U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Hyla wrightorum* – Huachuca/Canelo DPS

COMMON NAME: Arizona treefrog

LEAD REGION: 2

INFORMATION CURRENT AS OF: March 2008

STATUS/ACTION

___ Species assessment - determined we do not have sufficient information on file to support a proposal to list the species and, therefore, it was not elevated to Candidate status
___ New candidate
_X_ Continuing candidate
    _X_ Non-petitioned
    ___ Petitioned - Date petition received:
        _ 90-day positive - FR date:
        _ 12-month warranted but precluded - FR date:
        _ Did the petition request a reclassification of a listed species?

        FOR PETITIONED CANDIDATE SPECIES:
        a. Is listing warranted (if yes, see summary of threats below)?
        b. To date, has publication of a proposal to list been precluded by other higher priority listing actions?
        c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded.

___ Listing priority change
    Former LP: ___
    New LP: ___

Date when the species first became a Candidate (as currently defined):

___ Candidate removal: Former LPN: ___
    ___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
    ___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
    ___ F – Range is no longer a U.S. territory.
    ___ I – Insufficient information exists on biological vulnerability and threats to support

listing.
___ M – Taxon mistakenly included in past notice of review.
___ N – Taxon does not meet the Act's definition of "species."
___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Amphibian - Hylidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Arizona, USA; Sonora, México

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Arizona, USA; Sonora, México

LAND OWNERSHIP: **USA:** Estimated near 100% Federal: three of the 13-16 localities for the Huachuca/Canelo population are on the U.S. Army's Fort Huachuca. Other localities are either on the Coronado National Forest or are not specific enough to determine ownership (Robber's Roost and Miller Canyon in the Huachuca Mountains). **México**: 100% Naturalia, a non-governmental environmental protection organization.

All U.S. sites are small, ranging from stock tanks to short reaches of streams. Estimated breeding habitat in the U.S. is probably <10 acres (<4 hectares) (roughly 70% U.S. Forest Service – Coronado National Forest, and 30% U.S. Army - Fort Huachuca). In Sonora, breeding habitat consists of ciénegas (spring-fed wetlands) that are similar to small prairie potholes or vernal pools, or occur as sluggish ephemeral drainages. Estimated breeding habitat in Sonora is more difficult to assess, but probably is <20 acres (<8 hectares).

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BIOLOGICAL INFORMATION

Species Description: The Arizona treefrog is a small 1.8 inches (in) (4.6 centimeters (cm)) green frog with a dark eyestripe that extends past the shoulder onto the side of the body, and sometimes to the groin area (Figure 1). This dark stripe may break into spots or dashes past the shoulder. The eyestripe on the similar Pacific treefrog (*Pseudacris regilla* Complex), a complex of three species from the Pacific Coast region, does not extend past the shoulder. Some Arizona treefrogs exhibit dark spots on the head and upper back, and bars or spots on the lower back. The throat of the male is dusky green or tan, and males average a slightly smaller size than females (Duellman 2001, pp. 983-985; Stebbins 2003, p. 224).

Figure 1: Arizona treefrog, Scotia Canyon, Huachuca Mountains, Arizona.

Some characteristics of the species differ in disjunct areas. The species occurs in three disjunct regions: the mountains of central Arizona to west-central New Mexico, the Huachuca Mountains and adjacent Canelo Hills and Rancho Los Fresnos in southeastern Arizona and north-central Sonora, and the Sierra Madre Occidental and sky island mountain ranges from near Nacori Chico south to at least Yecora in eastern Sonora (Rorabaugh 2008, p. 29) and southwestern Chihuahua (Duellman 2001, p. 986; Lemos-Espinal and Smith 2007, p. 276, Map 29; Gergus et al. 2005, p. 462; Figure 2). The snout-vent lengths (SVLs) of treefrogs from the Huachuca Mountains and Canelo Hills of southeastern Arizona are intermediate, but significantly smaller than *Hyla wrightorum* of the Mogollon Rim in central Arizona, and larger than frogs from near Yecora, Sonora, Mexico. The calls of frogs from the three areas (Mogollon Rim, Huachuca/Canelo, Yecora) are similar, but the size-adjusted dominant frequency of the Huachuca/Canelo frogs are nearly 200 Hz (hertz) higher than those of the Mogollon Rim, and the Yecora frogs exhibit dominant frequencies about 100 Hz higher than the Huachuca/Canelo frogs (Gergus et al. 2004, p. 763).

Figure 2: Distribution of the Arizona treefrog in Arizona, New Mexico, and northern Mexico (adapted from Duellman 2001, p. 986 and Stebbins 2003, p. 477). The Huachuca/Canelo population is shown as the small, disjunct range on the Arizona/Sonora border.

