaptured is noted by letter in parentheses.

	GROUPS OF REINTRODUCED TOADLETS/TADPOLES								
SAMPLING PERIODS	**2 YR (a)**	**1-4 WK (1996) (b)**	**1 YR Intensively Hibernated (c)**	**1 YR Extensively Hibernated (d)**	**1 YR Not Hibernated (e)**	**1-4 WK (1997) Captive (f)**	**1-4 WK (1997) Wild (g)**	**T A D - POLES (Fed) (h)**	**T A D - POLES (Unfed) (i)**
1997									
30 June-14 July	18 ***(c),(e) NS(d)	165	65 *(e)	233 ***(c), (e) NS(a)	47	N/A	N/A	N/A	N/A
14 July-4 August	6 ***(c) *(e) NS(d)	98	32 NS (e)	79 ***(c) NS(a)	16 NS(c)	N/A	N/A	N/A	N/A
4-18 August	1	5	1	2	0	N/A	N/A	N/A	N/A
1998									
22-25 June	0	1	0	0	0	20 NS(g)	19 NS(f)	0	0
25 June-1 July	0	0	0	0	0	18 **(g)	25	0	0
1-13 July	0	0	0	0	0	7 ***(g), (b)	20 ***(b)	0	0
13-20 July	0	0	0	0	0	5 ***(b) **(g)	13 ***(b)	0	0
20 July-3 August	0	0	0	0	0	4 NS(g)	6 NS(f)	0	0
3-12 August	0	0	0	2	0	0	0	0	0
14-19 August	0	0	0	2	0	0	0	0	0
Total reintroduced	39	12 000	77	520	48	7 071	4 235	98	13
Date(s) reintroduced	9 June 1997	6-28 August 1996	9 June 1997	9 June 1997	9 June 1997	16 July-22 August 1997	23 July-22 August 1997	22 August-12 September 1997	13-22 August 1997

***=p≤0.001; **=p≤0.005; *=p≤0.05; NS=not significant

However, even though we released 98 toadlets that were reared from tadpoles with supplemental food, we did not find any of these toadlets in searches at Lost Lake or the beaver ponds. Toadlets reintroduced at later stages (fully metamorphosed) obviously had better survival than toadlets reared at Lost Lake from tadpoles. We believe that tadpoles are not the best age class to use for reintroduction.

In comparing proportions of toadlets of various groups recaptured, we can conclude that for the 1997 summer, 2 year old toadlets and 1 year old extensively hibernated toadlets dispersed or died faster than the 1 year old toadlets intensively hibernated or not hibernated. Among the toadlets released as 1-4 week olds in 1997, captive bred toadlets were generally dispersing or dieing faster than the wild bred toadlets. Finally, comparing toadlets released as 1-4 week olds in 1996 and 1997, those released in 1996 had a higher relative recapature rate than either of the two groups released in 1997. This is comparing recapture rates the first year after reintroduction, so there are two separate years being compared. However, given the confounding effect, the toadlets released in 1997 dispersed or died faster.

While this discussion does not lead us to a conclusion of which of these groups of toadlets has the highest survival following reintroduction, it may be useful when toadlets return as adults to breed. By knowing the pattern of dispersal or death, we may be able to predict earlier in future reintroductions which groups are most likely to return, based upon their rate of disappearance.

Maximum distance that toadlets were reported to have been found from Lost Lake should not be considered maximum possible distance traveled, as we searched beyond Lost Lake on only a few occasions and not as thoroughly as on the transects at Lost Lake. Toadlets noted on trail below Lost Lake as well as those discovered in searches outside of the reintroduction area give some indication that there may have been toadlets emigrating from the area.

Future plans

It is important to continue monitoring this population to note which, if any, toadlets return to breed after reaching maturity. Continued monitoring is planned for the summer of 1999.

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Boreal Toad Research in Rocky Mtn. National Park

Stephen Corn, USGS/BRD and Aldo Leopold Wilderness Research Institute, and Erin Muths, USGS/BRD.

