BEFORE THE SECRETARY OF INTERIOR

CENTER FOR BIOLOGICAL DIVERSITY AND PACIFIC RIVERS COUNCIL	)	PETITION TO LIST THE YOSEMITE TOAD (*BUFO CANORUS)* AS AN ENDANGERED SPECIES UNDER THE ENDANGERED SPECIES ACT
	)	
	)	
Petitioners	)	
	)	

February 28, 2000

EXECUTIVE SUMMARY

The Center for Biological Diversity and Pacific Rivers Council formally request that the United States Fish and Wildlife Service ("USFWS") list the Yosemite toad (*Bufo canorus*) as endangered under the federal Endangered Species Act ("ESA"), 16 U.S.C. § 1531 - 1544. These organizations also request that Yosemite toad critical habitat be designated concurrent with its listing. The petitioners are conservation organizations with an interest in protecting the Yosemite toad and all of earth's remaining biodiversity.

The Yosemite toad was historically abundant in the high country of the central Sierra Nevada, from Fresno to Alpine County. It has since declined precipitously. Recent surveys have found that the species has disappeared from a majority of its historic localities. What populations remain are scattered and consist of few breeding adults. Declines have been especially alarming in Yosemite National Park, where the toad was first discovered and after which it is named. Studies at Tioga Pass indicated wholesale population crashes, which may be indicative of less studied populations that appear to have disappeared elsewhere in the Sierra.

Numerous factors have contributed to the species' decline. Introduced fish, pesticides, ozone depletion, pathogens and cattle grazing have all been identified as factors impacting the species and its habitat. At this time, no single factor has been attributed as a primary cause of the toad's disappearance.

This petition sets in motion a legal process in which the USFWS has 90 days to determine if the Yosemite toad may warrant listing under the ESA.

PETITIONERS

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The above-listed petitioners formally request that the United States Fish and Wildlife Service (USFWS) list the Sierra Nevada population of the Yosemite toad (*Bufo canorus*) as endangered under the federal Endangered Species Act, 16 U.S.C. §1531 - 1544. This petition is filed under 5 U.S.C. § 553(e) and 50 C.F.R. part 424.14. Petitioners also request that Yosemite toad critical habitat be designated concurrent with its listing, pursuant to 50 C.F.R. part 414.12 and 5 U.S.C. § 553.

USFWS has jurisdiction over this petition. This petition sets in motion a specific process, placing definite response requirements on USFWS.

The petitioners are conservation organizations with an interest in protecting the Yosemite toad.

The Center for Biological Diversity is a non-profit organization dedicated to preserving all native wild plants and animals, communities, and naturally functioning ecosystems in the Northern Hemisphere.

The Pacific Rivers Council is a non-profit conservation organization dedicated to protecting and restoring the nation's rivers, watersheds, and native aquatic species. The Pacific Rivers Council, as an organization and on behalf of its members, is greatly concerned with protecting and improving aquatic ecosystems in the Sierra Nevada and is committed to the conservation and restoration of native Sierran aquatic species such as the Yosemite toad. Members of the Pacific Rivers Council live, recreate, and work in the Sierra Nevada and extensively utilize public lands located within the region.

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I. NATURAL HISTORY AND STATUS OF THE YOSEMITE TOAD

A. NATURAL HISTORY

1. Discovery and Name

The Yosemite toad was discovered by a University of California survey of vertebrate species in Yosemite Park led by Joseph Grinnel and Tracy Storer. (Camp, 1916; Grinell and Storer, 1924; Drost and Fellers, 1994). *Bufo canorus* Camp (1916) was originally called the Yosemite Park Toad. This name was changed by Grinnel and Storer (1924) to Yosemite Toad after populations were discovered outside the park. (Martin, 1990) Camp named the toad *"canorus"* due to the sustained melodious trill sung by male toads when breeding. (Camp, 1916)

2. Description of Species

The Yosemite toad is a small to medium sized (1 3/4 to 3 inches long, .6 ounces) toad with no head crests and large, flat, and circular paratoid glands which are slightly separated. Yosemite toads show the highest degree of sexual dimorphism of any North American anuran. Females are larger and typically dark colored, with irregular dark blotches, bordered with white. Males are smaller and speckled with black spots on a dull yellow to olive-greenish background and without distinct dark patches on their back. The ventral surface is grayish white color with slightly larger, scattered dots. The skin is exceptionally smooth, more similar to a frog. Larger tubercles and paratoids are noticeable (Camp, 1916; Grinell and Storer, 1924; Stebbins, 1951; Karlstrom, 1962; Sherman and Morton, 1984).

3. Distribution

The Yosemite toad is a high elevation toad that is endemic to the central Sierra Nevada of California. Historically, it was most common from 8,000 to 10,000 feet, with an overall elevation range from 6,400 to 11,300 feet. The Yosemite toad was originally discovered in Yosemite Park. (Camp, 1916; Grinell and Storer, 1924; Storer, 1925). Subsequent population surveys extended its distribution to an approximately 130 mile long segment, 35 miles wide, ranging from Ebbets Pass in Alpine County to south of Kaiser Pass and Evolution Lake in Fresno County. This historical range includes Tuolome, Mono, Mariposa, Madera and Inyo counties. Some hybrid populations of Western and

Yosemite toad occur near Blue Lakes, just southeast of Carson Pass in Alpine County. (Karlstrom 1958)(Stebbins 1966) (Karlstrom 1973). Populations found near Lake Tahoe in El Dorado county (Mullally and Powell, 1958) are now considered to be high elevation isolates of the *Bufo boreas*, with some *B. canorus* color dimorphism. (Jennings and Hayes, 1994).

