CANDIDATE AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Bufo boreas boreas*

COMMON NAME: Boreal toad, southern Rocky Mountain population

LEAD REGION: 6

INFORMATION CURRENT AS OF: January 30, 2003

STATUS/ACTION:
__ New candidate
_X_ Continuing candidate
  __ Non-petitioned
  _X_ Petitioned - Date petition received: September 30, 1993
    _X_ 90-day positive - FR date: July 22, 1994
    _X_ 12-month warranted but precluded - FR date: March 23, 1995
  ___ Is the petition requesting a reclassification of a listed species?
  ___ Listing priority change
    Former LP: ___
    New LP: ___
Latest Date species became a Candidate: March 23, 1995
___ Candidate removal: Former LP: ___
  __ A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
  __ F - Range is no longer a United States territory.
  __ M - Taxon mistakenly included in past notice of review.
  __ N - Taxon may not meet the Act=s definition of Aspecies.@
  __ X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Amphibian, Bufonidae.

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Colorado, New Mexico, and Wyoming.

CURRENT STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Colorado and Wyoming.

LEAD REGION CONTACT: Chuck Davis, (303) 236-7400, extension 235.

LEAD FIELD OFFICE CONTACT: Terry Ireland, (970) 243-2778.
BIOLOGICAL INFORMATION:

The southern Rocky Mountain population of boreal toads (hereinafter referred to as boreal toads)

typically occur between 2,420 and 3,420 meters (8,000 and 11,000 feet) in spruce-fir (*Picea spp.-Abies spp.*), forests, and meadows (Burger and Bragg 1946, Smith et al. 1965, Baxter and Stone 1985, Hammerson 1989). They also may be found as low as 2,100 meters (7,000 feet) in willow (Salix spp.) dominated riparian areas surrounded by sagebrush (*Artemisia spp.*) or grassland and as high as 4,000 meters (12,900 feet) in alpine habitats (Mark Jones, Colorado Division of Wildlife, pers. comm. 1996). Suitable breeding sites are in lakes, marshes, ponds, and bogs with shallow water and sunny exposure. The toads rarely lay eggs in streams. Breeding typically takes place in late May or early June but may occur as late as mid-July. Young toads are restricted to moist habitats but after breeding, adults, especially females, may move several miles into upland forests and meadows. Hibernation takes place in chambers near streams with ground water beneath the chamber floor or in rodent burrows deep enough to prevent freezing and with soil moisture high enough to prevent dessication. Most boreal toads are in hibernation by early October but association with the hibernacula may occur as early as late August (Steve Corn, U.S. Geological Service-Biological Resources Division, pers. comm. 1997).

Boreal toads were once common throughout much of the high elevations in Colorado and in the Snowy and Sierra Madre Ranges of southeast Wyoming. Boreal toads also were known to occur at three breeding localities (Lagunitas, Canjilon, and Trout Lakes) at the southern periphery of their range in the San Juan Mountains of New Mexico (Campbell and Degenhardt 1971, Jones 1978). Declines in isolated breeding sites or localities were first documented in New Mexico and Wyoming in the mid-1980s (Woodward and Mitchell 1985, Corn et al. 1989) and in Colorado in the 1970s (Carey 1993). Boreal toads may be extirpated in New Mexico though there were unconfirmed sightings in 1996 and 1997. Surveys conducted since 1989 have revealed no populations at the three previously known breeding localities in Rio Arriba County, New Mexico (Stuart and Painter 1994). Extirpation of 11 breeding sites in the Elk and West Elk Mountains of west-central Colorado were documented in the 1970s and 1980s. In the late 1980s boreal toads were found to be absent from 83 percent of breeding localities in Colorado and 94 percent of breeding localities in Wyoming previously known to contain toads. A locality may be comprised of more than one specific breeding site separated by no more than .5 mile. A population is comprised of one or more breeding localities in a second or third order drainage separated by no more than five miles (Boreal Toad Recovery Team 2001a).