We have been studying boreal toads in the Northfork drainage of the Big Thompson River in Rocky Mountain National Park and the Comanche Peak Wilderness since 1988 (Corn et al. 1997). The Lost Lake population (3265 m) and the Kettle Tarn population (2810 m) have been the focus of our studies. We have collected data on water quality and temperature and air temperature each season. Our mark recapture program, begun in 1991, has captured 1081 toads in the North Fork drainage. In addition to the breeding site population estimation, we monitor boreal toad movements within the drainage and search other known and potential breeding locations in the park. Spruce Lake, RMNP was confirmed as a breeding location this year and a reported boreal toad sighting on the west side of the park was investigated but no toads were found.

Population estimates for Kettle Tarn and Lost Lake indicate that a significant loss occurred between 1995 and 1996, which was most severe at Kettle Tarn. The estimated number of adult males was 237 (SE = 29) in 1995 and 55 (SE = 45) in 1996. Few toads marked before 1995 have been encountered at Kettle Tarn since 1996. Poor data precluded a population estimate at Kettle Tarn in 1997, but the mean capture probability from previous years (~0.5), combined with the number of males observed in 1997 (15) suggests a population estimate of about 30 males. Similar numbers apply in 1998, but a population estimate will not be available until 1999 data are collected. At Lost Lake, the estimated number of males dropped to 162 (SE = 19) in 1996, down from 238 (SE = 22) in 1995. The 1997 estimate was 170 males (SE = 15). In 1998, we observed 106 males at Lost Lake. Capture probabilities at Lost Lake also have averaged about 0.5, suggesting that the 1998 estimate may show a slight increase from the numbers in 1996-1997. The reason for the decline in numbers of toads between 1995 and 1996 are not apparent; we have failed to find large numbers of dead or diseased toads in our surveys. The stable population at Lost Lake in 1996-1997 suggests a single event rather than a chronic problem. The record late snowfall in 1995 may have contributed to the decline, but this is speculation.

In cooperation with Rocky Mountain National Park, we ran a two year (1995-1997) experimental translocation project using wild spawned eggs from Lost Lake. Eggs, toadlets (n = 800) and adults (n = 100) (reared in captivity) were released at Glacier Basin and monitored extensively (3-4 times per week) (Muths et al. submitted). In brief we had good short term survival with the released adults but as of this writing, none have been found indicating, thus far, that no toads returned to breed and may all be dead. None of the 800 toadlets were found. Based on past reports (Muths et al. submitted), our observations and our relative success with translocating egg masses, we suggest that the best strategy for the boreal toad is to translocate eggs deposited in the wild. *Bufo boreas* require 3 - 5 years to reproduce, therefore translocation of eggs to the same site, every year for a minimum 5 years is required to attempt the establishment of a breeding population. We have been monitoring this site fairly intensively, 2-4 times per week and will continue monitoring in 1999.

Effects of ultra-violet radiation have been considered as a potential threat to amphibians worldwide. We have examined the effects of UV-B radiation in the Rocky Mountains since 1994 (Corn, 1998

and Corn et al. unpublished). Results from these studies do not support UV-B radiation alone as the cause of the decline of *Bufo boreas* during the past 20 years in the southern Rocky Mountains, but UV-B cannot be dismissed because of contradictory results from other studies. We have also examined geographic variation of the effects of UV-B radiation on the hatching success and development of boreal toad embryos from four states, Washington, Montana, Colorado and Utah (Corn et al. submitted). We found no significant differences between states or between treatments again suggesting that it is not UV-B alone acting to depress boreal toad populations.

1998 was our pilot year using radio telemetry to examine habitat use and movement in adult boreal toads in RMNP. We collared only six toads that we followed through mid-October, but we were able to develop our collaring technique and work out logistics for vegetation sampling. Collared toads did not move far from the breeding pond (< 2km). However, some of our movement data from PIT tags show 9 moves greater than 5 km since 1991. All except one of the pilot toads were males and we did not begin collaring until July. We plan to continue our population monitoring in the Northfork, and will be collaring 20 toads at two sites in order to study their movement and use of habitat.

In addition to RMNP, we surveyed for boreal toads and other amphibians in various drainages in northern Colorado and south central Wyoming from May – August 1998. The only find was one boreal toad (male) at Pole Creek, in Larimer County, Colorado. This is the first record of a boreal toad in the Rawah Mountains, although there are numerous records from the Chambers Lake Area and the Fox Park area in southern Wyoming. This area will be more carefully surveyed in the spring of 1999.