4. Taxonomy of Yosemite Toad

The Yosemite toad is part of the *Boreas-canorus* group, the most primitive of three evolutionary lines of North American *Bufo.* (Camp 1917; Karlstrom, 1962) *Bufo canorus is* most closely related to the Western toad (*B. boreas*), from which it differs by its sexual dimorphism, smaller size, enormous width of paratoids, smoother skin, and lack of the broad vertebral stripe. (Camp, 1916; Karlstrom, 1962). The Yosemite toad is thought to have evolved from a primitive common ancestor with *B. boreas* through geographic isolation during recent periods of glaciation in California's history. (Stebbins, 1951; Karlstrom, 1962) With the retreat of the glaciers, Yosemite and western toads come into contact along the margins of their respective ranges, and are thought to hybridize in Alpine County, southeast of Carson Pass, the northern edge of the Yosemite toad range. (Mullally and Powell 1958; (Stebbins 1966)

5. Habitat

Yosemite toads occur from the upper montane into the subalpine zone, from 6300 to over 11,000 feet, just below timberline. Their preferred habitat is wet, montane meadows and lake shores, among lodgepole pines. (Camp 1916; Grinnel and Storer, 1924; Karlstrom, 1962; Sherman and Morton, 1984). During breeding season, toads may be found in aquatic habitats such as pools, small, slow moving streams or boggy meadows. (Stebbins 1951) Toads occupying such habitats tend to prefer vegetative cover, either thick meadow grass or low-lying bushes such as willows. (Sherman and Morton, 1993, 1984) Where vegetative cover is limited, home ranges for toads may be highly confined, sometimes less than 20 square feet. (Karlstrom, 1962). Yosemite toads may also be found in damp habitats beneath stones, logs and other surface objects and in rodent burrows. Toads may have a significantly larger home range in these environments, particularly where there is sufficient vegetative cover to allow the toad to conserve moisture. (Mullally 1953; David Martin, pers. comm. 2000). Generally, however, the species is not found more than 100 yards from permanent water. (Karlstrom 1962)

Yosemite toads share habitat with the mountain yellow legged frog (*Rana muscosa*) and the Pacific treefrog [chorus-frog] (*Hyla* [Pseudacris] regilla), particularly during breeding season. (Karlstrom, 1962; Cunningham, 1963). In these shared aquatic habitats, toads prefer breeding in the shallow runoff areas of meadow pools, while the tree frog prefers the deeper portions of those pools and the yellow-legged frog the still deeper portions of lakes and streams. (Karlstrom, 1962; Cunningham, 1963) Toads also utilize burrows dug by rodents such as meadow mice (*Microtus montanus)* or pocket gophers (*Thomomys monticola).* (Grinell and Storer, 1924; Mullally and Cunningham, 1956; Karlstrom, 1962)

B. LIFE HISTORY

Yosemite toads spend their lives in a mountainous habitat that is covered with snow for 7 to 8 months of the year. Toads may thus be active for only 4 to 5 months per year, in which time they must reproduce and consume enough food to survive the long season of hibernation. Perhaps due to their short active season, toads grow slowly, on average only .1 inches per year. Toads do not become sexually mature until 3 to 5 years for males and 4 to 6 years for females. Individuals may live more than 15 years. (Sherman and Morton, 1993, 1984)

1. Behavior

a. Movement

Yosemite toads are inactive from around early October until mid May to early June, typically hibernating under snow in rodent burrows or crevices in rocks or bushes. (Karlstrom, 1962; Sherman and Morton, 1984) After the snow melts, toads emerge from their hibernation quarters and bask in the spring sun to raise body temperature and increase metabolic activity. (Mullally and Cunningham, 1956; Sherman and Morton, 1984). Once warmed, toads make their way to breeding ponds, normally within 100 meters from the toad’s hibernation site. (Grinnel and Storer, 1924; Karlstrom, 1962; Sherman and Morton, 1984) Male toads usually reach breeding ponds several days before the females and stay for one to several weeks. (Grinell and Storer, 1924; Sherman and Morton, 1984) Once at a pond, male toads may choose a specific spot from which they call to attract a mate, or may search silently for an available female. Females spend less time at breeding ponds than males, typically less than a week, during which they mate and lay their eggs. (Sherman and Morton, 1984)

After breeding, the toads disperse into nearby meadow and moist vegetative habitat to feed for the remainder of the season.(Grinell and Storer, 1924; Mullally and Cunningham, 1956;

Sherman and Morton, 1984) In studies at Tioga pass, Sherman and Morton (1993, 1984) found that males tended to stay in the nearby meadows when not breeding, while females dispersed farther, into large willow thickets. In general, however, toads do not occur more than 100 yards from permanent water. (Karlstrom, 1962).

b. Feeding

During their short active season, toads must feed sufficiently to acquire the fat reserves necessary to survive the long period of hibernation. (Morton, 1981) Toads normally consume a variety of arthropods, including ants, beetles, millipedes, flies, spiders, and even bees and wasps. (Sherman and Morton, 1984; Grinell and Storer, 1924). Toads hunt by remaining motionless until a prey approaches, then capturing it with their sticky tongue. (Sherman and Morton, 1984).

c. Reproduction and Development

The typical breeding season for the Yosemite toad occurs anywhere from early May to July, depending upon the elevation and amount of snowfall the previous winter. Almost immediately following snowmelt, males and females make their way to breeding ponds from their winter hibernation sites. Early breeding is considered an adaptation to living at high elevations where the time available for reproduction and development of larvae is limited. (Camp 1916; Grinnel and Storer 1924; Stebbins 1951; Mullally 1953; Mullally and Cunningham, 1956; Karlstrom, 1962; Cunningham, 1963.)