Subsequent surveys in 1998, conducted by the parties involved in boreal toad conservation planning efforts, revealed about 33 active breeding localities; however, all localities but 1 in Wyoming were in Colorado. There were 30 sites where non-breeding adults were seen in 1998 (Boreal Toad Recovery Team 1999). In 1999, the number of known breeding localities jumped to 50, still with only 1 in Wyoming and none in New Mexico (Boreal Toad Recovery Team 2000). However, the increase in breeding localities was likely due to survey efforts rather than expansion of the population. The 50 breeding locations comprised 29 populations with 5 of these considered viable under the criteria established by the Recovery Team. In 2000, there were 33 active breeding localities, 19 inactive breeding localities, and 4 breeding localities of unknown status, totaling 56 breeding localities and comprising 29 populations (Boreal Toad Recovery Team, 2001b). There were five new breeding localities found in Colorado in 2000. However, severe declines in the two breeding localities in the North Fork of Big Thompson River Population were noted. Additionally, severe declines at the Urad/Henderson breeding

locality in the Clear Creek West Fork Population occurred that caused these strongholds to no longer be considered viable populations. Two other smaller populations also were not considered viable due to declines or changes in the viable population definition resulting in only 1 viable population in 2000 (Boreal Toad Recovery Team 2001b). The Cottonwood Creek drainage in Chaffee County represented the only remaining viable population of toads in the southern Rocky Mountains and continued to be the only viable population in 2001 (Colorado Division of Wildlife, unpubl. data 2001). Over half of the breeding sites and localities rangewide in 1999 only had 2 to 20 adults and the number of breeding adults at these sites did not generally increase in 2000 (Boreal Toad Recovery Team 2001b), 2001 (Colorado Division of Wildlife, unpubl. data 2001), nor 2002 (Colorado Division of Wildlife, unpubl. data 2003). There were 37 active breeding localities in 2001 and 10 inactive localities with three newly discovered localities comprising 32 breeding populations. Included in the total inactive sites was Bird Creek Wyoming where only one adult was seen in 2000 and 2001. Only two other single adults were seen in two other areas in Wyoming in 2001 (Colorado Division of Wildlife, unpubl. data 2001). In Wyoming in 2002, only one female toad was found at Bird Creek, five juveniles were found at Ryan Park, and four juveniles were found along the North Fork of the Little Laramie River. In some areas two or more breeding localities were combined in the 2001 computation of breeding localities or were thrown out as localities because they were experimental transplants (Lost Lake, Boulder County); thus the decline in total active and non-active breeding localities. In 2002, there were 38 active breeding localities, 16 inactive breeding localities, and 6 localities of unknown status comprising 32 breeding populations. The Cottonwood Creek drainage in Chaffee County is still the only viable population. A chytrid fungus (*Batrachochytrium dendrobatidis*) appears to have impacted at least 50 percent of the known range based on declines of adults in many breeding localities at the northerly limit in Wyoming down to Pitkin County, in approximately the middle of Colorado, and is what caused declines in the North Fork Big Thompson and Clear Creek West Fork populations.

The western toad (*Bufo boreas*)was described by Baird and Girard (1852). Camp (1917) combined *B. boreas* and *B. halophilus* as subspecies of *B. boreas*, resulting in two subspecies of the western toad, the boreal toad (*B. boreas boreas*) and the California toad (*B. boreas halophilus*). Boreal toads (*B. boreas boreas*) occur in western North America in Alaska, Alberta, British Columbia, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, and the Yukon. The California toad occurs in California, Nevada and the Baja peninsula in Mexico. A zone of hybridization was identified between the two subspecies in northern California (Stebbins 1985). However, more recent, but incomplete, genetic information may further divide the *B. boreas* group into several subspecies or species (Goebel 2000).