Related publications and Literature cited:

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Boreal Toad Tadpole Predators - Lauren J. Livo, CU/Boulder

Predator density study

Predator communities may shape the natural distribution of boreal toad populations by limiting successful reproduction. I studied aquatic predator communities by setting out arrays of 8 traps in 25 montane ponds in Clear Creek, Gilpin, Boulder, and Larimer counties. Traps were left in place for

24 hours to sample both diurnal and nocturnal invertebrates. Each study pond was sampled twice (once each in late June or July and again in August). (Note regarding DAPTF protocols: the traps were cleaned, dipped in a bleach solution, and dried after every use.)

Pond temperatures were correlated both with greater diversity of animals and with greater expected impact from tadpole predators. When the coldest ponds were excluded from the analysis, ponds used as boreal toad breeding sites had significantly fewer predaceous diving beetles (*Dytiscus dauricus* and *D. alaskanus*) and tiger salamanders (*Ambystoma tigrinum*) than ponds without records of boreal toad reproduction. These findings suggest that successful boreal toad reproduction depends on sites that are sufficiently warm but that do not include abundant populations of important tadpole predators.

My thanks to Boris Kondratieff of CSU for his help with invertebrate identifications.

Potential impact of Dytiscus larvae predation on boreal toad tadpoles

I placed 150 boreal toad tadpoles in each of 6 enclosures at Hesbo. Zero, 1 or 2 *Dytiscus* larvae were added to each enclosure. Only 2–20 tadpoles survived in enclosures with one or more *Dytiscus* larvae, while 144 and 146 tadpoles in the control enclosures survived the two week trial.

At Herman Gulch, I captured approximately 80 *Dytiscus* larvae between 2 June and July 17 during brief weekly visits. Based on consumption rates of 6.4 tadpoles consumed per larva per day in the Hesbo enclosures, a population of 80 *Dytiscus* larvae could potentially consume between 14,336 and 21,504 tadpoles over a 4-6 week period.

Smaller impacts from *Dytiscus* larvae would result at sites where there were smaller numbers of the larvae or where they tended to feed on other prey. However, potential impact on tadpole numbers may be greater since there is some indication that consumption rates increase over time, with later instar *Dytiscus* larvae consuming more tadpoles per day than early instar larvae. Tadpoles were nearly eliminated from the Hesbo enclosures by the end of the two week trial, so the calculated consumption rates may reflect the lack of availability of tadpoles. In addition, larval *Dytiscus* may be present at a site in greater numbers and over a longer period of time than the 4-6 week period used in for these calculations.

Phenological observations include presence of adult beetles at boreal toad breeding ponds in May and the appearance of first instar *Dytiscus* larvae at boreal toad breeding ponds before the toad eggs hatched. Through most of the summer the Herman Gulch and Hesbo breeding sites were visited at least weekly to catch *Dytiscus* larvae; these larvae abruptly disappeared in mid-July, probably when pupation began at these sites. Toad metamorphosis occurred shortly afterward at both sites. At higher elevation sites in the Urad drainage, *Dytiscus* larvae continued to be present well into August, as were boreal toad tadpoles. I observed pupation in the field in August, and teneral adults were observed mid- to late August.

Laboratory trials

I conducted a limited number of laboratory trials during 1998. Three trials with *Dytiscus* beetles indicate that these are minor *Bufo boreas* tadpole predators. The beetles consumed no tadpoles in the first 24 hours, but by 48 hours had consumed a mean of 1 tadpole (number of trials = 3).

Medium and large odonate larvae readily consumed boreal toad tadpoles. In two trials with 5 *B. boreas* tadpoles and 5 *Pseudacris triseriata* tadpoles, odonate larvae consumed a mean of 3.5 *B. boreas* tadpoles and 3 *P. triseriata* tadpoles. This preliminary information suggests boreal toad tadpoles and chorus frog tadpoles are about equally vulnerable to predation by dragonfly larvae. This is in contrast to the situation with *Dytiscus* larvae, in which results from trials in 1997 demonstrated that boreal toad tadpoles are much more vulnerable to this predator than are chorus frog tadpoles.