Breeding normally takes place in shallow, ephemeral montane meadow pools fed my melting snow water, but may also occur in deeper pools of permanent standing water, as well as slow moving, meandering streams. (Sherman and Morton, 1993; Karlstrom, 1962; Stebbins, 1966)

Males arrive first, usually staying for one to two weeks. Males will either call from the shoreline to attract a mate, or search silently along the shoreline. (Sherman and Morton, 1984) Breeding success for males depends heavily on how early a male arrives at a breeding pond, the length of the stay, and the ability of the male toad to defend calling territory or fight other males for possession of females, the latter factor being largely a function of size. (Sherman and Morton, 1984). Male toads do not feed while breeding, and thus their length of stay in the ponds is thought to be limited by the amount of their fat reserves from the previous winter. (Morton, 1981; Sherman and Morton, 1984).

Females arrive at breeding ponds several days after the males, and normally stay only a few days, long enough to mate and spawn. Due to the energy demands of egg development, females do not breed every year, often resulting in a greater number of males than females at toad breeding pond sites. (Morton, 1981; Sherman and Morton, 1993, 1984.) To breed, females will either seek out calling males, or be clasped by searching males, a union known as amplexus. Fertilization takes place externally, with the male releasing sperm onto the eggs as they are being laid. Eggs are typically laid in shallow water (typically less than 5 centimeters deep) and develop quickly in the summer sun, typically hatching in one and one-half weeks. (Sherman and Morton, 1993, 1984; Karlstrom, 1962).

To maximize the rate of development, young toad tadpoles seek the warmest water available; shallow water along the shoreline by day, and deeper interior water at night. (Sherman and Morton, 1984) Tadpoles metamorphose into young toads about five to seven weeks after hatching. While tadpoles may be preyed upon by a variety of water insects such as dragonfly nymphs, and occasionally birds, the largest cause of mortality is desiccation of their shallow snowmelt-fed, pond habitats prior to metamorphosis. (Cunningham, 1963)(Sherman and Morton, 1984) After making the transition to land, young toads have approximately four to six weeks to feed sufficiently in the montane habitat to survive the long winter hibernation. (Morton, 1981)

2. Natural Mortality

a. Predators

Like many toad species, Yosemite toads usually avoid predation by releasing a poisonous white secretion from their glandular skin, and from paratoid glands behind their eyes. (Sherman and Morton, 1984). Despite this defense, bird species such as Clarks Nutcrackers (*Nucifraga columbiana)* or California gulls (*Larus californicus)* have been observed preying on toads by picking away the glandular secretions. (Sherman and Morton, 1984; Karlstrom, 1962). Common ravens (*Corvus corax)* are also suspected of killing adult toads. (Sherman and Morton, 1993). Garter snakes such as western garter snake (*Thamnophis elegans)* are known predators of toad species in the west (Karlstrom, 1962; Sherman and Morton, 1984) and have been observed feeding on Yosemite toad metamorphs (David Martin, pers. comm. 2000) Fish predation has been hypothesized as a potential cause of mortality of toads breeding in permanent water bodies, which may serve as refuges during periods of drought when ephemeral breeding ponds dry up. (Knapp, 1996; Jennings 1988). Brook trout have been observed eating Yosemite toad tadpoles. (David Martin, pers. comm. 2000)

b. Disease

Overall, little is known about diseases that might effect Yosemite toads. In 1977 and 1978, Sherman and Morton (1993, 1984) observed toads at Tioga Pass in Yosemite Park dying of red-leg disease, a fatal skin infection caused by the fresh water bacteria, *Aeromonas hydrophila.* New discoveries of amphibian diseases in other locations in the western states and worldwide now raise the possibility that dying toads may have been afflicted with other pathogens which precipitated the observed bacterial infections. For example, chytrid fungi (Chytridiomycota; Chytridiales), an aquatic fungi that has killed other amphibian species in Australia and Central America, was identified on 2 museum specimens of *Bufo canorus* that were collected during the 1977-1978 die off at Tioga Pass.(Carey et. al., 1999)

c. Other Mortality

Cattle grazing in high elevation wetland habitats may have adverse impacts on toad habitats by reducing vegetative cover, creating excess nitrogen pollution, increasing siltation of breeding ponds, altering the local hydrology through erosion and lowering of the water table, and crushing embryos and larvae, as well as breeding adults. (Jennings and Hayes 1994; Martin 1992; Jennings, 1988). Airborne chemical pollutants, including acid rain or pesticide drift, may harm larval or adult toads directly, or indirectly act as environmental stressors that render toads more susceptible to disease and pathogens through various mechanisms, including immunosuppression. (Carey et. al., 1999, 1995, 1993; Seiber et. al. 1997; Bradford and Gordon 1992; Stolzenburg, 1989). Increased ultraviolet radiation (UV-B) due to the thinning of the atmospheric ozone layer has also been hypothesized as a potential cause of mortality for high elevation anuran species, either by directly harming embryonic or larval development (Blaustein 1994) or by contributing to environmental stress leading to immunosupression and disease. (Carey et. al., 1999)

C. DISTRIBUTION AND ABUNDANCE

1. Historic Distribution and Abundance

a. Historic Distribution

The Yosemite toad was historically endemic to the central Sierra Nevada of California, common from 8,000 to 10,000 feet, with an overall elevation range from 6,400 to 11,300 feet. The range of *Bufo canorus* was described as a 130 mile long segment, 35 miles wide (NW by SE), laid out across the middle of the central Sierra. (Karlstrom, 1962), including Alpine, Fresno, Inyo, Madera, Mariposa, Mono, and Tuolome counties.