Physical and climatic characteristics of the Great Divide Basin separate boreal toads in the southern Rocky Mountains (southeastern Wyoming, Colorado, and north-central New Mexico) from populations in the Wasatch and Uinta Mountains of Utah to the west and the Wind River and Salt River Ranges of Wyoming to the north. The basins hot, dry summers, lack of available water and high desert vegetation provide unsuitable habitat for the toad. Movement of toads between the southern Rocky Mountains and populations in western Wyoming and eastern Utah has been unlikely in recent millennia because of the great distance [>165 kilometers (100 miles)] and harsh environment. Because of this geographic isolation it was hypothesized that genetic

differentiation existed between toads in the southern Rocky Mountains and the remainder of their range (Blair 1964, Hubbard 1972). Recently completed genetic work supports earlier hypothesis of genetic differentiation (Goebel 1996, Goebel 1999, Goebel 2000). Boreal toads in southern Utah appear to be the parent population; however, the climatic conditions in recent millennia has caused separation of the populations leading to genetic divergence. The geographic isolation and genetic divergence led the Fish and Wildlife Service (FWS) to designate the boreal toads in the southern Rocky Mountain region as a distinct population segment. Once genetic analyses are completed, it is possible that the southern Rocky Mountain population of the boreal toad will be designated as a new species.

THREATS:

A. <u>The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range</u>.

The current distribution of the southern Rocky Mountain population of the boreal toad is encompassed primarily by land that is publicly owned including National and State forests, regional water control authority lands, and Rocky Mountain National Park. The use of these lands ranges from recreational to intensive timber and grazing management and watershed alteration activities. Though declines in toad numbers have not been directly linked to habitat alteration, activities that destroy, modify, or curtail habitat likely contribute to the continued decline in toad numbers.

Low impact recreational activities such as hiking, camping, wildlife viewing, non-motorized boating, and fishing may occasionally disrupt breeding pairs or trample recently metamorphosed juveniles along shorelines (Campbell 1970). No evidence suggests that these activities have been major factors in the overall decline of boreal toads in the southern Rocky Mountains.

High impact resource management activities such as timber sales may alter or cause the destruction of boreal toad habitat. Marshes, wet meadows and intermittent wetlands can be altered by timber sales or other management activities and allow increased evaporation, altered seepage flow (through reduced snow pack on exposed cut areas or road bed diversion of waters) and physical destruction of wetland vegetation. Activities such as peat mining and home construction also can significantly alter or destroy habitat. Trampling by livestock also may impact adults, particularly when they are present in concentrations at breeding sites. Eggs, larvae, and juveniles also may be vulnerable to livestock trampling.
Water retention projects may destroy boreal toad breeding habitat and summer foraging areas. The long-term effects of elevated water levels and dispersal of toads into different habitats is not known. The overall impact of water retention projects on the southern Rocky Mountain population of the boreal toad is not thought to be significant. Most reservoirs in this Region were constructed in the early 1900s, thus precluding their implication in recent toad declines. The drought of 2002 has caused much public discussion on building new reservoirs or changes in water use. If any of the ideas mentioned come to fruition it is possible that some boreal toad habitat and populations may be impacted. Although construction of new reservoirs may impact localized breeding sites or localities, range-wide declines cannot be attributed to past reservoir construction. However, past and future reservoir development would likely lead to cumulative loss of habitat over time.

The current and future use of water rights in the southern Rocky Mountains may impact boreal toads. Calls by downstream water users to release more water from upstream water users can result in water level drops in reservoirs that toads are using. Transferring rights from one user group to another (e.g., agricultural to municipal) also could reduce toad habitat, particularly if dewatering of reservoir sites resulted from these transfers. The actual impact of water right transfers is difficult to predict. Adoption of more stringent municipal or State water conservation measures may result in lower water demands and thus delay potential impacts associated with water right transfers.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes.

The boreal toad has no commercial value and any recreational values are low and non-consumptive. Scientific and educational collecting does not appear to be an impact. Overutilization is not currently thought to contribute to declines in the southern Rocky Mountain population of the boreal toad.

