# Wyoming Toad

## (*Anaxyrus baxteri*)

### 5-Year Review:

### Summary and Evaluation

**Photo by U. S. Fish and Wildlife Service**

**U.S. Fish and Wildlife Service**
**Cheyenne Field Office – Ecological Services**
**Cheyenne, Wyoming**

**September 2012**

# 5-YEAR REVIEW
# Wyoming Toad (*Anaxyrus baxteri*)

## 1. GENERAL INFORMATION

### 1.1. Purpose of 5-Year Reviews

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (ESA) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the ESA. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process that includes public review and comment.

### 1.2. Reviewers

**Lead Regional Office:** Mountain-Prairie Region (Region 6)
Mike Thabault, ARD Ecological Services, 303/236-4210
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### 1.3. Methodology used to complete the review

On October 6, 2008, we published a Notice of Review in the *Federal Register* (73 FR 58261-58262) soliciting any new information on the *Anaxyrus baxteri* that may have a bearing on its classification as endangered. Comments were received and all substantive comments and issues raised were considered. This 5-year review was primarily written by the Wyoming Ecological Services Field Office with substantive contributions and review by the Wyoming Toad Recovery Team. This review summarizes and evaluates information provided in the recovery plan and current scientific research and surveys related to the species. All pertinent literature and documents used in this review are on file at the Wyoming Ecological Services Field Office. The primary sources of information used in this 5-year review are the recovery plan, peer-reviewed literature, population demographic data, species' status reports, field notes, professional opinions of

biologists, and updated information provided by researchers familiar with the species.

## 1.4. Background

### 1.4.1. Federal Register Notice citation announcing initiation of this review

73 FR 58261, October 6, 2008

### 1.4.2. Listing history

Original Listing
**Federal Register notice:** 49 FR 1992; January 17, 1984
**Date listed:** The final rule became effective February 16, 1984
**Entity listed:** Species: *Bufo baxteri* (now known as *Anaxyrus baxteri*)
**Classification:** Endangered rangewide

### 1.4.3. Associated rulemakings: No associated rulemakings have been published.

### 1.4.4. Review History

Historic 5-year reviews for all species listed prior to 1991 were initiated by the Service's Washington, D.C., office (56 FR 56882, November 6, 1991). The notice initiating that review summarized the listing status of all species being reviewed, but did not further discuss species' status nor did it propose or change the status of any species, including the Wyoming toad. We also assessed the current status of the Wyoming toad in the 1991 recovery plan. This is our first 5-year review for the Wyoming toad since the recovery plan.

### 1.4.5. Species' Recovery Priority Number at start of 5-year review

At the start of the 5-year review, the Recovery Priority Number for the Wyoming toad was 2. This ranking indicates: (1) a high degree of threat; (2) high recovery potential; (3) and taxonomic standing as a full species (see Table 1).

**Table 1. The below ranking system for determining Recovery Priority Numbers was established in 1983 (48 FR 43098, September 21, 1983 as corrected in 48 FR 51985, November 15, 1983).**

| Degree of Threat | Recovery Potential | Taxonomy | Priority | Conflict |
|---|---|---|---|---|
| **High** | **High** | Monotypic Genus | 1 | 1C |
| | | **Species** | **2** | 2C |
| | | Subspecies/DPS | 3 | 3C |
| | Low | Monotypic Genus | 4 | 4C |
| | | Species | 5 | 5C |
| | | Subspecies/DPS | 6 | 6C |
| Moderate | High | Monotypic Genus | 7 | 7C |
| | | Species | 8 | 8C |
| | | Subspecies/DPS | 9 | 9C |
| | Low | Monotypic Genus | 10 | 10C |
| | | Species | 11 | 11C |
| | | Subspecies/DPS | 12 | 12C |
| Low | High | Monotypic Genus | 13 | 13C |
| | | Species | 14 | 14C |
| | | Subspecies/DPS | 15 | 15C |
| | Low | Monotypic Genus | 16 | 16C |
| | | Species | 17 | 17C |
| | | Subspecies/DPS | 18 | 18C |

### 1.4.6. Recovery Plan [or Outline]

**Name of plan [or outline]:** Wyoming Toad Recovery Plan, U.S. Fish and Wildlife Service 1991
**Date approved:** September 11, 1991
**Dates of previous revisions, if applicable:** No previous revisions.

# 2. REVIEW ANALYSIS

## 2.1. Application of the 1996 Distinct Population Segment (DPS) policy

### 2.1.1. Is the species under review a vertebrate?

☒ **Yes**
☐ No

### 2.1.2. Is the species under review listed as a DPS?

☐ Yes
☒ **No**

### 2.1.3. Is there relevant new information for this species regarding the application of the DPS policy?

☐ Yes
☒ **No**

Due to its limited distribution and severe threats, the species is listed in its entirety. We do not believe that any valid DPSs exist for the Wyoming toad.

## 2.2. Recovery Planning and Implementation[1]

### 2.2.1. Does the species have a final, approved recovery plan?

☒ **Yes**
☐ No

### 2.2.2. Adequacy of recovery plan?

We no longer consider the 1991 Wyoming Toad Recovery Plan (1991 Plan) to be adequate, and are in the process of revising the plan in coordination with the recovery team and other partners. Much of the information and many of the actions called for in the 1991 plan are out of date. Since the recovery plan was written, we have implemented several of the actions, completed a few, and have determined that a couple are no longer advisable.

Finally, the 1991 Plan did not specifically identify "threats" to the species, but the plan identified the following "reasons for listing" that are associated with curtailment of the Wyoming toad's habitat or range:

- Pesticides
- Predation
- Infectious Disease
- Habitat Modification
- Changes in Weather Patterns

[1] Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species, and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

Since then, the additional threat of infectious disease in the form of *Bd* has been identified as a major impediment to Wyoming toad recovery. Thus, the revised plan should include a thorough discussion of the current threats to the species, and develop measurable recovery criteria related to those threats so we and the public will know when the threats are adequately abated by our recovery actions.

### 2.2.3. Progress toward recovery

The following discusses recovery actions included in the 1991 Plan and subsequent progress toward Recovery of the Wyoming toad:

#### 2.2.3.1. Population Monitoring

From the early 1990s to 2008, field monitoring of Wyoming toad populations at Mortenson Lake consisted of informal visual encounter surveys and involved the use of volunteers, some with little experience. Volunteers reduced costs of monitoring, but also affected the continuity of data collection. In 2008, WYNDD developed a systematic monitoring protocol for Wyoming toads in permanently established search blocks that has been used since that time.