Taxonomy: Taylor (1938, pp. 421-445) described *Hyla wrightorum* from what had been recognized as *Hyla eximia*, which is a similar frog of the Mexican plateau (Mesa Central, Cordillera Volcanica, Sierra Madre Occidental, and Sierra Madre Oriental). Schmidt (1953, in Gergus et al. 2004, p. 758) disagreed and considered *H. wrightorum* a subspecies of *H. eximia*. Jameson et al. (1966, pp. 551-620) regarded *H. wrightorum* as a subspecies of *H.* (now *Pseudacris*) *regilla*, based on multivariate discriminant function analysis of morphological measurements. Based on serum albumins (water soluble proteins in blood serum) of *H. eximia*, *H. wrightorum*, and *H. regilla*, Maxson and Wilson (1974, pp. 66-68) argued that *H. eximia* and *wrightorum* are closely related but relatively divergent from *H. regilla*. In an analysis of *H. eximia* and *H. wrightorum*, Renauld (1977, in Gergus et al. 2004, p. 758) compared morphometrics, allozyme, and advertisement calls of the Mogollon Rim and mainland Mexico frogs and concluded that the former could be distinguished from the latter based on differences in size, shape, and dominant frequency of male advertisement calls. Crother et al. (2000, p. 10) compiled scientific and common names of North American amphibians and reptiles, which has become the standard for the Society for the Study of Amphibians and Reptiles, American Society of Icthyologists and Herpetologists, and the Herpetologist's League. In that list, Crother did not recognize *wrightorum*, but rather considered the frogs from Arizona and western New Mexico as *H. eximia*. However, in the 2003 update, Crother et al. (2003, p. 197) regarded these populations as *H. wrightorum* and noted that the status of frogs from Mexico (south to, but not including the Mexico City region) is unknown.

Gergus et al. (2004, pp. 758-769) were the latest investigators of the phylogeny and taxonomy of these frogs, and were the first to compare specimens from the Huachuca/Canelo population to other populations. Based on geographic variation in allozymes, mitochondrial cytochrome *b* gene (*mt*DNA) sequences, SVLs, and advertisement calls, they recognized *H. eximia* from southern Mexico and *H. wrightorum* (specimens from the Sierra Madre Occidental of Sonora, Huachuca Mountains and Canelo Hills of southeastern Arizona, and mountains of central Arizona) as distinct species. We concur with the recent taxonomic evaluations (Crother et al. 2003, p. 197; Gergus et al. 2004, pp. 758-769) and thus consider *H. wrightorum* to be a valid taxon.

Furthermore, the three populations of *H. wrightorum* examined differed somewhat in SVL, size-adjusted dominant call frequency, and in *mt*DNA sequences (see Species Description above, and Distinct Vertebrate Population, below). The Huachuca/Canelo population of the Arizona treefrog is disjunct from Arizona treefrog populations in the Sierra Madre Occidental and adjacent sky islands, and the mountains of central Arizona. Approximately 130 and 145 miles (mi) (208 and 232 kilometers (km)) separate the Huachuca/Canelo population from those in central Arizona and the nearest known population in the mountains of eastern Sonora, respectively (Stebbins 2003, p. 477; Gergus et al. 2005, p. 462; Maldonado-Leal et al. *in press*; Figure 2).

Liner (1994, p. 23) used "Wright's mountain treefrog" as the common name for *H. wrightorum*, whereas Crother et al. (2003, p. 10) used "Mountain treefrog." Gergus et al. (2005, p. 461), Brennan and Holycross (2006, p. 40), and Rorabaugh (2008, p. 29) used "Arizona treefrog." We have elected to use Arizona treefrog.

Habitat/Life History: Degenhardt et al. (1996, pp. 69-71), Duellman (2001, pp. 983-986), and Gergus et al. (2005, pp. 461-463) reviewed the biology of this species. In Arizona, the Huachuca/Canelo population of the Arizona treefrog is known from Madrean oak woodland and savannah, pine-oak woodland, and mixed conifer forest at elevations of approximately 5,000 to 8,500 feet (ft) (1,525 to 2,590 meters (m)). At Rancho Los Fresnos, Sonora, the species occurs in Plains grassland at about 5,000 ft (1,525 m) (Maldonado-Leal et al. *in press*).

The life history and habitats of the Huachuca/Canelo population has not been studied in detail; however, Holm and Lowe (1995, pp. 19-27) present the best description of the habitats and ecology of this population in Scotia Canyon, Huachuca Mountains, during 1980-1993. At that site, Arizona treefrogs were observed from late June to early October, during which adult treefrogs seemed to prefer more mesic oak groves and wet seeps during the day. Both adults and juveniles were also found during the day beneath logs and rocks in nearby moist areas. Use of refuges away from breeding ponds during the day may reduce risk of predation (Holm and Lowe 1995, p. 22). At night, adults would converge on a breeding pond near the Peterson Ranch in Scotia Canyon. This pond is an impoundment that typically holds water only during the rainy season. Other perennial pools in the canyon were not used for breeding.