C. Disease or Predation.

Recent information points strongly toward the chytrid fungus as the primary cause for boreal toad decline in the 1970s and presently. Chytrid funguses attack the skin of toads and other amphibians but are not always lethal. In the past, Carey (1987, 1993) theorized that the proximate cause of the widespread decline of boreal toads in northern New Mexico and west-central Colorado was a result of infection by Aeromonas bacteria (red-leg disease) but, upon examination of museum specimens collected in the 1970s, it is now believed that the deaths were caused by the chytrid fungus (Cindy Carey, University of Colorado, pers. comm. 2000). Other research has shown that a fungus, *Basidiobolus ranarum*, may be causing *mycotic dermatitis* in boreal toads. Some of the toads identified as having this fungus were reexamined and it was found that the infection was actually the chytrid fungus, but it is not known if the fungus on all the toads examined was misidentified (Mark Jones, Colorado Division of Wildlife, pers. comm. 2000). Of 60 breeding localities in 2002, 9 tested positive for chytrid fungus, 23 had negative results, and 28 were not tested. The nine positive localities were in six separate populations.

Internal parasites have been recorded from boreal toads in several locations. Nematodes, cestodes, and trematodes were found from toads in California (Koller and Gaudin 1977). In Colorado, trematodes were found in toads in Garfield County (Tiekotter and Mantor 1977). Protozoans, trematodes, and nematodes also were found in Utah boreal toads (Frandsen and Grundmann 1960) and Idaho boreal toads were infected with trematodes (Waitz 1961). However, none of these discoveries suggests that helminth parasites affected toad survival.

Numerous studies and discussions have been presented that implicate the introduction of bullfrogs (*Rana catesbeiana*) to regional declines in certain western amphibian species (Moyle 1973, Hammerson 1982, Hayes and Jennings 1986). Bullfrogs have not contributed to the decline of boreal toads, because they have not established populations in montane regions of the rocky mountains (Bury and Whelan 1984, Hammerson 1986).

The introduction of nonnative fish, and their subsequent predation on amphibian larvae, also has been widely reported to affect amphibian populations (Voris and Bacon 1966, Cochran 1983, Hayes and Jennings 1986, Bradford 1989). However, toad eggs and tadpoles reduce predation by producing chemical toxins that make them unpalatable (Licht 1968, Formanowicz and Brodie 1982, Hews 1988). In a couple studies Bufo sp. eggs were unpalatable to two species of sunfish (*Lepomis spp*.), catfish (*Ictalurus melas*), stickleback (*Gasterosteus aculeatus*), and cutthroat trout (*Salmo clarkii*) (Licht 1968, 1969). A similar study found that larval forms of Bufo sp. were eaten less frequently by *Lepomis spp.* when offered with tadpoles of other genera (Voris and Bacon 1966). Unpalatability of eggs and larvae and declining toad numbers in trout-free waters suggests that *Salmo spp*. introductions in the montane regions of the southern Rocky Mountains are not responsible for declining toad numbers.

There are several native predators that tolerate boreal toad toxins and eat boreal toad eggs, tadpoles, recently metamorphosed juveniles, and adults (Olson 1989). Giant waterbugs (*Lethocerus americanus*), dragonfly naiads (*Aeshna umbrosa*) (Hews 1988), gray jays (*Perisoreus canadensis*) (Beiswenger 1981), and mallards (Anas platyrhynchos) (Colorado Division of Wildlife, unpubl. data, 2003) have been observed preying on toad larvae. Metamorphosed juveniles are susceptible to predation by garter snakes (*Thamnophis spp*.) (Arnold and Wassersug 1978) and spotted sandpipers (*Actitis macularia*) while ravens (*Corvus coras*) have been observed to prey on breeding adult toads (Olson 1989). Though occasionally and locally catastrophic, predation of boreal toad life stages is a naturally occurring association between predator and prey. Small breeding sites could be impacted by predation but there is no evidence that predation or the introduction of nonnative predators has resulted in the range-wide decline in toad numbers; however, if toad numbers continue to decline localized predator control may be desirable.

D. The Inadequacy of Existing Regulatory Mechanisms.

The boreal toad has been listed as endangered in Colorado since 1993. The boreal toad also is listed as endangered in New Mexico, and collection, possession, and sale of this species is forbidden in both States (New Mexico Dept. of Game and Fish 1988). However, this protection is limited to the toad itself and does not include measures to protect its habitat. The Wyoming Game and Fish Department lists the boreal toad as a non-game species, and regulations restrict possession and sale. Again, that designation does nothing to protect the toad=s habitat from degradation.