Surveys are conducted by USFWS staff, WGFD, SNFH, and other local organizations in the area. In 2007, there was also a concerted effort to recruit volunteers from SSP zoos to come to Wyoming to help conduct systematic surveys. This included a "call for volunteers" in 2008 to AZA zoos to search for the toad at Mortenson Lake. Since these surveys were initiated, 13 zoos and over 40 volunteers have come to Wyoming during the 3 weeks of surveys during June, July, and August. Results of these surveys are shown in Table 3.

#### 2.2.3.2. Reintroduction/Release Efforts

##### 2.2.3.2.1. Mortenson Lake

The Wyoming toad captive breeding program started releasing Wyoming toad eggs, tadpoles, and toadlets back into the wild at Mortenson Lake in 1995. From 1995 to 2004, 37,382 tadpoles and toadlets were released. From 1995 to 2004, release efforts were primarily focused on Mortenson Lake. In 2003, a mass die-off of Wyoming toads occurred there; the cause was thought to be chytrid fungus (*Batrachochytrium dendrobatidis*) *(Bd)*. This has since been verified (Pessier 2011, pers. comm.). Also in 2003, the Sybille captive breeding facility was thought to be closing and because there was no place to house these toads, 10 adults and 61 sub-adults were released at Mortenson Lake. Sybille did not close in 2003, but did discontinue the captive breeding of Wyoming toads in 2006 and captive breeding was moved to Red Buttes.

Due primarily to increasing mortality of toads from *Bd* at Mortenson Lake, in 2004, at the recommendation of the WTRT and the Wyoming Toad Species Survival Plan (WTSSP), releases of tadpoles or toadlets to Mortenson Lake were halted. Releases of tadpoles and toadlets were shifted to two Safe Harbor Agreement (SHA) sites. One of those SHA sites was withdrawn in 2012, so we have only one SHA site for reintroduction of Wyoming toads.

The WTRT was concerned about degradation of habitat with overgrown vegetation observed during surveys during 2010 and 2011 at Mortenson Lake. Degradation of habitat is primarily related to overgrown vegetation and a thick layer of thatch. Overgrown vegetation and thatch prevent the sun from getting to the shallow waters where toads can breed in warmer waters. In 2005, we conducted a prescribed burn at Mortenson Lake to reduce built-up dead vegetation around the lake. Subsequent to the burn, as indicated in Table 3, populations at Mortenson Lake seemed to have rebounded slightly. However, populations began to decline again in 2010 and continue to decline; no toads were located in 2010 surveys and one over-wintered adult toad was located in 2011. A prescribed burn was conducted by the Service, the U.S. Forest Service, and the National Park Service in April of 2012 in order to improve habitat conditions for breeding toads.

**Table 3. Systematic survey results from 2008 through 2011**

| Year | People | Days | Hours | Adult toads | Over wintered | Young of the Year | Chytrid + | Chytrid - | Chytrid Unknown |
|---|---|---|---|---|---|---|---|---|---|
| 2008 | 34 | 10 | 476 | 4 Male<br>8 Female | 0 | 24 | 8 | 4 | 0 |
| 2009 | 33 | 9 | 540 | 17 Male<br>19 Female<br>2 Unknown | 87 | 1 | 93 | 32 | 1 |
| 2010 | 33 | 7 | 282 | 4 Male<br>2 Female | 0 | 0 | 4 | 0 | 2 |
| 2011 | 23 | 7 | 174 | 1 Male | 1 | 0 | 0 | 1 | 0 |

#### 2.2.3.2.2. Research Site on Private Lands

In 2005, a study was initiated to determine whether *Bd* was present in the Little Laramie River valley on private lands within the historic habitat of the toad. Over a three year period 18,563 *Bd*-free tadpoles were released at this site. Over the three years of the study, natural reproduction occurred for two consecutive years (2007-2008). Toadlets from this experimental site were collected and tested for *Bd*. *Bd* was detected on toads at the site confirming its presence in the Little Laramie River valley.

The most encouraging outcome of this study involved the location of toadlets at the research site that were thought to be Wyoming toads. The toadlets were taken from the site to Saratoga where they were confirmed to be Wyoming toads. However, no toads have been found at this research site since 2008.

#### 2.2.3.2.3. Safe Harbor Agreement Sites

In 2005, we entered into an agreement with the LRCD to negotiate SHAs in Albany County. The LRCD identified suitable habitat for reintroduction of Wyoming toads. In 2005, an SHA was finalized with a local private land owner to enable the Service to release Wyoming toad tadpoles and toadlets onto a new re-introduction site. To date, over 76,900 tadpoles and toadlets have been released onto this property. In 2011, over 40 adult breeders were found at this site and there was evidence of natural reproduction. However, no toads were located during the June, July and August surveys in 2012.

#### 2.2.3.2.4. Mark and Recapture - Toad Identification

Individual toads are very difficult to identify in the field, making data collection on survival and other demographic information very difficult. All adult toads located during surveys are PIT tagged. However, sub-adult toads are not big enough to tag. Therefore, mark and recapture surveys have not been successful. However, photographic analysis has shown that individual toads can be identified by unique skin color and wart patterns (Withers 1992). Unique throat patch markings have been used in captivity to identify individual toads, but not reliably.

Since sub-adults and toadlets all weight under 20 grams and cannot be Passive Integrated Transponder (PIT) tagged, mark and recapture studies of released sub-adults and toadlets are not possible because the recaptures cannot be reliably identified. In 2010, WYNDD, with the support of the Service, initiated a study using skin patterns as a unique

identifier. Results are expected in 2013. If wart patterns can be readily recognized through photos and pattern recognition software, this would allow for reliable mark and recapture studies that could significantly contribute to demographic information needed for recovery of the Wyoming toad.

#### 2.2.3.2.5. Toad Call Monitoring

We have been monitoring toads using formal and opportunistic call surveys during the early spring for many years. Prior to 2006, calling surveys were opportunistic and results were dependent on time of survey and number and experience surveyors. These calling surveys have had varying degrees of success. From 2006 to 2008, the Service used Froglogger recording devices, but the technology was unreliable and call recording was inconsistent. In 2009, the Service began a trial using newer Frogloggers and SoundScope software to analyze Wyoming toad calls. In 2009, the Frogloggers recorded three Wyoming toad calls at Mortenson Lake. However, no calls were detected by frogloggers in 2010 and 2011 when populations at Mortenson Lake were low. We will continue to monitor Wyoming toad calling using Frogloggers and opportunistic surveys.