Polymer marking

In August, Mark Jones (CDOW) and I began a trial on newly metamorphosed toadlets with the Visible Implant Fluorescent Elastomer (VIE) tagging system from Northwest Marine Technology. We set up four enclosures at Hesbo, each with 30 toadlets. Toadlets in two enclosures were injected with a red fluorescent material, while toadlets in the other two enclosures served as controls. A mean of 27 toadlets/enclosure survived the two week field trial, and there were no significant differences in survival (Chi square = 0.261, df = 1). In an evaluation of mark visibility, only two of 50 toadlets were scored incorrectly, and one of the incorrect scores was for a toadlet with an extremely small mark. Several marked toadlets are being held in the laboratory; and there has been no further mortality and the marks remain highly visible.

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Boreal Toad Genetics Studies - Anna Goebel, CU/Boulder

Recent declines of *Bufo boreas* across much of its distribution identified the need for comprehensive systematic analyses for the species group for conservation purposes. Analyses that included specimens from across the full distribution, especially specimens from the eastern half of the toads range were lacking. Therefore, genetic analyses for the *B. boreas* species group were initiated in 1992. In general, the goals of analyses have been to describe genetic diversity in the *B. boreas* group at three levels; first, among deep relationships, specifically among the *Bufo boreas* species group and other *Bufo* species in North America; second, among recognized species and potential unidentified cryptic species (species not identified with morphological diversity) within the *B. boreas* group; third, within and among populations that have recently declined in Colorado. Two questions were of special interest to managers in Colorado. First, what was the systematic relationship of the populations in Colorado (which are disjunct or geographically isolated) to the rest of the group? And second, what is the degree of differentiation among the remaining (and now isolated) populations within Colorado? See "Report on the Status and Conservation of the Boreal Toad in the Southern Rocky Mountains, 1997" for information on work done prior to 1998.

Three projects were in progress in 1998. These were (1) Range delineation of the Southern Rocky Mountain mitochondiral DNA clade of *Bufo boreas*, (2) Mitochondrial DNA (mtDNA) analyses of *Bufo boreas* in Colorado, and (3) Nuclear DNA analyses of *Bufo boreas* in Colorado and Utah, using AFLPs (Amplified Fragment Length Polymorphisms). The first was funded by Stephen Corn (USDA Funds) and the second two by Mark Jones (CDOW Aquatic Research Section).

The purposes of these genetic analyses are two-fold. First, a detailed analysis of both mitochondrial and nuclear DNA within and among populations in Colorado will identify management units (evolutionarily significant units) within the endangered southern Rocky Mountain (SRM) group of *Bufo boreas* found in Colorado, southeastern Wyoming and northern New Mexico. Second, a similarly detailed genetic analysis of *Bufo boreas* from regions surrounding the SRM group will identify the distribution of genetically similar toads (i.e., identify the range of the taxon that includes those currently considered "endangered" in Colorado).

About 150 new samples were received in 1998, representing populations from Colorado, northern, central and southern Utah (N=45), as well as Idaho, Montana, Washington and Alaska. MtDNA was analyzed from all new samples, and nuclear DNA was analyzed from all new and previously collected samples from Colorado, souheastern Wyoming, and Utah. Nuclear DNA from 5-10 samples representing both the northwest and soutwest mtDNA clades were analyzed also.

The highly differentiated mtDNA clade previously identified as the SRM group includes all toads sampled from Colorado, southeastern Wyoming, central and northern Utah, southeast Idaho (Caribou County), and some samples from northeast Nevada (Elko County). Mitochondrial DNA haplotypes from specimens in the disjunct SRM region are not monophyletic: several populations from northern Utah share mtDNA haplotypes with those from populations in Colorado. Nuclear AFLP data were very similar to mtDNA data in that only a few polymorphisms within and among populations in Colorado were identified, but a very high number of polymorphisms were identified among the SRM clade and the northwest and southwest mtDNA clades. The level of divergence between the SRM clade and the southern Utah clade was not clear.

The mtDNA and nuclear data identified similar differences among samples, suggesting that the northwest and southwest clades previously identified with mtDNA alone represent real organismic clades (they are not artifacts of mtDNA lineage sorting). More detailed cladistic analysis of mtDNA and frequency analysis of nuclear data are in progress.

Further information and Publications in Progress:

Goebel, A.M., P.S. Corn, T.A. Ranker and R.G. Olmstead. Mitochondrial DNA evolution in the *Bufo boreas* species group: using phylogeny, phylogeography, and the pattern of mtDNA evolution to assess the correspondence of mtDNA clades with organismal clades. Submitted to Evolution, May 1998, peer reviews in progress.