Sredl and Collins (1992, pp. 607-614) studied *H. wrightorum* on the Mogollon Rim of Arizona and found that reproduction occurred in both perennial and ephemeral waters, and that there was a tradeoff between predation risk and risk of desiccation in these two breeding habitats. The ephemeral pools contained few predators, but carried a risk of drying before tadpoles could metamorphose (Sredl and Collins 1992, p. 610, reported mean larval periods of 38-46 days in central Arizona). The perennial pools have no risk of drying, but predators in these environments can greatly reduce larval survival. Collins (1994, p. 5) described the preferred breeding habitats of Arizona treefrogs on the Mogollon Rim as "temporary, shallow ponds filled during the summer monsoon rains." Collins never found larval Arizona treefrogs where nonnative fish or bullfrogs occurred. At Rancho Los Fresnos, the species was found in ciénegas (spring-fed wetland) within grasslands or along drainages in early May, late August, and again in early October. The portions of the ciénegas where the frogs were found were likely ephemeral. Bullfrogs, nonnative fishes, and crayfish (*Orconectes virilis*) occurred in the most perennial waters – Arizona treefrogs were not found in sympatry with these species at Los Fresnos (U.S Fish and Wildlife Service 2006a, pp. 2 & 5; 2006b, pp. 4-5; and 2006c, p. 2).

In the fall in Scotia Canyon, metamorph frogs were abundant in the marshy seeps and edges of the perennial Peterson Ranch Pond, which is adjacent to the breeding pond. Post breeding adults and juveniles can also be found along the creek and at other ponds in Scotia Canyon (Wooldridge 2005). After early October, frogs could not be found by Holm and Lowe (1995, pp. 21-22), and little is known of habitat use from late October to the onset of the summer rains (Gergus et al. 2005, p. 463), although one individual was found active at the Los Fresnos Ciénega on May 23, 2006 before the monsoon season (U.S. Fish and Wildlife Service 2006a, p. 2 & 5). Holm and Lowe (1995, p. 22) suggested that frogs may overwinter in deep fissures in limestone outcrops in Scotia Canyon. On the Mogollon Rim, Arizona, an Arizona treefrog was found in a debris pile in January, and in Durango, Mexico, Arizona treefrogs were found in

March beneath boulders surrounding a small pond (Gergus et al. 2005, p. 463).

Adult males called from as early as July 1 to as late as August 6 in Scotia Canyon (Holm and Lowe 1995, p. 23); however, males were heard calling at two localities at Rancho Los Fresnos on August 23, 2006 (U.S. Fish and Wildlife Service 2006b, p. 4). Calling takes place primarily after dark at the breeding pond, but some males call during the day, typically from sites on the ground within 600 ft (183 m) of the breeding pond. At the breeding pond in Scotia Canyon, males called mostly from the shore or shallow water where they were often found clinging to emergent grasses and sedges.

Eggs were observed near the edge of the pool, singly or in clusters of up to 15 and attached to debris or vegetation up to 2.8 in (7.1 cm) below the water's surface. Clutch size of one female was 826 eggs. Eggs hatched in about one week and metamorphosed into frogs at least one month later. Arizona treefrogs did not reproduce in Scotia Canyon in 1993 because the rains came late and the breeding pond did not fill until 30 August. This lack of breeding occurred despite the presence of adjacent perennial pools. Thus, unlike Mogollon Rim treefrogs, breeding in the Huachuca/Canelo population may be more restricted to ephemeral waters.

Throughout their range, Arizona treefrogs breed in ponds with abundant aquatic vegetation, often in grassy, shallow waters in mountain meadows (Stebbins 1962, pp. 328-329; Gergus et al. 2005, pp. 462-463). Males use vegetated shorelines for calling sites and juvenile frogs have been found amongst emergent vegetation on the shorelines of the breeding pond in Scotia Canyon (Holm and Lowe 1995, p. 23; Gergus et al. 2005, p. 462).

Holm and Lowe (1995, pp. 24-26) observed predation on Arizona treefrogs in Scotia Canyon by Mexican gartersnakes (*Thamnophis eques*), which they believed were significant predators on the species. Giant water bugs (*Lethocerus* sp.) were also found to prey upon eggs, larvae, and adults. On the Mogollon Rim, Sredl and Collins (1992, pp. 610-613) found that Arizona tiger salamanders (*Ambystoma mavortium nebulosum*) were significant predators on Arizona treefrogs. The endangered Sonoran tiger salamander (*Ambystoma mavortium stebbinsi*) occurred in Scotia Canyon historically, but has not been observed there since 1995. Holm and Lowe (1995, p. 26) suggested that recent invasion of Scotia Canyon by American bullfrogs (*Lithobates catesbeiana*) could impact the treefrog population through predation. They found that bullfrogs could not breed in the ephemeral pond used as a breeding site by Arizona treefrogs because their tadpoles need two years to develop. However, bullfrogs reproduce in other perennial pools in the canyon, and adults forage in the Arizona treefrog breeding pool where they likely prey upon breeding treefrogs (Rorabaugh 1998, 2007). In the fall, juvenile treefrogs also frequent the Peterson Ranch Pond (Holm and Lowe 1995, p. 22) and other perennial pools where bullfrogs are abundant and probably prey upon those juveniles.