With data from these new frogloggers and call surveys, we hope to determine: 1) what time of year peak calling occurs for Wyoming toads; 2) what time of day peak calling occurs; 3) whether call intensity increases after flood events, and; 4) whether there differences in timing of calls between different individuals and locations.

#### 2.2.3.2.6. *Bd* Monitoring

Many previously unexplained amphibian declines worldwide have been linked to outbreaks of infection with the amphibian *Bd* fungus (Berger 1998). It was a factor and probably cause of recent die-offs in remaining populations of the boreal toad (*Anaxyrus boreas*) in the southern Rocky Mountains (Muths *et al.*, 2003). Dead and dying Chiricahua leopard frogs (*Rana chircaheunsis*) in Arizona were diagnosed with chytridiomycosis (Bradley *et al.*, 2002). Populations of the California red-legged frog have been lost or reduced by amphibian chytrid fungus outbreaks (USFWS 2002). Furthermore, two amphibian species in the Sierra Nevada, mountain yellow-legged (*Rana mucosa*) and the Yosemite toad (*Anaxyrus canorus*), have been infected by the amphibian *Bd* fungus (Green and Sherman 2001, Rachowicz *et al.,* 2006 ). Wyoming toad also experienced a die off from *Bd* in 2003 (Pessier 2009, pers. comm.).

The effects of exposure to *Bd* occur on a spectrum from mild infection with few detrimental effects to a lethal infection. As with the Wyoming toad, management priorities are generally divided between (1) halting pathogen spread and developing survival assurance colonies, and (2) prophylactic or remedial disease treatment. However, epidemiological models of *Bd* in amphibians suggest that mitigation strategies can control disease without eliminating the pathogen. They suggest that successful disease mitigation must be context specific with epidemiologically informed strategies to manage already infected populations by decreasing pathogenicity and host susceptibility (Woodhams, et. al. 2011).

In 2009, ninety-three toads (74% of the 125 samples) tested positive for *Bd* fungus. In 2010, 2 of 6 toads tested for *Bd* had positive results.

#### 2.2.3.2.7. Movement and Habitat Use Monitoring

In 1998, a radio-telemetry field study was funded by the AZA Conservation Endowment Fund (CEF) and a Challenge Cost Share Agreement from the FWS was initiated to look at microhabitat use. However, this study yielded little information on specific habitat use by Wyoming toads because of equipment failure and toad mortalities.

In 2011, we released thirteen captive, adult Wyoming toads with radio transmitters at Mortenson Lake. The purpose of this research was to document habitat use and movement patterns of captive-raised Wyoming toads released at Mortenson Lake.

Two toads were tracked into hibernation. Eleven toads either died, dispersed beyond tracking distance, or the battery in the transmitter lost power: that is, transmitter signals were lost and the fate of these individuals remains unknown. The two toads that were tracked into hibernation during October made moves away from the lake or into mammal burrows between August 21 and August 29. Last known locations were checked twice weekly until October 28, and once a week there-after.

#### 2.2.3.2.8. Hibernation

Captive Wyoming toads are routinely hibernated on a short cycle of 60 days in artificial hibernation units (refrigeration units). This short-cycle hibernation, in addition to hormone injections, has been effective in priming toads for breeding and has produced eggs at all captive breeding facilities.

In 2008, Red Buttes began experimenting with hibernating toads outdoors in large plastic containers buried in the ground and filled with

*Bd*-free soil. Adult toads were placed in these containers in the early fall and were able to dig down and hibernate for the winter. Eighty-five percent of the adult toads in these containers came up from hibernation ready to breed; most, however, still required hormone injections to breed. However, in 2010, two of the toads, upon emerging from the containers, bred without the use of hormone injections. Red Buttes plans to continue hibernating some toads in this manner and will attempt to refine the protocol for hibernating toads outdoors.

## 2.3. Updated Information and Current Species Status

### 2.3.1. Background on the Species

#### 2.3.1.1. Biology and life history

The Wyoming toad was federally listed as endangered in 1984. The known historic distribution of the Wyoming toad is restricted to approximately 5,000 hectares of habitat consisting of flood plains, ponds, and small seepage lakes in the shortgrass communities of the Laramie Basin in Albany County, Wyoming.

Our knowledge of the biology and life history of the Wyoming toad has changed very little since the 1991 Plan. The following will briefly describe the biology and history of the toad:

##### 2.3.1.1.1. Reproduction

Adult Wyoming toads emerge in May after daytime temperatures have reached 23°C. Males appear first and begin calling. The mating call of the Wyoming toad is a buzzing trill that lasts a few seconds (Baxter 1952). Calling is related to temperature and not light (Withers 1992). In 1991, calling at Mortenson Lake took place when air temperatures ranged from 17.5°C - 21.1°C, and water temperatures ranged from 17.9°C – 21.9°C. Calling continued as air temperatures fell toward 10°C and decreased once the temperatures fell below this point. Calls could be heard from a distance of 200 m when no wind was present (Withers 1992).

Wild Wyoming toad males can achieve sexual maturity at one year. Withers (1992) observed secondary sexual characteristics such as a dark throat patch and nuptial pads in yearling male Wyoming toads. These males would vocalize when handled and mature sperm was discovered upon necropsy. However, whether or not wild yearling Wyoming toads breed is not documented. It is not possible to determine the sexual maturity of female Wyoming toads in the field. Upon necropsy, a small proportion of yearlings had mature eggs in the ovary. However, Withers thought that most female Wyoming toads did not breed until their second or third year (Withers 1992). In captivity, both males and females have been successfully bred as yearlings.

Dr. George Baxter (1980-2004, pers. comm.) observed breeding congregations in floodplains of the Big Laramie River that consisted of at least twenty toads. However, recent surveys and field observations at Mortenson Lake found only small congregations. Breeding occurs

in shallow, relatively open water with emergent vegetation, and usually on the north shore (Baxter 1980-2004, pers. comm.). Dominant plant communities at these sites are mixed sedge, grasses, and American bulrush (Withers 1992).

The breeding season is from mid-May to mid-June depending on annual weather conditions (McCleary 1989, Chamberlin 1990, Withers 1991). Eggs are deposited in gelatinous strings resembling a black pearl necklace. Eggs are laid in shallow water averaging 3.5 – 6.3cm in depth. Eggs generally develop in water temperatures ranging from 20.6°C to 23.7°C (Withers 1992). Eggs are most often found intertwined with vegetation.