E. Other Natural or Manmade Factors Affecting its Continued Existence.

Available data indicate that boreal toad populations have decreased substantially over the past 15 years. Additionally, declines in several other pond-breeding amphibians have been noted (Hayes and Jennings 1986; Stolzenburg 1989; Cindy Carey, University of Colorado, pers. comm. 1994) and several causes have been proposed, including acid precipitation (Harte and Hoffman 1989), application of fish toxicants (Burress 1982), droughts (Corn and Fogleman 1984), pollution, increased incidence of ultraviolet radiation (Carey 1993), and natural population fluctuations (Pechman et al. 1991).

However, several of these factors may not be relevant to the decline of boreal toad populations. For instance, drought has been implicated in localized amphibian reproductive failures and extinctions but it is unlikely that it can be applied as the underlying factor responsible for declines in a wide-ranging, long-lived amphibian such as the boreal toad. Weather conditions could not be determined to be a factor in the toad declines over the last 30 years (Cindy Carey, University of Colorado, pers. comm. 2000). In the 1980s researchers examined inputs of acid-producing anions to the mountains of Colorado and Wyoming and concluded that acid precipitation was unlikely to have caused or contributed to the decline of boreal toads (Corn and Vertucci 1992).

Fish toxicants are used widely in Colorado to manage sport fisheries and reestablish native fish populations. Extremely high concentrations of rotenone (5 µl/l) have been shown to cause mortality in larval leopard frogs (*Rana pipiens*) in controlled conditions (Burress 1982). The effects of rotenone use under field conditions and concentrations on boreal toads is unknown. Another fish toxicant, antimycin, was used in Lost Lake, Rocky Mountain National Park, during 1986. Information on the presence of toad larvae and the effects of antimycin treatment were not gathered, but subsequent amphibian surveys of Lost Lake since 1990 indicate a large adult population and reproductive effort over the next several years. Antimycin, also was used in 1990 to eradicate fish in Spruce Lake, Rocky Mountain National Park. Park biologists indicated that after treatment, late stage larval boreal toads were found dead, but the overall effect on the 1990 year class was unknown (David Stevens, Rocky Mountain National Park, pers. comm. 1993).

The potential effects of pollution, ultraviolet radiation and natural population fluctuations remain unknown and may be working synergistically with other environmental or anthropogenic factors to cause declines in toad populations.

FOR RESUBMITTED PETITIONS:

a. Is listing still warranted? Yes
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? Yes
c. Is a proposal to list the species as threatened or endangered in preparation? No
d. If the answer to c. above is no, provide an explanation of why the action is still precluded:

Since publication of the 2002 CNOR, the publication of a proposed rule to list this species has been precluded by other higher priority listing actions, and based on work scheduled we expect that will remain the case for the remainder of Fiscal Year 2004. Almost the entire national listing budget has been consumed by work on various listing actions taken to comply with court orders and court-approved settlement agreements, emergency listing, and essential litigation-related, administrative, and program management functions. We will continue to monitor the status of the boreal toad as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

LAND OWNERSHIP:

Land ownership has not been quantified for the boreal toad. The majority of occupied habitat is on National Forest land but State Forest Service land, NPS land and private land also harbor breeding and non-breeding sites. No boreal toads have yet been found on Bureau of Land Management lands though elevation and habitat of some BLM lands is suitable for the toads.

PRELISTING:

The Colorado Division of Wildlife (CDOW) has led an interagency Recovery Team for the boreal toad following advice of the FWS to include the toad=s range in Wyoming and New Mexico into the recovery planning process. The Recovery Team is currently made up of personnel from the BLM, USGS-BRD, CDOW, Environmental Protection Agency, NPS, New Mexico Department of Game and Fish, FWS, USFS, and Wyoming Game and Fish Department. There also was a Technical Advisory Group created from former members of the Recovery Team. These include people from Waldorf College, University of Wyoming, University of Colorado, FWS, CDOW, Denver Water Department, USGS-BRD, and Colorado Natural Heritage Program. Members of the Recovery Team and Technical Advisory Group developed a Conservation Plan to address management and research needs in 1998 (Boreal Toad Recovery Team 1998a) which was revised in 2001 (Boreal Toad Recovery Team 2001a). The following paragraphs describe actions carried out under guidance of the Boreal Toad Recovery Team and Conservation Plan.