Diet of the Huachuca/Canelo population has not been investigated. Chapel (1939, p. 227) found beetles, spiders, earthworms, flies, and grass particles in the stomachs of seven Arizona treefrogs from west-central Arizona. Arizona treefrogs presumably eat a variety of invertebrates.

<u>Historical Range/Distribution</u>: The historical distribution of the Huachuca/Canelo population of

the Arizona treefrog is poorly documented, due to the paucity of early collections. Arizona treefrogs were first reported from the Huachuca Mountains by Campbell (1934, p. 6) who collected a single individual on 1 August 1933 "on the very summit of the Huachuca Crest, at the head of Miller Canyon, at an elevation of about 8,500 feet." Stebbins (1954, p. 122) reported the species from the Huachuca Mountains at "1.5 miles NW of Millers Peak", which would be near Bear Spring or Bear Canyon, and also near "Robber's Roost" (location unknown).

The species was collected in Scotia Canyon, Huachuca Mountains, in 1974 (specimens at the American Museum of Natural History; U.S. Bureau of Land Management 1980, no page #). Holm and Lowe (1995, p. 20-21) reported the species from other sites in the Huachuca Mountains, including Miller Canyon (1970s, although the authors considered this report "unverified"); a site labeled "6,600 feet in Huachuca Canyon"; localities in Oversite, Lone Mountain, and Scotia canyons; and a tributary to Scotia Canyon (0.8 mi (1.3 km) north of Forest Road 78), as well as from Canelo in Turkey Creek in the Canelo Hills.

Arizona treefrogs were also found at 7,000 ft (2,135 m) in Sunnyside Canyon, Huachuca Mountains (1994) and recently (1995) from Whiner Tank in the headwaters of Turkey Creek and at Hannah Tank, the latter of which is near or may be the same locality as Holm and Lowe's "tributary to Scotia Canyon" (Arizona Game and Fish Department's Heritage Data Management System 2005, pp. 1-10). Eric Wallace and Sheridan Stone found Arizona treefrogs in upper Garden Canyon, Huachuca Mountains, Fort Huachuca in 1998, and Arizona Game and Fish Department personnel also found frogs in 1998 in a tributary to Huachuca Canyon, Huachuca Mountains, at 6,625 ft (which may be the same as Holm and Lowe's 6,600 ft (2,013 m) Huachuca Canyon locality). Arizona treefrogs were also found in 2003 in a cave south of Scheelite Canyon, Huachuca Mountains, Fort Huachuca (Sidner and Stone 2005, p. 131). Tom Beatty, Jr. reported the species from the Miller Canyon (south fork), Huachuca Mountains, "several years ago" below the crest at 7,500-8,300 ft (2,290-2,530 m) (Beatty 2005, p. 1).

At Rancho Los Fresnos, Sonora, the species was first found in 1990 at an unspecified location in the Los Fresnos Ciénega (Maldonado-Leal et al. *in press*). During three survey trips in 2006, the U.S. Fish and Wildlife Service (2006a-c) documented the species at two sites in the Los Fresnos Ciénega, but also in an ephemeral wetland just downstream of La Ciéneguita and near Arroyo Los Fresnos. Whether the Huachuca/Canelo population occurs in Sonora outside of Rancho Los Fresnos is unknown. The Ranch was grazed conservatively for a long time, and cattle have been removed by Naturalia, the current owners; hence the ciénega habitats there are in good ecological condition (see Hendrickson and Minckley 1984, pp. 160-169 for discussions of how livestock grazing can degrade ciénegas). However, based on some reconnaissance by U.S. Fish and Wildlife Service staff, examination of Google Earth imagery, and discussions with Mexican partners, there are other similar ciénega habitats in the vicinity of Rancho Los Fresnos where the species may occur.

We have examined site-specific specimen records from 23 museums as well as published accounts and have not found other records or reports of Arizona treefrogs from north-central Sonora. A distribution map for the species in Duellman (2001, p. 986) shows a locality near Rancho Los Fresnos, but this is a misplotted locality based on a specimen collected at Yecora in

east-central Sonora (Duellman 2007). There is another notable record at the American Museum of Natural History (AMNH 53033) of an Arizona treefrog collected from Trincheras, Sonora (~93 mi (~150 km) SW of Rancho Los Fresnos). The locality is in the Sonoran Desert, which is outside of habitats known to be occupied by the species. Data accompanying the specimen included the following note: "Data questionable, from memories of collectors, as spec without tag when rec'd at AMNH". The specimen was lost on a loan made in 1982, and was eventually deaccessioned (in 1995), so there is no way to check the identification (Dickey 2007).