#### 2.3.1.1.2. Diet

Little information is available about the diet and nutritional needs of the Wyoming toad, which hinders development of an optimal captive diet and complicates identification of potential reintroduction sites. Thirteen scat samples from Wyoming toads were collected at Mortenson Lake during 1998 and 1999. The most common insects Wyoming toads eat are ants. Two species were identified: *Myrmica incompleta* and *Formica fusca*. Two types of beetles in the Carabidae family were identified: *Elaphrus sp*. and *Anara sp*. Dungbeetles (*Canthos sp*.) were also identified. *Myrmica incompleta* was the dominant food source found in the samples submitted. Although this information is valuable, more samples should be collected, as these may not be indicative of the food source of the population as a whole.

Tadpoles of the Wyoming toad have mouthparts suited for scraping surfaces, and have been observed feeding on unidentified algae in Mortenson Lake. Nutritional value of these algae has not been determined. Initially, captive Wyoming toad tadpoles were fed algae, dried *Daphnia* and shrimp (*Hyalella axteca*, *Gammarus sp*., and *Artemia salina* because these were found in abundance at Mortenson Lake. However, most captive breeding facilities do not have access to food items available at Mortenson Lake. Therefore, captive breeding facilities are now feeding tadpoles a varied diet, including; tropical fish flakes, frozen kale, frozen romaine lettuce, algae cultured in tanks, spirulina, fish flakes, and tetra min tablets.

#### 2.3.1.1.3. Movement

Compared to other species of frog and toad, Wyoming toads do not appear to move far within their habitat. For example, dispersal of the several hundred wild toads studied at Mortenson Lake in 1987 seems to have been limited, and over the next five years, only three Wyoming

toads were observed to have dispersed to Meeboer Lake (Baxter 1980-2004, pers. comm.) which is less than ¼ mile from Mortenson Lake. However, in 2009 and 2010, Wyoming toads were heard calling between Mortenson Lake and Meeboer Lake (Palmer 2011, pers. comm.). The general pattern observed in 2011 was that toads stayed near the lake edges or substantial marshy areas for most of the summer and began moving into drier upland areas in September.

#### 2.3.1.2. Distribution, Abundance, and trends

Historically, Wyoming toads were commonly associated with the floodplains of the Big and Little Laramie Rivers. Dr. George Baxter concluded historic use by Wyoming toads of lakes in the Laramie River Basin was limited, as the shallow, seepage lakes were very saline and toads preferred ponds in the flood plains of the Big and Little Laramie Rivers (Baxter, pers. comm.). Once irrigation was implemented in the Basin, the lakes were flushed out, which made them less saline and more suitable as toad habitat. At that time, the range of the Wyoming toad was believed to be 2,331 square kilometers in the Laramie Basin, with the town of Laramie near the eastern border of the range.

Currently, the range of the toad is limited to Mortenson Lake and one SHA site. Both populations are a result of reintroductions. No other populations are known to exist in the wild. Despite the increasing and decreasing numbers over the years, until 2008 a small (less than 50 animals) population of Wyoming toads were reproducing, over-wintering, and persisting at Mortenson Lake and the SHA site. However, from 2009 to present, the population at Mortenson Lake has crashed; one adult toad was found in 2011 and 2012 surveys (the same toad). No toads were found during surveys in June and July of 2012.

The WTRT made the decision in April of 2012 to repopulate Mortenson Lake with reintroductions. In 2012, the Service conducted a pilot study using headstart tanks (mesh cages) for growing tadpoles to the toadlet (metamorph) stage. The toadlets were then moved to small corrals to be protected and fed to allow them to grow before they were released. Over 800 toadlets were released at Mortenson Lake in August, 2012 and we hope these toads will be the foundation for a new population at Mortenson Lake.

#### 2.3.1.3. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.)

When a population's genetic variability falls to low levels, its long-term persistence may be jeopardized because its ability to respond to changing environmental conditions is reduced. In addition, the potential for inbreeding depression increases, which means that fertility rates and survival rates of offspring may decrease. Although environmental and demographic factors usually supersede genetic factors in threatening species viability, inbreeding depression and low genetic diversity may enhance the probability of extinction of rare species (Levin *et al*. 1996).

Presently, the Wyoming toad captive population is less than 500 animals and is managed by the WTSSP to retain maximum gene diversity.

The entire Wyoming toad population is managed as two separate units. The first group (Group A) is composed of animals that have known pedigrees that can be traced back to the original collection of animals in the early 1990s. Because all other animals in the population are derived from these earlier collections, Group A represents all of the known diversity for the species. The second group (Group B) is composed of animals that were collected as offspring of reintroduced *A. baxteri* previously released from Group A. While Group B represents less genetic diversity than Group A, these individuals have survived in the wild, which may be an indication of greater fitness (Odum 2009, pers. comm.).

Using studbook data, mean kinship (mk) is calculated to determine which pairs will maximize the amount of genetic diversity retained in the next generation. Unfortunately, due to husbandry difficulties, this method has not been entirely successful. Many scheduled priority breedings have not produced offspring while other, less genetically important pairings, have been successful (Odum 2009, pers. comm.).

Stochastic, or random, changes in a wild population's demography or genetics, can threaten its persistence (Brussard and Gilpin 1989, Lacy 1997). A stochastic demographic change such as a skewed age or sex ratio (for example, a sudden loss of adult females) could negatively affect reproduction, especially in a small population. Disruption in gene flow due to reduction and isolation of populations may create unpredictable genetic effects that could also impact the Wyoming toad's existence.

#### 2.3.1.4. Taxonomic classification or changes in nomenclature

There has been a change in classification of frogs and toads of the world since we listed the Wyoming toad. Frost *et al.,* (2006) divided New World toad species into a number of new or revised genera. North American "*Bufo*" were placed into the new genus *Anaxyrus* (Frost *et al.,* 2006; Crother, 2008; Collins and Taggart, 2009).

In CNAH's 2009 *Standard Common and Current Scientific Names for North American Amphibians, Turtles, Reptiles & Crocodilians* as well as the Integrated Taxonomic Information System (ITIS) lists the taxon as *Anaxyrus baxteri* (Porter, 1968). The Service now uses the scientific name *Anaxyrus baxteri* for the taxon.