Goebel, A.M., and P.S. Corn. Range delineation of *Bufo boreas* in the southern Rocky Mountain mtDNA clade. Paper in progress.

Goebel, A.M. 1999. Conservation Systematics: Integrating diversity into systematics and taxonomy using examples from North American bufonids and the *Bufo boreas* species group. In, M. Lanoo (ed.) Status and Conservation of U.S. Amphibians. Accepted, pending revision.

Goebel, A.M., J.M. Donnelly and M.E. Atz. 1998. PCR primers and amplification methods for 12S Ribosomal DNA, the control region, cytochrome oxidasel, and cytochrome b in bufonids and other frogs, and an overview of PCR primers which have amplified DNA im amphibians successfully. Molecular Phylogenetics and Evolution.

Goebel, A. M. 1996. Systematics and Conservation of Bufonids in North America and the in *Bufo boreas* Species Group. Dissertation, University of Colorado, Boulder, CO.

Goebel, A. M. 1997. Molecular genetic determination of management units of the endangered boreal toad (*Bufo boreas*) in Colorado and southeast Wyoming. Report to the Colorado Division of Wildlife.

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Immunosuppression and Limiting Factors in Boreal Toad Populations

Cynthia Carey, CU/Boulder

Boreal toads experienced die-offs and extinctions in the mountains of Colorado in the late 1970's - early 1980's, possibly due to disease in adults. the putative pathogen was a facultative bacteria, *Aeromonas*, but no definitive identification of the pathogen was made at the time. Operating under the hypothesis that some man-made environmental change caused increased vulnerability to disease by impacting immune function, studies have been done to learn about how amphibian immune systems are affected by various stressors. (See "Report on the Status and Conservation of the Boreal Toad in the Southern Rocky Mountains, 1997" for information on work prior to 1998).

The analysis of heavy metal concentrations in sediment in historical and extant boreal toad breeding sites and at sites at which salamanders have experienced mass mortality has been completed, thanks to an extensive statistical analysis by Howard Ramsdell of Colorado State University. Historical sites, at which boreal toads are now absent, had significantly higher levels of cadmium, arsenic and selenium than sites at which boreal toads still exist. Sediments from ponds at which salamanders have experienced mass mortalities have significantly higher levels of strontium.

On the national front, I hosted an NSF-supported workshop at the San Diego Zoo in July, 1998, on Amphibian Diseases and Immune Function. Since mass die-offs of amphibians in Central America and Australia, which are presently occurring, are apparently attributable to a fungus, and die-offs of salamanders throughout the US west are due to a virus, it remains to be determined why immune systems are not defending amphibians against these pathogens.

Bufo canorus, which experienced mass die-offs in the California Sierra Nevada range during the same years as boreal toads and leopard frogs in the Colorado Rockies, have now been found to have been exposed to the same fungus which has been killing amphibians in Central America and Australia. Studies are now underway on museum specimens of our frogs and toads to determine if the fungus was the likely primary cause of mass mortalities of boreal toads during the 1970's in Colorado.
UV-B radiation studies were completed in conjunction with Dr. Ed Little (USGS). The life stage

most sensitive to existing levels of UV-B in the Colorado Rocky Mountains are boreal toadlets, which are exposed to radiation levels very close to levels necessary to cause damage and death. However, behavior allows them to regulate the amount of UV-B they actually encounter. Boreal toad eggs and tadpoles are resistant to UV-B levels greater than those they ever experience in the field.

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Toxicology Studies - Steve Brinkman, CDOW

The Colorado Division of Wildlife Aquatic Toxicology Laboratory is continuing to assist with investigations into possible water quality related causes of the decline of Boreal toads. These efforts consist mainly of analysis of water samples collected from current and historic breeding ponds, developing techniques to measure effects of toxicants to tadpoles, and conducting experiments to determine toxicity of selected compounds to boreal toad tadpoles. In 1996, effects of long term exposure to the metals cadmium, copper on tadpoles were studied. Effects of short term exposure to manganese and zinc on survival of tadpoles was studied in 1997. The toxicity of a highway deicing compounds, used by the Colorado Department of Transportation (CDOT), to two stages of tadpoles have also been examined in 1996 and 1997. In 1998, research efforts focused on investigating effects of long term exposure to zinc and manganese on survival, development, growth and accumulation. Effects of deicing compound on survival and growth of tadpole eggs/larvae were also studied in 1998. Analyses of water samples for metals is continuing, although at a slower than hoped for pace. We expect to have results for all samples submitted for analysis completed and tabulated by April 1999. The results of the 1998 toxicity studies are briefly summarized below.