Grinnel and Storer's 1914-1920 Yosemite Park survey found the toad from Tamarak Flat and the ridges east of Chinquapin on the west, to Tioga Pass on the east. (Grinnell and Storer 1924).[1] Subsequent surveys extended its distribution southward to Kaiser Pass and Evolution Lake in Fresno County (Stebbins, 1966) and northward, to within 1.5 miles south of Ebbet's Pass, Alpine County (18 miles northwest of Sonora Pass) (Livezey, 1955). Additional populations found at Blue Lakes in Alpine County are considered to be hybrids between *B. canorus* and *B. boreas*, the latter species occurring in the high Sierra from Eldorado County northward. (Mullally and Powell, 1958; Stebbins, 1966).[2]

b. Historic Abundance

Where records were taken, Yosemite toads were common in their historical habitat. The U.C. Berkeley survey led by Grinnel and Storer described *Bufo canorus* as a "common resident" in the upper montane to subalpine zones from near Chinquapin and Tamarak Flat eastward to Tioga Pass. (Grinnell and Storer 1924). 1939 records of the Yosemite Park Wildlife office indicate that toads were "numerous" and "abundant" in both streams and lake margins in Virginia Canyon, and "common" at McCabe Lakes. In 1940, thirty toads were collected in breeding ponds at Tioga Pass

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[1]During the survey, *Bufo canorus* was recorded at 13 survey sites including upper Dana Meadows, Dingley Creek, Elizabeth Lake, Lyell Canyon, Mt. Conness, Porcupine Flat, Tioga Meadow, Tioga Lake, Tioga Pass, Westfall Meadows and Young lakes.

[2]Populations discovered in the 1950s at Heather and Grass lakes near Lake Tahoe, Eldorado County (Mullally and Powell, 1958) are now thought to be high elevation *Bufo boreas*. (Jennings and Hayes, 1994).

Meadow. (Yosemite Park Wildlife Office, 1999). Mullally and Cunningham (1956) found "many toads" in String Meadow, at 9800 feet in Fresno County. These researchers hypothesized that the use by many adult toads of unfavorably situated burrows as shelter may have been due to "population pressures."

Later studies in Yosemite found the toads to be "numerous" about the lakes on the crest of Tioga Pass and common in the Gaylor Lakes Basin. (Mullally, 1953). Karlstrom (1962) noted that toads were "often numerous along the clumps of willows which grow in seeps and along runoff streams" at Tioga Pass. During the 1970s, researchers Sherman and Morton recorded thousands of Yosemite toads in wetland habitats near Tioga Pass, and at Saddlebag lakes. (Sherman and Morton, 1993). Sherman and Morton (1993) noted that in the 1970s, toads were “abundant around willows and on hillsides.” On July 10, 1977, for example, two researchers searching for 3 hours found 15 adult to subadult toads. (Sherman and Morton, 1993).

Other Sierra amphibian researchers or observers have noted that Yosemite toads were once common in their high Sierra habitat, often occurring in large numbers. (Bradford et. al. 1992; L. Cory, pers. comm. as cited in Stebbins 1995)

2. Current Distribution and Abundance

a. Current Distribution

Research over the last decade indicates that the historical distribution of *Bufo canorus* has been reduced both in overall range and historical distribution. A survey by Bradford and Gordon (1992) found *Bufo canorus* at only 17 of 235 sites within 30 randomly selected study areas above 8,000 feet in toad habitat. In 1990, David Martin surveyed 75 historical localities for Yosemite toads (verified by museum specimens collected prior to 1980). Martin found that Yosemite toads were absent from 35 of the 75 historic localities he surveyed throughout the high Sierra. Martin also found no toads at historical localities less than 7,500 ft. indicating a possible elevation shift in the distribution of the Yosemite toad from its historical range down to 6,500 feet. (David Martin pers. comm. 2000)

In 1992 and 1993 Martin conducted anuran surveys at randomly selected high elevation sites for Eldorado, Inyo (1993 only), Stanislaus, Sierra and Sequoia National Forests.[3] No Yosemite toads were found at any of the random sites surveyed in on the Stanislaus (8 and 11 sites for each year respectively) or Sequoia (8 and 8 sites) National Forests. Small numbers of Yosemite toads were found on the Sierra Forest at five of nine sites surveyed and on 3 of 17 pre-selected sites surveyed on the Inyo. (Martin, 1992; pers. comm. 2000). In addition, three historical breeding populations of the Yosemite toad occurring between Ebbitt's Pass and Highland Lakes disappeared between 1989 and 1993. Two other historical populations occurring east of Levitt Lake in Toiyabe National Forest also disappeared between 1990 and 1994. (David Martin, personal comm. 2000)

Recent surveys in Yosemite Park have failed to locate toads in many sites where they were historically present. In 1992, a Yosemite research survey team found toads in only 50% of the locations in which the original U.C. Berkeley survey team led by Grinnell and Storer had located toads. (Drost and Fellers, 1996, 1994) A subsequent research team in 1997 found toads in only 5 locations within Yosemite Park out of a total 260 sites surveyed. (Fellers, 1997).[4] In the Tioga Pass area, researchers Sherman and Morton noted the toads' disappearance from Sylvester Meadow and several other nearby sites where it had been common in the 1970s. (Sherman and Morton, 1993). On June 23, 1991, E. L. Karlstrom found no toads, nor any evidence of breeding activity, at his 1954-1958 Tioga Pass study area where toads had formerly been abundant. (Sherman and Morton, 1993; Karlstrom, 1962).

b. Current Abundance

Recent surveys indicate that Yosemite toads have declined significantly in overall abundance in the central high Sierra. Martin's 1990 survey of 75 historical sites, for example, found an average of only 5.75 individuals in each of the 40 sites where toads still occurred, compared to an estimated average historical density of over 100 toads per site. (David Martin, pers. comm.