In summary, the Huachuca/Canelo population is known from three general localities at Rancho Los Fresnos, Sonora, Mexico and 13-15 verified localities and one unverified locality in the Huachuca Mountains and Canelo Hills, Arizona. The Arizona localities include 11 different canyons or drainages and one unspecific locality (Robber's Roost). All but one of those drainages (Turkey Creek) are in the Huachuca Mountains. Turkey Creek originates on the northeastern slope of the Canelo Hills, which is the range of hills just west of the Huachuca Mountains. Elevations of specific localities range from about 5,000-8,500 ft (1,525-2,590 m). The species likely occurs or occurred in other wet canyons with suitable breeding habitat in the Huachuca Mountains, and perhaps in ciénegas in the vicinity of Rancho Los Fresnos. The frogs are difficult to detect outside of the monsoon season and late summer, and most are found when calling and breeding (primarily July-August); thus they could be overlooked, at least in less visited canyons and locales.

Current Range/Distribution: We can not say with any certainty that the species has disappeared from any of the localities from which it has been found or reported. It was located at all three general localities from which it is known in Sonora in 2006. In Arizona, the species has been found at only eight of 13-16 sites within the last 10 years (Scotia, Sunnyside, south of Scheelite, Gardner, and Miller canyons, tributary to Huachuca Canyon, Whiner Tank, and Hannah Tank); however, surveys are either lacking or inconclusive as to the species' current presence or absence at the other 5-8 sites.

Because the location of Robber's Roost within the Huachuca Mountains is unknown, the species' presence there cannot be investigated. At "1.5 miles NW of Miller's Peak" frogs have not been reported since Stebbins reported them (1954, p. 122), but comprehensive surveys to search for the species have not been conducted at this site in recent years. We are not aware of any reports of or surveys for the species at Oversite or Lone Mountain canyons, or Turkey Creek at Canelo since Holm and Lowe (1995, p. 20) reported them there. U.S. Fish and Wildlife Service biologists visited Whiner Tank in August 2005. We found no treefrogs there and the habitat appeared unsuitable or only marginally suitable (Rorabaugh 2005). The Huachuca Mountains have long been the subject of many herpetological investigations, including both casual and more thorough surveys and collections (see Wright and Wright 1949, pp. 515-516; Bureau of Land Management 1980, no page #s; Collins et al. 1988, pp. 45-53; Clarkson and Rorabaugh 1989, pp. 531-538; Morrison et al. 1995, pp. 185-192; Goldberg 2002, pp. 54-56; Sredl and Wallace 2000, pp. 1-8; Ramsey Canyon Leopard Frog Conservation Team 2006, pp. 2-8), yet Arizona treefrogs have been reported from relatively few localities and are infrequently observed.

Population Estimates/Status: There are only 13-16 known localities in Arizona. All of these sites are small, ranging from stock tanks to short reaches of streams. Only eight of the known locatities have yielded observations of frogs in the past decade, and observed breeding populations range between 2-30 individuals. Compared to suitable habitats in east-central Arizona, Arizona treefrogs in the Huachuca Mountains and Canelo Hills DPS are found infrequently and populations contain relatively small numbers of frogs. Gergus et al. (2005, p. 462) wrote, "In the Huachuca Mountains, Arizona treefrogs were observed to have relatively low abundance (between 2 and 30 adults observed at any one breeding locality) and may be susceptible to extirpation by virtue of their small population sizes (Gergus 1999)." Although Arizona treefrogs have occupied some canyons with extensive aquatic systems (e.g., Garden, Scotia, and Sunnyside canyons), they breed in specialized and limited habitats (mostly or exclusively ephemeral pools), which limit their populations in these areas. As noted above, at Rancho Los Fresnos, Sonora, the species was first found in 1990 at an unspecified location in the Los Fresnos Ciénega (Maldonado-Leal et al. *in press*). During three survey trips in 2006, the U.S. Fish and Wildlife Service (2006a-c) documented the species at two sites in the Los Fresnos Ciénega, but also in an ephemeral wetland just downstream of La Ciéneguita and near Arroyo Los Fresnos. Whether the Huachuca/Canelo population occurs in Sonora outside of Rancho Los Fresnos is unknown. No more than two frogs were found at any one site at Rancho Los Fresnos, Sonora, Mexico, and "choruses" consisted of only one or two frogs (although Los Fresnos was not visited at the peak of the breeding season).