Manganese

The 96 hour median lethal concentration (LC50) for tadpoles exposed to manganese was 16.7 mg/L. Exposure for 6 weeks at a concentration of 3.4 mg/L resulted in reduced survival, development, mean body weight, total length, and snout-vent length of tadpoles. Tadpoles exposed to 2.2 mg/L for 6 weeks were unaffected by manganese exposure.

Zinc

The 96 hour LC50 for tadpoles exposed to zinc (Zn) was 840 μg/L. Exposure to 922 μg Zn /L resulted in near complete mortality after 4 weeks. Exposure to 404 μg Zn /L did not affect survival but did reduce development, total length, and snout-vent length. Mean weight of tadpoles was reduced at concentrations as low as 62 μg Zn /L after 2 weeks.

Deicer

Effects of CDOT deicer on the earliest possible life stage of boreal toads were investigated. Survival of boreal toad egg/larvae (approximately Gosner stage 11) was not affected by exposure to deicer dilutions as high as 2.0%; the highest concentration tested. The deicer did reduce development of eggs/larvae at levels as low as 0.1%; the lowest level tested.

The results of the above toxicity tests are a brief outline of the findings of the experiments. Detailed reports will be available in Federal Aid in Fish and Wildlife Restoration Job Progress Report. F-243R-6.

Future research:

For the summer of 1999, we plan to focus on effects of sediments and possible interaction of low pH on boreal toad egg hatching success, survival, growth and development.

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Effects of UV-B Radiation on Tadpole Food Quality

Karel Rogers, Grand Valley State University, Allendale, MI.

With the help of undergraduate students, we have been testing the effects of ultraviolet radiation on the periphyton that is the primary food source for boreal toad tadpoles. Poor survival of tadpoles and toadlets may be due to decreased quality of food available during these critical stages of the life cycle. Using an experimental set-up modeled after Blaustein et al. (1994), we grew algae at four different elevations in two drainages in Chaffee County (South Cottonwood, 2971 m elevation; Denny Creek, 3029 m; Morgan's Gulch, 3143 m, and Hartenstein Lake, 3272 m elevation). The sites were chosen because each had boreal toad tadpoles that were living nearby and were under the observation of Craig Fetkavitch. Each set-up contained three treatments: mylar-covered, acetate-covered, and open-topped boxes; duplicates were placed at each locality but all three treatments of the duplicate at Hartenstein Lake and one mylar treatment at Morgan's Gulch were lost.

Hartenstein Lake algae were allowed to grow on microscope slides in the experimental apparatus for three weeks during late June and early July, 1996. Algae at the other three localities were grown for thirteen days during late June and very early July, 1997. A sample of 15 tadpoles from each of the 1997 localities was taken and preserved in formalin. The foregut contents of each tadpole were analyzed for algal species composition.

The algae from each microscope slide (or tadpole foregut) were prepared using standard methods; algal counts were made in a Palmer-Maloney counting cell. Counts were then translated to an algal

count per cm^2 (or per foregut). During the analysis phase, it became clear that different students identified some morphologically similar algae differently. Therefore, we have combined data to remove this error. Thus, in the discussion below, a "genus" can be either an individual genus or a group of morphologically similar genera.

Floral analysis was done using only on the most abundant algae. Ten genera were abundant at all localities. Seven more genera were chosen for analysis because they had densities above 20 million per cm^2 in at least two experimental set-ups (or at least one at Hartenstein Lake). All other genera identified occur at much lower concentrations so their contributions as a food source are considered minor.

These select standardized data were then analyzed statistically using a General Linear Models Procedure in the SAS statistical package. Students and faculty from the Mathematics and Statistics Department at Grand Valley have assisted in the choice of procedures and in the analysis. Because the design is unbalanced, all statistics are based on a Type III Sum of Squares. Reliability has been based on consistently high R-square values.

There are no statistically significant differences between the tadpole gut contents and the open treatment boxes when the two are put on a similar scale (density percents). There are highly significant differences ($p<.001$) between genera, between sites (altitude), and between genus interacting with altitude. In addition, treatment and altitude interact in a significant way ($p<.05$) but treatment alone is not significant. These data make more sense as they are dissected into the response of individual genera to the variables present.