### 2.3.2. Five-Factor Analysis - threats, conservation measures, and regulatory mechanisms

There is not a definitive understanding of what caused the Wyoming toad to decline. However, declines in amphibian populations have occurred globally during recent years. Factors proposed or identified in amphibian declines include: UV radiation (Blaustein *et al.,* 1997), pollution (Bishop 1992; Bidwell and Gorrie1995; Berill and Bertram 1997), herbicide and pesticide use (Taylor 1998; Davidson *et al.,* 2001), habitat degradation (Laan and Berboom 1990; Johnson 1992; Wardell-Johnson and Roberts 1991; Gillespie and Hollis 1996; Dubuis 1997; Waldick 1997), grazing (Lusby 1970; Winegar 1977; Behnke and Raleigh1978; Kauffman and Krueger 1984; Marlow and Pogacnik 1985), introduction of exotic predators (Orchard 1992; Bradford *et al.,* 1993; Lannoo *et al.,* 1994), immune system suppression (Taylor 1998), lack of prey base, and disease (Berger 1998). Many experts think cumulative effects of more than one factor rather than single factors have led to declines.

The 1984 listing identified the following threats:

- Habitat modification through historic ranching practices
- Pesticides/Herbicides
- Predation
- Inadequate regulatory mechanisms

The 1991 Plan did not specifically identify “threats” to the species, but the plan identified the following “reasons for listing” that are associated with curtailment of the Wyoming toad’s habitat or range. These will hereinafter be referred to in this document as “threats”.

- Pesticides
- Predation
- Infectious Diseases
- Habitat Modification

All threats identified in the 1984 listing and the 1991 Plan continue to threaten the continued existence of the Wyoming toad. In addition to threats identified in the listing and the Plan, the following additional threats were identified;

- *Bd*
- Livestock Grazing
- Climate Change

The following section discusses all present threats to the Wyoming toad.

### 2.3.2.1. Factor A: Present or threatened destruction, modification or curtailment of its habitat or range

#### 2.3.2.1.1. Irrigation Practices

Habitat modification through irrigation practices was listed as a threat in the 1984 listing. Historic ranching practices involved flooding the plains adjacent to the Big and Little Laramie Rivers creating more habitat for the toad. In addition, a 2001 study showed that 65% of Laramie Basin wetlands are dependent on flood irrigation for their support. A high percentage of wetlands would be lost if flood irrigation was discontinued or replaced with more efficient sprinkler irrigation (Peck and Lovvorn 2001). At this time, no plans are being considered to improve irrigation practices in Albany County.

#### 2.3.2.1.2. Livestock Grazing

Livestock grazing has been shown to have both negative and positive impacts for other anuran species. Some biologists have noted that when cattle drink from small ponds and streams they can draw down water levels, leaving egg masses above the water level subjecting them to desiccation (S. Chubb *in litt.* 1998). Amphibians of all life stages can be negatively affected by factors including trampling, water quality degradation, water reduction (particularly at sites with tadpoles), prey reduction and microhabitat loss due to vegetation removal, and reduced availability of overwintering sites if cattle trample spring openings and under-cut stream banks or cause reduced oxygen content of water (Munger *et al.,* 2002). The negative impacts of grazing are primarily from unmanaged grazing

Wyoming toads have been coexisting with grazing livestock at Mortenson Lake since they were discovered there. In the past and to present, managed grazing has been conducted in the late summer and early fall and has significant beneficial impacts to vegetation. Cattle can clear out overgrown vegetation that can be a hindrance to toad movements. However, conditions are not always conducive to cattle grazing. Areas that are too wet in any season can cause foot rot in cattle and the local rancher will not put cows in the Mortenson Lake pasture. Therefore, some years, the vegetation is not grazed at the appropriate time.

Prescribed burning at Mortenson Lake has also been used to manage the vegetation. Prescribed burns were conducted in 2005 and 2012, and were an effective method of clearing out overgrown vegetation and thatch buildup. An analysis of before and after vegetation surveys will be ongoing.

#### 2.3.2.1.3. Pesticides/Herbicides/Fertilizers

The 1984 listing and 1991 Plan states that pesticides/herbicides use in the area continue to threaten the Wyoming toad. However, the widespread aerial spraying of Fenthion (Baytex) for mosquito control in Albany County, which coincided with population declines of Wyoming toads, is no longer used in the Laramie Basin. Albany County is now using *Bti* (*Bacillus thruingienis* ssp. *israelensis*), a bacteria which infects and kills mosquito larvae, but does not harm any other plant or animal life. However, Malathion and Atrazine are still used in the basin.

In Mortenson Lake during 2004, Atrazine was not detected, but the metabolites desisopropyl and desethyldesisopropyl were detected. A follow-up study in 2008/2009 indicated no Atrazine or metabolites were detected in extracts at Mortenson Lake or the reference site. No Atrazine or metabolites were detected in chorus frog or Wyoming toad toadlets at Mortenson Lake or in reference animals. The SHA introduction site has not been tested for Atrazine.

Fertilizer runoff is a major source of nitrogen pollution in aquatic habitats. Aquatic habitat at Mortenson NWR is fed by the Laramie River, but also receives snowmelt and irrigation runoff from nearby agriculture fields and pastures. In 1992, the Service investigated whether nitrates were present in surface waters at Mortenson Lake and the potential effects to the Wyoming toad. The study used a surrogate species, Woodhouse's toad (*Bufo woodhousii*) (Little *et al.,* 2002)

Ammonia nitrate can cause significant reductions in survival and metamorphosis over a range of concentrations test. However, comparison of these result to concentrations measured at Mortenson Lake indicated that current levels of aquatic nitrate and ammonia contamination do not pose a threat to the Wyoming toad at Mortenson Lake (Little *et al.,* 2002)

In 2002, the Service investigated the possibility of agricultural fertilizers containing nitrates to enter surface water at Mortenson Lake. The purpose of the study was to determine the concentrations of nitrates at Mortenson Lake and whether these concentrations are potentially affecting the survival of the Wyoming toad. Results of this study showed that ammonia nitrate concentrations were not elevated to concentrations that would adversely affect the Wyoming toad (Little, *et al.,* 2002).

At this time, Atrazine, other herbicides and pesticides or agricultural fertilizers do not appear to be a direct threat to the Wyoming toad. However, since these chemicals are still used in the area, ongoing monitoring will be necessary to ensure these chemical continue to be absent at Mortenson Lake and other reintroduction sites.

#### 2.3.2.1.4. Heavy Metals, Soil and Water Conditions and Pollution

The 1991 Plan identified heavy metals, soils, water quality and pollution as a potential contributor to declining Wyoming toad. The role of trace elements in the decline of the Wyoming toad is unknown. The Service conducted a study in 1989, 1990, and 1991 to determine if trace elements occurred at levels that could affect the Wyoming toad. Water, sediment and biota were analyzed. This study determined there were no elevated concentrations of trace metals at Mortenson Lake that could impact the Wyoming toad (Ramirez 1992).