Many of the involved entities have already expended large amounts of staff time and money for recovery efforts. In 2002, the CDOW continued a mark-recapture study using Passive Integrated Transponder (PIT) tag identification at Climax Molybdenum Mining Company=s Henderson

Mine in Clear Creek County to determine population size, movements, habitat use, and hibernacula locations. This population is known to be declining due to chytrid fungus but information gathered has been useful. The USGS continued a mark-recapture study in Rocky Mountain National Park that has been ongoing since 1991 and also has provided information on population estimates and decline due to chytrid fungus, as well as habitat use information. Few toads remain in this population. Another mark-recapture study was conducted by the Colorado Natural Heritage Program in the Chaffee County toad population which has not been infected with chytrid fungus. Twenty-two out of 174 females PIT-tagged since 1998 have been recaptured in different years at breeding sites revealing that 55 percent of the females returned for breeding annually, 40 percent returned every other year, and 5 percent returned after a 2-year absence. This shows a varied breeding cycle but assumes that females captured at breeding sites were actually attempting to breed (Colorado Division of Wildlife, unpubl. lit. 2003).

Several chytrid fungus and other disease studies were conducted by involved organizations in 2001 and 2002 to determine extent of area of chytrid fungus infection, detection ability of the fungus by various methods and means, identification of other possible diseases contributing to declines, environmental factors contributing to chytrid fungus infection, exposure levels contributing to mortality, life-stage acquisition and detection of chytrid fungus, physiological changes in amphibians to chytrid fungus exposure, and transmission of chytrid fungus and another disease between amphibian species (Colorado Division of Wildlife, unpubl. lit. 2003). An international chytrid fungus working group has been formed to address the fungus problem since declines have been noted in central America and Australia as well as the United States. Members of the international working group and the Boreal Toad Recovery Team and Technical Advisory Group have been working on determining the life history of the fungus and infection pathways. Specifically, work is proposed to determine if temperature, heavy metals, UV-B radiation, pH, and perhaps pesticides are impacting anti-microbial peptides on toads skin which, if so, would allow the chytrid fungus to invade and cause death in boreal toads (Cindy Carey, University of Colorado, pers. comm. 2000). A Polymerase Chain Reaction (PCR) protocol and primer sequences were developed in 2001 and 2002 by Dr. Seanna Annis (University of Maine) to detect the chytrid fungus on the toads. It is hoped, through ongoing refinements in the PCR test methodology, that the test will be able to be used for detection of the fungus in soil and/or water in the near future (Colorado Division of Wildlife, unpubl. lit. 2003).

A chytrid fungus study was conducted at the Henderson Mine, the Henderson Mill site in Grand County, Lost Lake in Boulder County, and the Grand Mesa in Delta County (site of planned reintroduction) in 2002. The chytrid fungus study=s purpose was to identify detection methods of chytrid fungus using sentinel tadpoles. Samples of chorus frogs and tiger salamanders also were taken from the Grand Mesa to determine if the planned reintroduction site has chytrid fungus but none was detected on the specimens. A CDOW employee conducted another chytrid fungus study in 2002 and collected 213 boreal toad samples from 34 sites in north-central Colorado. Eight of the boreal toad samples were chytrid positive. Dr. John Wood from Pisces Molecular has conducted much of the PCR testing to date and conducted methodology studies to determine sample collection procedures and sensitivity of detection of the fungus. Dead boreal toads and other amphibians also were sent to Dr. Allan Pessier at the University of Illinois for histologic and pathologic study. Dr. Pessier also initiated a study on efficacy of treatments for chytrid fungus infections but this has not yet been completed. Of the 13 boreal toads submitted