Genera can be divided into several categories:

1) Some are not sensitive to altitude, drainage, or to UV-B exposure. Most of these are cyanophytes, blue-green algae.
2) A second category includes genera that are highly significant ($p<.001$) in their reaction to treatment, altitude, and to the interaction of the two. In general, these genera are most abundant when they have the highest light and when they are shielded from ultraviolet. Included in this category are the cyanophytes (blue-green algae) *Epithemia*_and *Chamaesiphon*, and the chlorophytes (green algae), *Carteria/Mesotaenium* and *Oedogonium/Bulbochaete*.
3) A third group is sensitive ($p<.001$ or $p<.05$) to treatment and altitude, but not to an interaction of the two. In general, these are most abundant at all altitudes under mylar shielding. They also increase with higher altitude except for the highest site, Hartenstein Lake. This may be due to the difference in years; Hartenstein Lake algae were grown the year before the other three localities. It may also be due to the longer growing time used in 1996. Regardless, these algae appear to be damaged by increased UV-B. Included are the cyanophytes *Cymbella* and the *Bacillaria* group, and the chrysophytes (diatoms) *Botrydiopsis* and the *Uronema* group.
4) The fourth group is significant ($p<.001$ or $p<.05$) in altitude differences and in treatment interacting with altitude. Assuming increasing UV-B with increasing altitude, it appears these algae reach a "boundary condition" in their UV exposure; they are most abundant when

unshielded at lower altitude but also most abundant shielded from ultraviolet at higher altitudes. Included in this group are the chlorophyte *Draparnaldia* and the chrysophytes *Dinobryon/Epiphyxis*.

5) Lastly, the chlorophytes *Teilingia/Orychonema/Desmidium* are sensitive to altitude alone, but not to ultraviolet.

From these data and from the literature, several observations can be made. Selected taxa of all three major groups of algae were negatively affected by UV-B but no diatoms were unaffected. These results are in broad agreement with Rader and Belish (1997) who found diatoms most reactive to UV-B. Other work by DeLange and VanDonk (1997) documents changes in fatty acid content and other biochemical characteristics of four species of algae cultured in lab under various UV-B regimes. Arts and Rai (1997) also document species-specific responses to UV-B with diatoms most sensitive and with protein content the most sensitive fraction of the biochemical composition. They, like us, found no consistent reaction of chlorophyll content. A series of other papers report similar results. In addition, our data on these localities, reported last year, indicates a highly significant loss of protein concentration with increased UV-B.

Although ultraviolet may not penetrate far into the water column of these boreal toad ponds, it appears to be having an effect. It is well known that UV-B, oxygen, and certain organic compounds can result in the production of reactive oxidants that are highly toxic to many forms of aquatic life (Vincent and Roy, 1993; Drzal, 1996, pers. Comm.).

Thus, there is evidence that food quality available to the boreal toad tadpoles may be impacted by increased exposure to UV-B. We have no data to directly tie these ecosystem effects to recruitment success in adult populations of boreal toads. Nevertheless, these data do support the hypothesis. Further testing could be done by the CDOW during summer 1999 by supplementing tadpole food in several isolated pools. If abundance of yearlings is improved at those localities by summer 2000, then we may have a tool to preserve the genetic diversity present in critically low populations.

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

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. It is believed that this effort may 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.

A total of 183 male and 25 female toads were PIT tagged at five of the six breeding localities in this population. PIT tagging and intensive monitoring will be continued in this area in 1999 and beyond.

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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).

In 1997, the Colorado Department of Transportation (CDOT) cooperated with the Colorado Division of Wildlife to help improve habitat at the Herman Gulch boreal toad breeding site adjacent to Interstate Hwy. 70. The site was becoming increasingly choked with vegetation, resulting in reduction of water depth and little or no recruitment of toads. CDOT provided a backhoe and operator to clear the pool of excess vegetation and sediment, and as a result thousands of tadpoles successfully metamorphosed in 1997. This effort demonstrated not only that interagency efforts can be productive, but that habitat improvement for boreal toads can be an effective management tool.

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 been in contact with private land owners and developers, mainly in Summit and Grand counties, and has worked 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 pursuing 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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