### 2.3.2.2. Factor B: Overutilization for commercial, recreational, scientific, or educational purposes

Overutilization was not identified as a threat in 1991. However, deleterious effects from disease could occur as a result of research efforts. Equipment or waders used in habitat during population assessment could serve as pathways for the introduction of disease into the population.

The Service has a strict boot and equipment disinfecting protocol that must be followed for all visitors to Mortenson Lake. This protocol is strictly enforced with visitors prior to entering Mortenson and on departing from the lake. Although *Bd* is a rangewide threat, the Service believes the disinfecting protocol can ensure *Bd* is not transmitted to or from Mortenson Lake.

### 2.3.2.3. Factor C: Disease or predation

#### 2.3.2.3.1. Infectious Disease

The 1991 Plan identified as "bacterial infection red leg" as a threat to Wyoming toads. However, since that time, the infectious disease has been identified as chytrid fungus *(Bd)*. *Bd* is responsible for amphibian population declines throughout the world (Berger 1998). *Bd* was also a factor and probably the cause of recent die-offs in remaining populations of the boreal toad (*Anaxyrus boreas*) in the southern Rocky Mountains (Muths *et al.,* 2003).

*Bd* was documented in wild Wyoming toads from Mortenson Lake NWR in 2000 (USGS, Dr. David E. Green) and 2001 (University of Illinois, Dr. Allan Pessier) and was a recurring problem of captive toads in some facilities during this time period. It is unknown at this time

whether *Bd* was the cause of the initial Wyoming toad decline; however, the presence of the disease is a crucial consideration for recovery efforts.

The captive population is free of *Bd* because of the biosecurity efforts of the SSP zoos and Federal facilities. However, *Bd* in the wild is the primary threat to the survival of the Wyoming toad.

#### 2.3.2.3.2. Predation

Predation was identified as a threat in the 1991 Plan and continues to be a threat to Wyoming toads. However, significant predation by animals from fish, birds, or mammals has not been documented. Toads are generally distasteful and toxic and are avoided by many predators.

Some birds are potential predators of Wyoming toad tadpoles, toadlets, and adults. Birds in the Mortenson Lake area include the California gull (*Larus californicus*), white pelicans (*Pelecanus onocrotalus*), American avocets, (*Recurvirostra americana*), common mergansers (*Mergus merganser*), and sandhill cranes (*Grus canadensis*).

Common mammalian predators include skunks (*Mephitis mephitis*), raccoons (*Procyon lotor*), and foxes (*Vulpes* sp.).
Fish can predate on Wyoming toad tadpoles and toadlets. Mortenson Lake was at one time a stocked fishing lake. However, all of the introduced trout species have since died out at the lake and only small fish (fathead minnows and golden shiners) have been spotted in the Lake including fathead minnows (*Pimephales promelas*) and golden shiners (*Notemigonus crysoleucas*). At this time there are plans to seine the lake in 2013 to make sure no large fish are present that could cause a significant impact on Wyoming tadpoles and toadlets.

More information is needed on the level of Wyoming toad predation. Future studies will focus on Wyoming toad predators and levels of predation to determine if this factor continues to significantly threaten the continued existence of the toad.

### 2.3.2.4. Factor D: Inadequacy of existing regulatory mechanisms

The existing regulatory mechanisms were not considered to be inadequate in the 1984 listing or the 1991 Plan. However, several regulatory factors now influence the survival of the Wyoming toad. At this time, other than the ESA and minimal State and County statutes, the protection of the Wyoming toad and its habitats is restricted to captive populations, the Mortenson Lake population, and one SHA site.

Wyoming does not have an endangered species act for plants or animals. Instead, the state abides by the ESA. The State also has a list of "Species of Special Concern". The Wyoming toad is not on that list because it is protected by the ESA.

In Albany County, 8 percent of the land is State owned lands, 24 percent Federal lands and 67 percent private lands. State lands in Albany County are primarily State Trust lands, more commonly referred to as "State School Sections." Federal lands include the Hutton Lake complex and Mortenson Lake on National Wildlife Refuge lands, as well U.S. Bureau of Land Management (Bureau) lands and USDA Forest Service's southern portion of Medicine Bow National Forest and the northern portions of Routt National Forest. However, the historic range of the toad includes USFWS, Bureau, State and private lands. The suitable habitat along the Big and Little Laramie River is almost exclusively private lands.

#### 2.3.2.5. Factor E: Other natural or manmade factors affecting its continued existence

##### 2.3.2.5.1. Small Population Size

The small population size and severely limited distribution of the Wyoming toad are significant threats to its continued survival. Small populations are more susceptible to environmental changes both biotic and abiotic. Factors that influence population size include food availability, nutrient limitations, pollutants, disease, competition, and predation. Populations of all animals fluctuate depending on these factors. However, a small population is more vulnerable to fluctuating to low levels that cannot be sustained and the population is more susceptible to extinction.

The small population size of the Wyoming toad limits its dispersal to new habitats and also has long term genetic implications (genetic drift). Dispersal is limited by population size and availability of suitable habitat. Wyoming toads at Mortenson Lake have few opportunities for dispersal because of limited habitat in the area. Genetic drift is also a factor in small populations as discussed earlier in this section.

##### 2.3.2.5.2. Genetic defects, drift, or homogeneity in small populations

The 1991 Plan states that from the late 1970s through 1986, the lack of substantial reproduction hinted that genetic issues could be a factor in declining populations.

A genetic study of the Wyoming toad in 2010 identified a decrease in genetic diversity during the period 2000 to 2010 as compared with the period from 1989 to 1999. The mean relatedness of the 1989 to 1999 samples was lower than in the 2000 to 2010 samples, suggesting the original founding individuals may have been less related to each other than the 2000 to 2010 individuals (Martin 2010). Although not immediately applicable to toad pairings, we now have a baseline for future work in assessing the relatedness of Wyoming toad.

*Bd* has decimated amphibian populations globally and may pose increased threat to populations and species with low levels of genetic diversity. There are differences in levels of susceptibility and survivorship following infection among species, suggesting a genetic connection to *Bd* resistance. Recent studies have demonstrated a link between variation at the major histocompatibility complex (MHC) of genes, and ability to survive *Bd* infection (Savage & Zamudio 2011) (May *et al.*, 2011). North Carolina State University is initiating a study of immune-related genes in the Wyoming toad. We are hopeful this study will provide the foundation for future studies on evaluating the genetic diversity of the extant toads, identifying biomarkers for *Bd* and possibly identifying individual toads resistant to *Bd* for release into the wild. This work could also lead to the eventual sequencing of the entire Wyoming toad genome.