to Dr. Pessier in 2001, 1 toad from the Henderson Mine was infected with chytrid fungus. In 2002, five boreal toads were submitted but none showed evidence of infection. In 2001 and 2002, Dr. Cindy Carey, from the University of Colorado and Lauren Livo from the CDOW, conducted environmental interaction experiments with boreal toads and chytrid fungus. Isolates of differing strains of chytrid fungus also were tested to determine mortality rates. Tadpoles also were experimentally exposed to chytrid fungus in two experiments. Furthermore, a study to determine if chytrid fungus grown in a broth creates toxins was conducted with northern leopard frogs. Lastly, Dr. Carey and Ms. Livo exposed tiger salamanders, boreal toads, and northern leopard frogs to *Ambystoma tigrinum* virus (ATV) to determine if this virus caused illness or mortality to other amphibian species. Final analysis of all these studies are pending (Colorado Division of Wildlife, unpubl. lit. 2003).

Additional actions carried out by CDOW, and other organizations are described below. A graduate student, funded by the CDOW, developed a computer model to identify suitable boreal toad habitat (Holland 2002). An amphibian field guide was developed through funding by CDOW to help people identify the boreal toad and other amphibian species. Several of the entities have been involved over the last several years, and especially the last 5 years, conducting inventory and breeding area monitoring actions (Boreal Toad Recovery Team 1998b, 1999, 2000; Colorado Division of Wildlife, unpubl. lit. 2001, 2003). The monitoring includes counting adults, egg masses, and tadpoles as well as recording breeding, non-breeding, and wintering habitat and recording water quality at breeding sites. The CDOW maintains a population database and GIS maps of the historic and current distribution of the boreal toad. Extensive genetic work has been accomplished by Dr. Anna Goebel, during and after her phD internment at the University of Colorado, to determine relatedness of boreal toads within and outside of the southern Rocky Mountain population range (Goebel 1996, Goebel 1999, Goebel 2000). Furthermore, the USGS-BRD funded a graduate student to examine theoretic causes of decline in the Lost Lake and Kettle Tarn breeding localities. The USGS-BRD and the University of Colorado have conducted some studies on ultraviolet radiation. Ultraviolet radiation (UV-B) research conducted by Dr. Cindy Carey (University of Colorado, pers. comm. 2000) found that boreal toads are not affected by current levels of UV-B in the environment but additional studies are proposed to determine if UV-B allows for chytrid fungus invasion. Contaminant studies on heavy metals and transition elements also have been conducted by and funded through the University of Colorado, FWS, and CDOW. Research into a combination of pH, metal contamination, and water temperature was conducted (Carey et al. 1999) but it concluded that temperature in the study was so low as to mask any effects from pH or metals. A similar study with warmer temperatures was determined to be needed.

Additionally, salmonid and predacious diving beetle, tiger salamander, and wandering garter snake predation have been investigated and other predators have been recorded. Boreal toad tadpole palatability tests with native and nonnative salmonids have been conducted in hatchery raceways by CDOW. The trout appeared to react negatively to the taste of tadpoles and largely ignored the tadpoles. Wild brook trout (*Salvelinus fontinalis*) inhabiting a pond with boreal toad tadpoles also were examined by CDOW, but no tadpoles were found in the trout stomachs (John Goettle, Colorado Division of Wildlife, pers. comm. 1996). Recent work by Livo (1999) investigated predacious diving beetle larvae (*Dytiscus sp.*), tiger salamander larvae (*Ambystoma tigrinum*), and western terrestrial garter snake (*Thamnophis elegans*)predation and influences on

boreal toad tadpoles. It was discovered that the beetle larvae not only eat the tadpoles but also can affect their foraging behavior, timing of metamorphosis, and size of young toads. Color variation in one group of tadpoles was thought to be a cryptic response to garter snake predation. Boreal toads appeared to occur more frequently at ponds without tiger salamanders and predacious diving beetles.