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[3] Each survey site covered approximately five linear miles of stream or river channel including associated lakeshores and meadows to give an approximate representation of the available habitat.

[4] The survey results do not indicate the percentage of sites that were within the Yosemite toad's historical elevation range.

2000).[5]

The decline in Yosemite toad abundance is best documented in Yosemite Park. The 1992 Yosemite amphibian survey observed that at sites where *Bufo canorus* was still present, the numbers of toads were much lower than those recorded by the Grinnell and Storer survey. (1924). At locations such as Mount Conness, Dingley Creek and Lyell Glacier where toads had previously been common, the 1992 survey found only small populations of toads -- typically one or two adults or subadults and tadpoles. (Drost and Fellers, 1994).

The well documented population declines of Yosemite toads in the Tioga Pass area corroborate this trend. Sherman and Morton (1993) documented significant declines of toad populations they had studied since 1971. By 1982, marked male toads entering the main study ponds at Tioga Pass Meadow (TPM) had declined from a 1974-1978 average of 257 to only 28. Between 1982 and 1991, toad populations at TPM continued to decline, and breeding became sporadic. By 1990, only one female, two males, and 4 to 6 egg mass were located. In 1991, only two egg masses and single calling male were observed. Breeding toads were also not located at other suitable locations in TPM. (Sherman and Morton, 1993) In 1992, Drost and Fellers found no toads and only two populations of tadpoles during several searches at Tioga Lake, Tioga Meadows, and upper Dana Meadows, despite the abundance of suitable habitat. (Drost and Fellers, 1994). Toads also became scarce at TPM in non-breeding habitat. Frequent searches by Sherman and Morton in 1990 and 1991 found only 2 toads, compared with the “numerous” toads observed in these areas less than two decades earlier. (Sherman and Morton, 1993). David Martin's own surveys of Sherman and Morton's TPM sites supports this significant decline in toad abundance. Over a nine year period between 1988 to 1997, Martin located only 1 to 5 toads per year, and no significant breeding populations (Martin pers. comm. 2000).

The pattern of decline of Yosemite toads recorded at Tioga Pass is consistent with declines observed elsewhere in Yosemite, and throughout the toad’s range in the central Sierra. In sites where they still occur, the toads continue to breed sporadically and in greatly reduced numbers from their prior abundance. (Martin, pers. comm. 2000, Jennings and Hayes, 1994) In the

[5] This estimate was based on conversations between Martin and E. Karlstrom and M. Morton regarding Martin's survey protocol and site selection. (David Martin, pers. comm. 2000).

vicinity of Tioga Pass, Sherman and Morton recorded breeding populations, at significantly lower populations at Saddlebag Lake, Frog Lakes, Hoover Lake and Mildred Lake. (Sherman and Morton, 1993). This pattern has been generally observed throughout the Yosemite Park high country.[6]

Reduced populations of toads have also been observed outside Yosemite. In 1988 David Martin (pers. comm.) noticed significant declines in the numbers of Yosemite toads present in High Emigrant Meadow and Lunch Meadow (in Emigrant Wilderness on Stanislaus National Forest). Subsequent searches by Martin in the Sonora Pass area revealed that many formerly large populations were now small or undetectable. In 1992, Martin found Yosemite toads "throughout the high elevation areas of the Sierra, but only in very small numbers." (Martin 1992). In 1993, Martin found larvae, post-metamorphs and a few adults in the random sites surveyed on the Sierra National Forest, but none in the random sites surveyed on the El Dorado, Sequoia, or Stanislaus Forests (Stebbins, 1995). Subsequent surveys in the Stanislaus National Forest indicate small breeding populations of toads in the Emigrant Wilderness.[7] Overall, many researchers have observed the declines in Yosemite toad numbers throughout their range. (Jennings, 1996; Jennings and Hayes, 1994; Martin, pers. comm. 2000; Sherman and Morton 1993.)

II. CRITERIA FOR ENDANGERED SPECIES ACT LISTING

A. THE YOSEMITE TOAD IS A "SPECIES" UNDER THE ESA

Under the ESA, any individual species, subspecies or distinct population segment may qualify for listing. 16 U.S.C. § 1532(16). The Yosemite toad is a separate species and is thus eligible for listing. It is most closely related to the Western toad (*B. boreas*), but does not share habitat, nor interbreed with

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[6] In the 1990s, park surveys have found isolated toads or tadpole populations in small numbers at Mono Pass, Mt Dana, Gaylor Lakes and Creek, Dingley Dome, Kerrick Meadow, Elizabeth Lake, Unicorn Peak, Lower McCabe Lake, Young Lake Meadow, Rafferty Creek, Skeleton Lake, Lyell Canyon Trail, Delaney Creek, Upper Slide Canyon, and Rock Island Canyon. (Yosemite Park Wildlife Office, 1999)