#### 2.3.2.5.3. Lack of scientific knowledge

The lack of scientific knowledge of the Wyoming toad may be causing the species to be managed below sustainable levels in captivity and in the wild. We still know very little about the Wyoming toad's life history, demographics in wild populations, habitat requirements, hibernation requirements, disease interactions, and dietary needs. However, recent studies and captive breeding have contributed to our understanding of toad, reproduction, hibernation and movements, but more information is needed to adequately manage and recover the Wyoming toad.

#### 2.3.2.5.4. Climate Change

Climate change was not identified as a threat to the Wyoming toad in the 1991 Plan. However, since that time more information is available on climate change.

The magnitude of warming in the northern Rocky Mountains has been particularly great, as indicated by an 8-day advance in the appearance of spring phenological indicators since the 1930s (Cayan *et al.*, 2001). The hydrologic regime in the northern Rockies also has changed with

global climate change and is projected to change further (Bartlein *et al.*, 1997, Cayan *et al.*, 2001, Stewart *et al.*, 2004). Under global climate change scenarios, the mountainous areas of northwest Wyoming may eventually experience milder, wetter winters and warmer, drier summers (Bartlein *et al.*, 1997). Additionally, the pattern of snowmelt runoff also may change, with a reduction in spring snowmelt (Cayan *et al.*, 2001) and an earlier peak runoff (Stewart *et al.*, 2004), so that a lower proportion of the annual discharge will occur during spring and summer.

Information on the potential threats of climate change on the Wyoming toad is unavailable; there is no evidence of direct effects to the species this time. However, amphibian populations are sensitive to changes and variability in air and water temperature, precipitation, and the hydroperiod (length of time and seasonality of water presence) of their environments (Carey and Alexander 2003). For amphibians and reptiles, the timing of key ecological events is influenced by environmental conditions, such as air and water temperature and precipitation patterns. The timing of reproduction (breeding/egg laying), metamorphosis, dispersal, and migration may shift in response to higher temperatures and changes in rainfall (Beebee 1995). As temperatures warm and the availability of water in aquatic habitats become more variable, amphibians are likely to experience lower rates of survival to metamorphosis. Temperatures outside of their thermal optima can also cause physiological stresses (Gibbons *et al.*, 2000). Because of their affinities to aquatic habitats and their small size, amphibians typically have relatively small home ranges and low dispersal rates (Deullman and Trueb 1986, Wells 2007).

Some studies have predicted that amphibians will be even more susceptible to climate change than birds or mammals because of their dependence on microhabitats, hydrological regimes, and limited dispersal abilities (Blaustein *et al.*, 1994), and susceptibility to diseases that may be influenced by climate change (Pounds *et al.*, 2006). Some models predict substantially larger changes in amphibian populations than in birds or mammals based primarily on potential future range contractions and expansions. "This multitude of projected impacts could exacerbate the current declines being observed across many amphibian populations (Stuart *et al.*, 2004)."

Changes in climatic regimes are likely to increase pathogen virulence and amphibian and reptile susceptibility to pathogens (Daszak *et al.*, 2003). *Bd* is a cool climate pathogen. It prefers a temperature of 15C to 23C (59F to 74F). Warming may, in fact, have a negative influence on *Bd*, resulting in a positive influence on toads. The researchers warn that climate change may increase mortality rates among some amphibian populations by weakening their ability to withstand *Bd*

infections, but say it could reduce the impact on other populations by making conditions less optimal for the fungus (Garner, *et al.*, 2009). Conclusions regarding direct and indirect impacts to the Wyoming toad from climate change are uncertain at this time. Even though specific information on the effects of climate change on Wyoming toads is not available, research on amphibians and reptiles indicate they are particularly sensitive to potential long-term changes to weather patterns.

#### 2.3.2.5.5. Invasive Species

No threat to the toad by invasive species was identified in the final listing rule (Service; 49 F.R. 1992) and it was not included as a threat in the 1991 Plan. At this time, there are no invasive species (plant or animal) that are threatening the Wyoming toad or its habitat.

#### 2.3.2.5.6. Weather Events

"Late spring weather events" was listed as a threat in both the 1984 listing and 1991 Plan and continue to threaten toad reproduction and survival. Warm weather in early spring can induce toads to come out of hibernation and begin to breed. However, a cold weather event with freezing temperatures later in the spring or early summer can freeze Wyoming toad eggs, and cause significant mortality in metamorphs (toadlets). A series of the late-spring cold weather events can result in successive years of reproductive failure.

## 2.4. Synthesis

As discussed throughout this document, the Wyoming toad continues to be at risk of extinction. Despite the success of our partnerships and the captive breeding efforts to date, the low numbers of Wyoming toads in the wild remain are alarming. Based on 2012 surveys, only one adult Wyoming toad was found in the wild at Mortenson Lake and no toads were found at the SHA site. However, the Service is hopeful that the 2012 release of over 200 toadlets at Mortenson Lake will begin the process of repopulation.

Captive breeding has been successful through the hard work of the WTSPP, twelve WTSSP zoos, and two Federal captive breeding facilities. There are now approximately 500 Wyoming toads in captivity. The successful captive breeding allows us to have sufficient numbers of toads for ongoing reintroduction into its historic habitat. However, the SSP and the Service have been hesitant to increase captive numbers with the lack of suitable reintroduction sites.

Suitable habitat for the Wyoming toad in Albany County is mostly on private lands and not available for reintroductions. Presently, SHA sites and Federal lands are the only option for reintroduction. We are also pursing reintroductions on the Hutton Lake complex of the refuge. Acquisition of fee title and conservation easements would allow reintroductions into historic toad habitat. The Service should also pursue a 10(j) Rule for the Wyoming toad in historically occupied areas of Albany County. This would allow private landowners to have toads on their land without the concern of ESA "take" provisions.

We are also addressing the overall lack of knowledge of life history traits through new research. The tracking study in 2011 helped us to know more about toad movements. The 2012 Pilot Study looked at head starting tadpoles to improve survivorship of tadpoles to the toadlet stage. This involved supplemental feeding within enclosures at Mortenson Lake until tadpoles developed into metamorphs. More than 75 percent of 1400 tadpoles placed in mesh cages metamophed to toadlets. These studies will continue through the University of Wyoming. The University has acquired a student to work on Wyoming toad research for the next two years. The study will primarily focus on improving survivorship of Wyoming toad tadpoles to toadlet stage and habitat requirements. We are optimistic that future research will increase our knowledge and our ability to recover the Wyoming toad.