DISTINCT POPULATION SEGMENT (DPS)

Under the Endangered Species Act (Act), we must consider for listing any species, subspecies, or, for vertebrates, DPSs of these taxa, if information is sufficient to indicate that such action may be warranted. To implement the measures prescribed by the Act and its Congressional guidance, we, along with the National Oceanic and Atmospheric Administration Fisheries, developed policy to clarify our interpretation of the phrase "distinct population segment of any species of vertebrate fish or wildlife" for the purposes of listing, delisting, and reclassifying species under the Act (U.S. Department of the Interior and Department of Commerce 1996). The policy allowed us to interpret the requirement of the Act to "* * * determine whether any species is an endangered species or a threatened species" (section 4(a)(1)) in a clear and consistent fashion for the term "distinct population segment." Under our DPS policy, we consider three elements in a decision regarding the status of a possible DPS as endangered or threatened under the Act. These are applied similarly for addition to the lists of endangered and threatened wildlife and plants, for reclassification, and for removal from the lists. The elements are: (1) the population segment's discreteness from the remainder of the species to which it belongs; (2) the population segment's significance to the species to which it belongs; and (3) the population segment's conservation status in relation to the Act's standards for listing (i.e., when treated as if it were a species, is the population segment endangered or threatened?). Our policy further recognizes it may be appropriate to assign different classifications to different DPSs of the same vertebrate taxon (U.S. Department of the Interior and Department of Commerce 1996).

Discreteness

The DPS policy's standard for discreteness allows an entity given DPS status under the Act to be adequately defined and described in some way that distinguishes it from other representatives of its species. A population segment of a vertebrate species may be considered discrete if it satisfies either one of the following two conditions: (1) it is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation; or (2) it is delimited by international governmental boundaries within which significant differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist.

Condition (1) "it is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors"

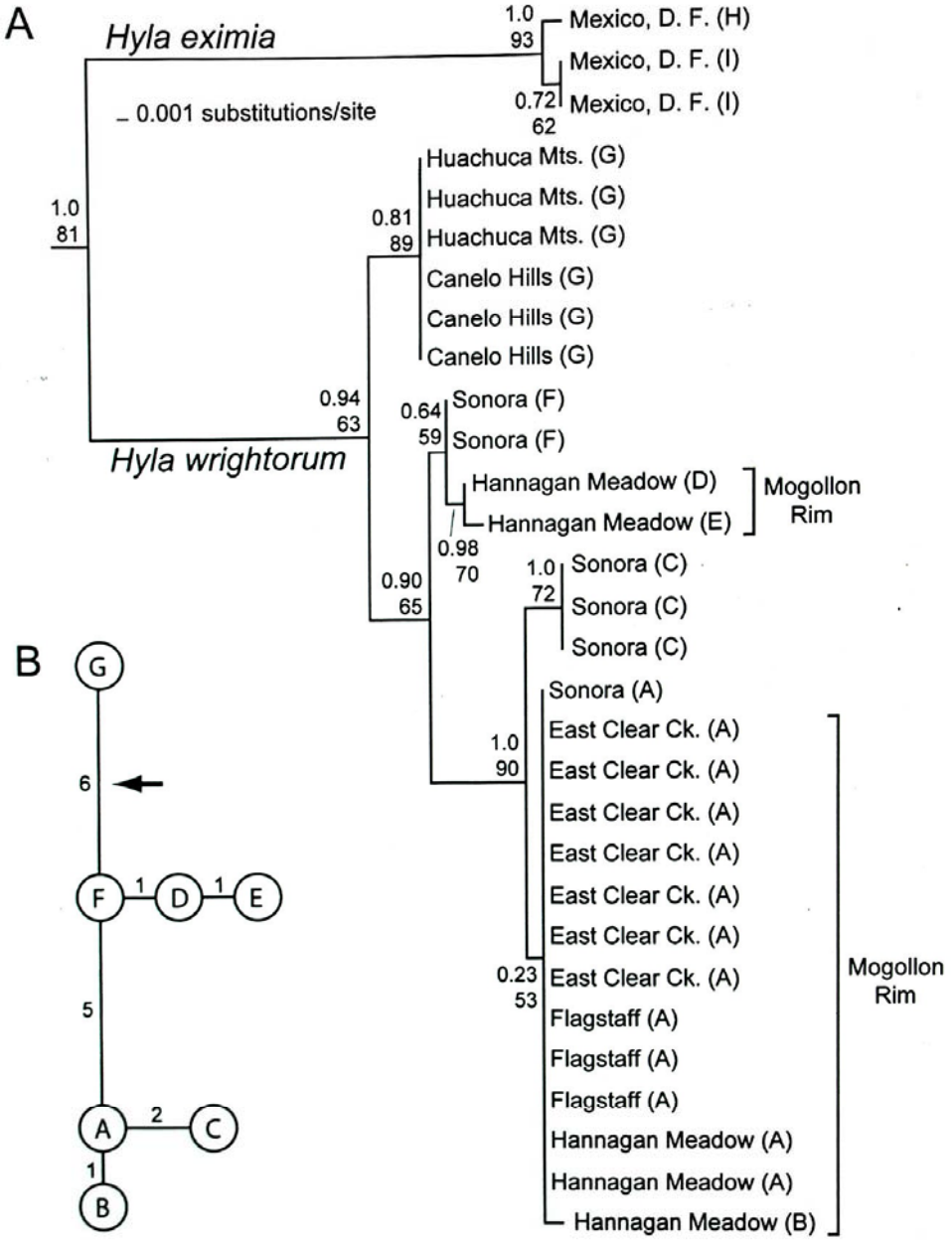
Physical Discreteness: The range of the Huachuca/Canelo population of the Arizona treefrog lies between that of the populations in the Sierra Madre Occidental and adjacent mountain ranges of México (Sierra Madre Occidental population) and the Mogollon Rim region of central Arizona and west-central New Mexico (Mogollon Rim population) (Figure 2). It is geographically disjunct by approximately 145 and 130 mi (232 and 208 km), respectively, from these population segments. Although the species is difficult to detect much of the year, a long history of herpetological surveys in the southeastern Arizona mountain ranges have only located the species in the Huachuca Mountains and Canelo Hills. It is very unlikely that it would be found in other southeastern Arizona mountain ranges. Because of comparatively little herpetological inventory, the species could have gone undetected in one or more mountain ranges in northeastern Sonora, such as the Sierra los Ajos or Sierra el Tigre, both of which include high elevation mixed conifer forests and canyons similar to where Arizona treefrogs are found in the Huachuca Mountains. Based on museum specimens (see especially University of Arizona herpetological collection records), considerable herpetological collecting has occurred in both of these ranges; however, access to the higher portions of these mountains is more difficult than in southeastern Arizona, hence most collecting has occurred at lower elevations (lower than at least some populations would likely be). If the species were found in one or both of these ranges, the Huachuca/Canelo populations would still be disjunct by a minimum of 50 mi (80 km, the distance from the Huachuca Mountains to the Sierra los Ajos) of unsuitable, lowland valley habitats. The Huachuca/Canelo populations are therefore markedly separated from other populations of the Arizona treefrog because of their physical and geographical separation. This separation is marked by intervening habitat types that are not hospitable to Arizona treefrogs and distances that are large in comparison to their limited dispersal abilities. Dispersal capabilities are evaluated below under "Ecological or Behavioral Factors."