[7] The largest observed populations have been recorded at Highland Lakes, and Emigrant Lakes and Meadow. (Stanislaus National Forest, 1999)

this species, save for potential hybridization on the northern edge of the Yosemite toad's range in Alpine County. (Stebbins, 1966; Mullally and Powell 1958)

B. THE YOSEMITE TOAD IS ENDANGERED UNDER THE ESA

The recently observed declines of Yosemite toads across its narrow range in the high country of the central Sierra Nevada indicates that this species should be listed as endangered under the Endangered Species Act, 16 U.S.C. § 1532 et. seq. As described above, these declines are especially well documented in Yosemite National Park, the heart of the range of *Bufo canorus*, where studies over the last decade demonstrate that once abundant breeding populations are now either extinct or dangerously reduced. The potential causes of this decline, discussed below, fulfill each of the factors supporting listing under the Act, 16 U.S.C. § 1533(A)(1)(A)-(E). At this time, most researchers agree that the specific cause of the toad's decline is unknown, and may well involve a combination of several factors. (Drost and Fellers, 1996, 1994; Corn, 1994; Sherman and Morton, 1993)

1. Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

The habitat of the Yosemite toad consists of high elevation wetlands areas located primarily in National Forests, Wilderness Areas or National Parks. Thus, unlike many currently imperiled species in the United States, Yosemite toads are not threatened by direct habitat alteration for human development such as housing or agriculture. However, a number of human activities, discussed more fully below, have the potential to affect toad habitat adversely. These include cattle grazing, fish stocking, and chemical pollution through airborne drift.

The impact of livestock grazing on high elevation wetland communities is well documented. (Jennings 1986 and authorities cited within). Livestock trample and remove wetland vegetation which toads use for cover and for egg laying, as well as increasing erosion of connecting stream channels that lower the water table, thus eliminating the ephemeral and even once permanent water bodies used by toads for breeding. (Martin, pers. comm. 2000; Armour, 1991). Grazing may also lead to pollution of sensitive aquatic habitat through excess nitrogen input, often resulting in increased levels of aquatic bacteria (Martin, pers. comm. 2000). Cattle may also trample rodent burrows used by toads for nocturnal shelter or for hibernation (Martin, pers. comm. 2000).

Until the late 19th century, fish did not occur in the high Sierra habitat occupied by *Bufo canorus* (Jennings, 1988; Moyle, 1976). Human introduction of trout into high elevation lakes and streams may thus adversely impact toad habitat by altering the food chain of those aquatic ecosystems, as well as introducing a potentially new predator of adult, juvenile and larval toads into toad habitat (Knapp, 1996; Jennings, 1996; Bradford, 1993, 1989). While toads may breed in fishless, ephemeral pools, most researchers believe that deeper, permanent water bodies historically provided refugia for toad populations during periods of prolonged drought, which could replenish peripheral populations through recolonization (Knapp, 1996; Drost and Fellers, 1996, 1994; Bradford, 1993). The introduction of non-native trout over the last century may have eliminated these refuge habitats, thus rendering toad populations more susceptible to extinction events (Knapp, 1996; Drost and Fellers, 1996, 1994; Bradford, 1993).

At present, there is little to no published literature describing the fate of airborne chemical pollutants in toad habitat, either through direct precipitation, windborne dust particles or snowmelt. However, many studies have demonstrated the presence of airborne pollution in the high Sierra, including acid precipitation, smog constituents such as ozone, or pesticide drift. (Seiber et. al. 1998; Aston and Seiber, 1997; Cahill et. al. 1996; Miller 1996; Byron, 1991; Nikolaidis, N.P., 1991; Laird et. al., 1986) Many of the windborne pollutants found in the Sierra have the potential to harm toads in aquatic environments, through lethal and sublethal effects such as delayed or altered larval development or reduced breeding or feeding activity. (Berrill,et. al. 1998, 1995, 1994, 1993; Boyer and Grue, 1995; Bradford and Gordon, 1992; Bradford et. al. 1992; Beaties and Tyler-Jones, 1992; Corn and Vertucci, 1992; Hall and Henry, 1992). In addition, chemical pollutants may act as environmental stressors to toads in aquatic habitats, thus rendering them susceptible to aquatic pathogens such as the chytrid fungus or red-leg bacteria. (Carey et. al., 1999, 1995, 1993; Jennings, 1996; Drost and Fellers, 1996; Sherman and Morton, 1993).

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

Yosemite toads are generally not collected for commercial or recreational purposes. Scientific and/or educational collecting has declined significantly over the last three decades, particularly as researchers have recognized that toad populations are in jeopardy. (Martin, pers. comm. 2000). Frogs and toads occurring near populated areas such as campgrounds are often subject to harassment and collection by children. (Pers. observation). The Yosemite toad’s tenuous existence in a heavily visited National Park makes it particularly vulnerable to this phenomenon.