*Bd* is still the primary main threat to the Wyoming toad. Toads in captivity, if infected with *Bd*, can be successfully treated with antifungal solutions. However, there are no good methods for the treatment of wild animals in the natural environment. It is very difficult or impossible to get enough antifungal medications into the environment to be able to successfully rid infected amphibians of *Bd*. In the future, it may be possible to treat some amphibians in the wild in order to reduce the intensity of infection to a less lethal level with hope that animals could survive with a

mild *Bd* infection (Briggs *et al.*, 2010; Vrendenberg *et al.*, 2010). A promising area of research is looking at the possibility of introducing symbiotic bacteria that inhibit the growth of *Bd* into wild amphibian populations (Harris *et al.,* 2009). No evidence that a vaccine for chytridiomycosis could be effective for controlling the disease in wild population (Stice and Briggs, 2010).

In summary, the Wyoming toad is in a dire situation, but we believe that the species can be recovered through acquisition of suitable habitat for reintroduction, increased captive populations and continued research into population viability demographics and potential mitigation efforts to address the *Bd* threat in the wild.

# 3. RESULTS

## 3.1. Recommended Classification:

☐ Downlist to Threatened
☐ Uplist to Endangered
☐ Delist (Indicate reasons for delisting per 50 CFR 424.11):
    ☐ Extinction
    ☐ Recovery
    ☐ Original data for classification in error
☒ **No change is needed**

## 3.2. New Recovery Priority Number

No change in recovery priority number is recommended at this time. The recovery priority for the Wyoming toad remains 2, indicating: (1) occurrences face a high degree of threat; (2) recovery potential is high; and (3) the taxonomic standing as a full species.

# 4. RECOMMENDATIONS FOR FUTURE ACTIONS

## Administrative Actions

The 1991 Plan is no longer adequate to address the current threats and challenges of captive breeding of the Wyoming toad to support the continued existence of the species. It is recommended by the WFO, WTRT, and WTSSP that the 1991 Wyoming Toad Recovery Plan be revised in 2012. This action is underway.

We recommend publishing a technical correction in the Federal Register regarding the currently accepted Latin name for the species.

We recommend the expansion of the Mortenson Lake boundary in conjunction with the development of a 10(j) Rule for historically occupied areas of Albany County. The Wyoming Field Office should pursue the development of a 10(j) rulemaking for the historic range of the Wyoming toad. Section 10(j) allows reintroduced "experimental non-essential populations" of endangered species to be managed as if they were threatened. Landowners can engage in lawful activities, such as recreation, forestry, agriculture and are relieved from liability for the unintentional take of a Wyoming toad. This approach would allow private landowners to continue to manage their lands with reintroduced toads. Federal lands and fee title lands acquired with the expansion of Mortenson Lake will be designated as "essential populations", with full protection of an endangered species and will not be subject to the 10(j) exemptions. The 10(j) rule would encompass only the toad's historic range within Albany County.

A cooperative effort between Refuges and ES can increase the number of Wyoming toads for reintroduction and acquire habitat for reintroduction. This could significantly increase the possibility of recovery of the Wyoming toad. Recovery of the Wyoming toad is dependent on the ability to reintroduce Wyoming toads into their historic, suitable habitat along the Little Laramie River, including private lands.

## Implementation Actions

The most important action is to secure stable populations in the wild via reintroduction. Reintroductions into lakes have not yet been successful; reintroductions into wetlands along the Laramie River, the former stronghold for the species, may be the key to successful reintroductions. However, before we can reintroduce toads, we need willing landowners. We believe that land acquisition through fee title or conservation easements is essential to securing additional reintroduction locations.

Historic habitat for the Wyoming toad is in wet meadows adjacent to the Big and Little Laramie Rivers. This is the appropriate habitat for reintroduction. However, at this time, private lands dominate the floodplains of the Big and Little Laramie Rivers. The acquisition of Federal lands for the benefit of Wyoming toads is not possible with the existing refuge boundary for Mortenson Lake and the Hutton Lake complex. At present, the only avenue of reintroduction of Wyoming toads on private lands is through SHAs.

Because of the option of the landowner to opt out of the agreement at any time, SHAs are not considered regulatory mechanisms.

The Arapaho National Wildlife Refuge is in the process of developing an expanded landscape protection plan in the area around Mortenson Lake and the Hutton Lake complex. The expansion area includes suitable habitat for the Wyoming toad along the Little Laramie River and adjacent wet meadows and ponds within the floodplain. Acquisition of fee title lands and conservation easements in these areas would allow for reintroductions and protection of the Wyoming toad habitat within its historic range on public and private lands. The Preliminary Project Proposal (PPP) for this expansion project was approved by the Service in December 2010.

We recommend significant increases in captive populations through:

1. Increased participation of SSP zoos
2. Construction of a breeding facility on FWS lands to accommodate an increase in captive breeding production.

## Future Research

Upcoming research projects will include studies on the effects of temperature and the duration of hibernation, field work to identify toad hibernation sites, and a genetic analysis of captive versus wild bred populations. Each facet of the Wyoming Toad SSP and recovery program is an integral part in our plan to restore this endangered amphibian to a secure status. With continuing cooperation among AZA institutions, the FWS, and WGFD, this effort is achieving promising results. It is an excellent example of how dedicated biologists and resource managers can work together to save a critically endangered species.

In 2011, the WTRT developed “research priorities” which has identified research priorities for future investigations. However, since all research identified in this document are critically important to the survival of the toad, the WTRT has not been able to assign specific priorities to the research needs identified.

The WTRT identified seven categories of research needed for Wyoming toad recovery:

- Population Demographics
- Habitat Requirements
- Re-introduction Strategies
- Survey and Monitoring
- Health and Disease
- Captive Husbandry
- Captive Reproduction

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## SIGNATURE PAGE
## U.S. FISH AND WILDLIFE SERVICE
## 5-YEAR REVIEW OF THE WYOMING TOAD (*Anaxyrus baxteri*)

**Current Classification:** Endangered rangewide

**Recommendation resulting from the 5-Year Review:**

- ☐ Downlist to Threatened
- ☐ Uplist to Endangered
- ☐ Delist
- ☒ No change needed

**Review Conducted By:**

**FIELD OFFICE APPROVAL:**

**Lead Field Supervisor, Fish and Wildlife Service**

Approve _____ Date 9-13-2012
Field Supervisor, Wyoming Ecological Services Field Office