Quantitative Measure of Genetic or Morphological Discontinuity: As discussed in the "Description" above, Gergus et al. (2004, pp. 765-766) found that SVLs of Huachuca/Canelo frogs are intermediate, but significantly shorter than *Hyla wrightorum* of the Mogollon Rim in central Arizona, and longer than frogs from the Sierra Madre Occidental (Yecora), Sonora Mexico. The calls of frogs from the three areas (Mogollon Rim, Huachuca/Canelo, Sierra Madre Occidental) are similar, but the size-adjusted dominant frequency of the Huachuca/Canelo frogs is nearly 200 Hz higher than those of the Mogollon Rim, and the Sierra Madre frogs exhibited

dominant frequencies about 100 Hz higher than the Huachuca/Canelo frogs. However, Gergus et al. (2004, p. 767) considered these differences small and not biologically significant. They believed females from any particular population would probably identify a male from any other population as a potential mate. Holm and Lowe (1995, p. 27) found tail fin height to body length ratios of 10 Scotia Canyon Arizona treefrog tadpoles to be intermediate (0.633) between samples from Mexico (0.728) and the White Mountains of Arizona (0.558, Zweifel 1961, p. 3). These morphological and call data suggest clinal variation between frogs of east-central Arizona and the Sierra Madre Occidental.

Allozyme analysis of the three geographic groupings of the Arizona treefrog revealed some mild differentiation among these groups. Differences in allele frequency were found, and in some cases alleles were present at a low frequency in one population and absent in others. The Mogollon Rim and Huachuca/Canelo populations showed qualitative differences at two loci (maximum Nei's unbiased genetic distance was 0.0221); however, greater differences existed between these populations and the frogs in the Sierra Madre Occidental (Nei's unbiased genetic distances of 0.0643 to the Huachuca/Canelo population and less than 0.0570 to the Mogollon Rim population). The Sierra Madre Occidental population showed qualitative but no fixed differences with the Mogollon Rim and Huachuca/Canelo populations. Several alleles were found only in the Sierra Madre Occidental frogs. All populations of the Arizona treefrog differed from *Hyla eximia* from Mexico by at least 0.4651 (Gergus et al. 2004, p. 763).