3. **<u>Disease and Predation</u>**

a. **<u>Disease</u>**

Disease has likely played a significant -- if not direct -- role in the decline of Yosemite toad populations. In fact, the only witnessed adult toad mortalities (besides several isolated examples of avian predation) have been the individual toads at Tioga Pass that Sherman and Morton (1993, 1984) observed with red-leg disease in the late 1970s. Sherman and Morton identified the pathogenic agent as the ubiquitous fresh water bacteria, *Aeromonas hydrophila*, which typically causes red-leg disease. The fact that the aquatic borne disease appeared to affect male toads at a greater rate than females was consistent with the life history of *B. canorus*, in which males frequent the breeding ponds containing the bacteria more frequently, and for a longer time period, than females. (Karlstrom, 1962; Sherman and Morton, 1993, 1984). Sherman and Morton’s observations were also consistent with the declines of the closely related boreal toad (*Bufo boreas boreas)*, also attributed to red-leg disease, on the west slope of the Rockies. (Carey, 1993) In 1997, David Martin found 15 dead toads in early summer immediately following snowmelt in the Highland Lakes area of the Stanislaus National Forest, apparently from a pathogenic infection. (Martin pers. comm. 2000) However, the question of whether similar disease events have played a role in the declines of other Yosemite toad populations in Yosemite Park and elsewhere in the central Sierra remains a mystery.

Since 1993, new aquatic pathogens have been observed killing amphibian species, both in the western United States, and worldwide. (Carey et. al., 1999.) Chief among these is the chytrid fungus, an aquatic fungi whose taxonomy is still being investigated. (Longcore, 1999; Berger, 1998). Chytrid fungi have been observed decimating frog populations in Australia and Central America. (Lips, 1998; Laurence et. al., 1996). Recent investigation has shown that at least two museum specimens of Yosemite toad collected by Sherman and Morton during the 1977-1978 die off at Tioga Pass were infected with the chytrid fungus.(Carey 1999) These discoveries, in conjunction with other recent findings indicating the presence of the fungus in declining populations of Wyoming toads (Taylor et. al, 1999a) and of mountain yellow-legged frogs in the Sierra Nevada (Vance Vredenburg pers. comm. 2000; Roland Knapp, pers. comm. 2000) now raise the possibility that the fungus -- or even some other pathogen -- may have precipitated the observed bacterial infections. (Carey et. al., 1999)

Significant research remains regarding the taxonomy of aquatic Sierra pathogens, and their relationship to the ecology of the Yosemite toad (and other montane amphibian species). If the pathogens are native to the Sierra Nevada (a question still unanswered for the chytrid fungus), it is highly likely that the pathogens are taking advantage of some sort of environmental stressor that renders the toad more susceptible to disease. A number of environmental stressors could theoretically have such an effect, including UV-radiation, chemical pollution, extremely cold temperatures, or even excessive handling. (Sherman and Morton, 1993; Drost and Fellers, 1996; Carey et. al., 1999, 1995, 1993; Jennings, 1996; Taylor et. al. 1999b.)

b. Predation

As discussed above, the stocking of non-native trout into high Sierra lakes and streams may harm toads by either altering the food chain of those aquatic ecosystems, or by introducing a potentially new predator of adult, juvenile and larval toads into toad habitat. (Knapp, 1996; Jennings, 1996; Bradford, 1993, 1989). While toads typically breed in fishless, ephemeral pools, trout may occur in the slow moving connecting streams used by toads and their larvae, which criss-cross the montane meadow environment. Moreover, most researchers believe that deeper, permanent pools of water historically provided refugia for aquatic amphibian populations during periods of prolonged drought, which could replenish peripheral populations through recolonization. (Knapp, 1996; Drost and Fellers, 1996, 1994; Bradford, 1993). Since 1977, when Yosemite toads were first observed on the decline, California has gone through two major drought periods, either of which could have limited the toad’s ability to breed successfully in ephemeral pool habitat. (Sherman and Morton, 1993, 1984). The introduction of non-native trout over the last century may have eliminated these permanent water, refuge habitats, thus rendering toad populations more susceptible to extinction events. (Knapp, 1996; Drost and Fellers, 1996, 1994; Bradford 1993.)

Due to the high elevation habitat of the Yosemite toad, the non-native, lower elevation bullfrog (*Rana catesbeiana)* does not pose a threat to the toad’s survival.

4. Inadequacy of Existing Regulatory Mechanisms

The Yosemite toad is currently listed as species of special concern by the U.S. Fish and Wildlife Service. It has previously been considered under the Endangered Species Act as a Category 2 candidate species (59 Fed. Reg. 58995, 56 Fed. Reg. 58804), but has never been formally reviewed. At this time, the U.S. Forest Service, Department of Agriculture considers *Bufo canorus* to be an "at risk" species. 63 Fed. Reg. 64452, 64456. The standards and guidelines in subsequent Forest Plans will thus attempt to protect Yosemite toad habitat from adverse human activities. 63 Fed. Reg. at 64456.

The California Department of Fish and Game has designated the Yosemite toad to be a species of special concern and "protected" from "taking" without permit. At this time, however, the state has not instituted any formal listing procedures under the California Endangered Species Act. None of these various federal and state designations offer enforceable protections from harmful human activities to the Yosemite toad or to its critical habitat.

5. Other Natural or Anthropogenic Factors

a. Airborne Contaminants

As described above, airborne contaminants originating in the Central Valley and urban centers to the west are transported on wind currents or as part of eastbound storm systems into the Sierra Nevada. (Seiber et. al. 1998; Aston and Seiber, 1997; Cahill et. al. 1996) Surveys of fresh fallen snow at 7,000 feet have, for example, revealed the presence of toxic organophosphates such as diazinon, malathion, and chlorpyrifos residues. (Seiber et. al. 1998; Aston and Seiber, 1997). The use of such second generation pesticide chemicals have increased greatly since the mid to late 1970s, about the time Yosemite toads were first observed to be in decline. (Scheuring, 1983; Sherman and Morton, 1993). At this time, little to no information is known as to the fate of these chemicals in high elevation aquatic habitats historically occupied by the Yosemite toad. (Boyer and Grue, 1995; Seiber, pers. comm. 1999)