Propagation and rearing of boreal toads also has been conducted under the direction of the Boreal Toad Recovery Team and by CDOW to maintain genetic stocks in case of chytrid fungus or other related die-offs. A AHatchery Manual for Rearing and Propagation of Captive Boreal Toads@was produced by CDOW in 1997. Facilities currently housing toads for propagation and possible future reintroductions include the Native Aquatic Species Restoration Facility operated by CDOW (Alamosa, Colorado), Saratoga National Fish Hatchery operated by FWS (west of Laramie, Wyoming), Cheyenne Mountain Zoo (Colorado Springs, Colorado), Henry Doorly Zoo (Omaha, Nebraska), and the Toledo Zoo (Dayton, Ohio). There also are toads being reared primarily for education, display, and research at Ocean Journey Museum (Denver, Colorado); the CDOW offices in Ft. Collins and Durango, Colorado; the Morrison Museum of Natural History (Morrison, Colorado); and, the Cincinnati Zoo (Cincinnati, Ohio (Colorado Division of Wildlife, unpubl. lit. 2003)). Additionally, some toads will be given to members of the Integrated Research Challenges in Environmental Biology-National Science Foundation (IRCEB) group for chytrid fungus research. A revised husbandry manual was produced in 2002 for NASRF called the ANative Aquatic Species Research Facility Boreal Toad Husbandry Manual.@Experimental reintroductions have occurred in four sites in Colorado and one in Wyoming, but with limited success or no evidence of success (Colorado Division of Wildlife, unpubl. lit. 2003). A reintroduction is planned on the Grand Mesa for 2003. Short distance translocation and alteration of habitat to help survival of eggs and tadpoles also has occurred with limited success (Boreal Toad Recovery Team 1998b, 1999). There also have been a number of newspaper articles and televised reports about the boreal toad in order to inform the public about the boreal toad=s status and what agencies are doing to recover the toad.

Conservation agreements, signed by participating entities, that describe actions to be carried out by the entities, have been included in the Conservation Plan. One parcel of private land within the range of a small breeding site was placed in an Open Space designation. A mining company west of Denver has initiated preparation of a Candidate Conservation Agreement with Assurances (CCAA). A golf course containing another breeding locality near Winter Park also is interested in entering into a CCAA, and Breckenridge Open Space near the Town of Breckenridge recently expressed interest in entering a CCAA. Impacts to several occupied or potentially occupied breeding sites have been avoided through informal consultation with the FWS by the USFS or U.S. Army Corps of Engineers.

Despite numerous conservation actions funded and implemented to date, additional populations or breeding localities of the toad being found in the last several years, and protection of the toad afforded by State and Federal laws, the FWS should retain the toad at a listing priority of 3. This is due to the high magnitude (extent) of the chytrid fungus infection, high likelihood of imminence of extirpation in boreal toad populations infected with the chytrid fungus, high likelihood of imminence for potential endangerment of the boreal toad should the chytrid fungus

spread to the Chaffee County population. Additionally existing State and Federal measures are not preventing loss of habitat (and resultant population loss) on private, State, and Federal land.

REFERENCES:

The references cited above and listed below are available at the Grand Junction, Colorado, Office of the FWS. Other references not cited in this document also were reviewed and are available in the Grand Junction Office.

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LISTING PRIORITY

THREAT			
MAGNITUDE	IMMEDIACY	TAXONOMY	PRIORITY
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3*
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude:

Despite numerous conservation actions funded and implemented to date, additional populations or breeding localities of the toad being found in the last several years, and protection of the toad afforded by State and Federal laws, the FWS should retain the toad at a listing priority of 3. This is due to the high magnitude (extent) of the chytrid fungus infection. Additionally, existing State and Federal measures are not preventing loss of habitat (and resultant population loss) on private, State, and Federal land.

Imminence:

The high likelihood of imminence of extirpation in boreal toad populations infected with the chytrid fungus, high likelihood of imminence for potential endangerment of the boreal toad should the chytrid fungus spread to the Chaffee County population, argues the FWS should retain the toad at a listing priority of 3.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all additions of species to the candidate list, removal of candidates, and listing priority changes.

Approve: Ralph O. Morgenweck April 1, 2003
Regional Director, Fish and Wildlife Service Date

Concur: Steve Williams April 5, 2004
Director, Fish and Wildlife Service Date

Do not concur:_____ _____
Director, Fish and Wildlife Service Date

Director=s Remarks:

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Date of annual review: February 5, 2003

Conducted by: Terry Ireland

Comments:_____

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