Numerous studies have demonstrated that pesticide residue contamination in water, sediment and aquatic vegetation may harm toads in aquatic environments by delaying or altering larval development or by reducing breeding or feeding activity. (Berrill,et. al. 1998, 1995, 1994, 1993; Boyer and Grue, 1995; Beaties and Tyler-Jones, 1992; Corn and Vertucci, 1992; Hall and Henry, 1992). Moreover, many pesticide chemicals currently in use in the Central Valley have the potential to disrupt endocrine systems, thus adversely effecting adult breeding, and embryonic and larval development. (Reeder, 1998; Hayes, 1997; Colburn et. al. 1991). Amphibians such as the Yosemite toad are particularly sensitive to such hormonal disruptions due to their metamorphic development cycle in which larvae are transformed from aquatic to terrestrial organisms. (Hayes, 1997).

The "sub-lethal" effects of pesticide residues on adult toads may be catastrophic to a population given the limited active season in which toads must emerge, successfully breed, and consume sufficient food to withstand the 7 to 8 month hibernation. (Karlstrom, 1962; Sherman and Morton, 1984; Morton, 1981). Similarly, delayed development and metamorphosis could prove fatal for toad larvae which must transform into juvenile toads before the end of the summer season, or before ephemeral pools dry up. (Karlstrom, 1962; Cunningham, 1963; Sherman and Morton, 1984).

a significant cause of concern for chemical contaminants is the possibility that they may act as environmental stressors, rendering toads susceptible to aquatic pathogens such as the chytrid fungus or red-leg bacteria. (Carey et. al., 1999, 1995, 1993; Jennings, 1996; Drost and Fellers, 1996; Sherman and Morton, 1993). These aquatic pathogens have historically been considered to be opportunistic, infecting only injured or immumosuppressed toads, but not healthy individuals. (Carey et. al., 1999, 1995, 1993; Cahill, 1990; Anver and Pond, 1984). Recent research indicates that sublethal levels of organophosphate pesticides in combination with normal background levels of red-leg bacteria may result in fatal infections. (Taylor, 1999b). Since disease has played a direct role in the only observed Yosemite toad population declines, the possibility of this type of synergistic effect occurring in the Sierra should not be underestimated. (Carey et. al., 1999; Sherman and Morton, 1993)

b. Ultraviolet Radiation

At this time, there is no direct evidence that the thinning of the ozone layer has had an adverse impact upon toad populations. However, studies have shown an increase in UV-B radiation in higher montane environments such as those occupied by the toad. (Blumthaler and Ambach, 1991; Cahill et. al., 1990) Blaustein et. al. (1994) found a potential correlation between increased UV-B exposure and embryonic failure. In addition, increased UV-B radiation may also act as an environmental stressor, leading to increased disease susceptibility. (Carey et. al. 1999).

c. Climate Change

The possibility that global climate changes are affecting the environment of the Yosemite toad in the Sierra Nevada has not been adequately explored. In his 1990, 1992 and 1993 surveys, David Martin did not find any toads below 7,500 feet elevation, 1,000 feet higher than their historical elevation range down to 6,500 feet. (Martin, pers. comm. 2000). Such an elevational shift, if substantiated, is consistent with theories of species adjustment to shifting climatic patterns. (Pounds et. al. 1999). Widespread climatic changes may also alter the evolutionary balance between the toad and various pathogens. (Carey et. al. 1999.) Thus, climate change must be considered as a possible cause of the pathogenic infections that appear to have played a role in the toads' decline (Pounds et. al. 1999; Carey et. al. 1999).

III. CONCLUSION

The Yosemite toad is clearly imperiled and warrants endangered status under the Endangered Species Act. *Bufo canorus* has declined in distribution and abundance throughout a significant portion of its range in the Sierra Nevada. The species has been documented to have disappeared from a number of its historic locations. Recent surveys show that the Yosemite toad has become a rare species in Yosemite National Park, where it was once abundant. The most well-documented surveys of toad populations, conducted in the area around Tioga Pass, in and adjacent to Yosemite, reveal population crashes that would indicate the species is heading towards extinction. Survey data in other parts of the Sierra, while less comprehensive, appear to corroborate this trend.

Anthropogenic and natural factors such as fish stocking, pesticide use, livestock grazing, UV radiation, acid deposition, and drought have likely each played a role individually and in combination, in contributing to the alarming declines of the species. As early as 1994, Charles Drost and Gary Fellers, herpetologists with the U. S. Geological Service - Biological Resources Division, concluded that the Yosemite toad warranted endangered status. Drost and Fellers (1994) stated "There have been efforts to gain Federal Endangered Species status for some or all populations of three of the species discussed here: 1) the Yosemite Toad; 2) the California Red-legged Frog; and 3) the Mountain Yellow-legged Frog. Our results argue strongly for such listing for all three of these species." Today, as the information presented in this petition makes clear, the Yosemite toad is in peril. It deserves prompt action under the ESA to protect it and its threatened habitat.

IV. CRITICAL HABITAT

Petitioners request the designation of critical habitat for the Yosemite toad concurrent with its listing. The Yosemite toad already has vanished from many areas in its historic range. Critical habitat should encompass all lakes, ponds, springs, tarns, streams and wet meadows within the historic range of the species, as well as a 500 m buffer around those features to allow for adult and juvenile dispersal and migration corridors to allow for genetic mixing.

V. SIGNATURE PAGE

Submitted this _____ day of February, 2000

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