The *mt*DNA analysis provides clearer evidence of genetic discontinuity between the Huachuca/Calenlo populations and the other geographic groupings. Gergus et al. (2004, p. 764) found seven haplotypes within the three geographic divisions of the Arizona treefrog (Mogollon Rim, Huachuca/Canelo, and Sierra Madre Occidental; Figure 3). In the Mogollon Rim, haplotype A predominated, but types B, C, D, and E were also present. In the Sierra Madre Occidental, haplotypes C and A were found. Only haplotype G was detected in the Huachuca/Canelo population, and this haplotype was not found on the Mogollon Rim or in the Sierra Madre populations. The phylogenetic analysis placed haplotype G as the sister lineage to the remaining haplotypes within the Arizona treefrog (Figure 3). Figure 3B shows a unique and quite divergent fixed haplotype for the Huachuca/Canelo population. The G haplotype differs from all other haplotypes by a minimum of six nucleotide substitutions, which is greater than the maximum difference between other haplotypes pairs (see haplotype network in Figure 2). As a result, the Mogollon Rim and Sierra Madre Occidental populations are more similar to each other than to the Huachuca/Canelo population. The authors suggest that the three geographic divisions have likely been evolving independently for approximately the same amount of time (estimated 11,000-700,000 years), with the apparent lack of haplotypic diversity in the Huachuca/Canelo frogs likely due to small populations, allowing for more rapid haplotype fixation. The unique haplotype of the Huachuca/Canelo populations provides a quantitative measure of genetic discontinuity between them and other populations of the Arizona treefrog.



(A) Single optimal maximum-likelihood phylogeny of the cytochrome *b* haplotypes within *Hyla eximia* and *Hyla wrightorum*. Letters following the individual localities denote the given haplotype. Numbers along the branches represent Bayesian posterior probabilities (above) and bootstrap percentages (below). Maximum-likelihood model (GTR + I + Γ)parameters used: Base frequencies: A = 0.28132, C = 0.31993, G = 0.10084, T = 0.29792; R-matrix: A–C = 2.34, A—G = 26.05, A–T = 2.63, C—G = 1.39, C–T = 21.20, G—T 1.00; Pinvar = 0.52; α = 0.97. (B) Haplotype network for *H. wrightorum*. Numbers along branches denote the number of nucleotide substitutions between haplotypes. The arrow denotes optimal placement of the root for this network based on the maximum-likelihood analysis.

Figure 3: Phylogeny of *Hyla wrightorum* and *H. eximia*. From Gergus et al. (2004, p. 764). haplotype of the Huachuca/Canelo populations provides a quantitative measure of genetic discontinuity between them and other populations of the Arizona treefrog.

The stronger evidence for genetic discontinuity based on mtDNA data than for the allozyme data can be explained by the greater evolutionary rate of mtDNA sequences compared to allozymes (Avise 2004, p. 124). Also, if females disperse less than males, a maternally-inherited genetic gene like mtDNA will show greater differentiation than allozymes and other nuclear genes, which are dispersed more readily (Avise 2004, p. 273)

Ecological or behavioral factors: That the habitat between the Huachuca/Canelo populations and other Arizona treefrog populations is unsuitable for Arizona treefrog residence or dispersal indicates that these populations are marked separated by ecological and behavior factors.

Significance

Under our DPS policy, once we have determined that a population segment is discrete, we consider its biological and ecological significance to the taxon to which it belongs. This consideration may include, but is not limited to, (1) evidence of the persistence of the discrete population segment in an ecological setting that is unique for the taxon; (2) evidence that loss of the population segment would result in a significant gap in the range of the taxon; (3) evidence that the population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historical range; or (4) evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

In regard to (1), the population has persisted in unique Arizona sky island mountain range and Plains grassland habitats. The habitat occupied by the Arizona treefrog in the Huachuca Mountains and Canelo Hills area is more arid and limited than in the Mogollon Rim populations; however, not enough is known about the Sierra Madre Occidental populations to compare these attributes. Vegetation communities are intermediate; although Sierra Madrean species predominate in the Huachuca Mountains (69.9 percent of the flora, versus 21.5 percent characteristic of the Mogollon Rim highlands; Bowers and McLaughlin 1994, p. 139). The Plains grassland and ciénega localities at Rancho Los Fresnos are very different than the montane canyons and meadows where the species is found in Arizona and New Mexico. It is also unique for Sonora (Maldonado-Leal *in press*), but Van Devender and Lowe (1977, p. 43) collected a "*Hyla eximia wrightorum*" = *Hyla wrightorum* from Plains grassland in northeastern Chihuahua (but at higher elevation [>6,500 ft, 1,980 m] than at Los Fresnos). The Huachuca/Canelo population is similar to other populations of the Arizona treefrog in regard to seasonal or life-stage specific habitat use, breeding phenology, and other ecological or behavioral factors. However, as mentioned in "Habitat/Life History", Holm and Lowe (1995, pp. 22-23) present evidence that frogs in Scotia Canyon breed exclusively in ephemeral ponds, whereas frogs on the Mogollon Rim will breed in both ephemeral and permanent waters (Sredl and Collins 1992, p. 608); but E. Gergus never observed Arizona treefrogs associated with permanent water (Gergus et al. 2005, p. 462). Duellman (2001, p. 985) also reported that the species breeds in both permanent and ephemeral ponds. However, it is unknown if the pattern Holm and Lowe observed in Scotia Canyon holds true at other locales in the Huachuca Mountains, Canelo Hills, and Rancho Los Fresnos; although the species was not found in the

most permanent aquatic sites at Rancho Los Fresnos (U.S. Fish and Wildlife Service 2006a, b, and c).

The differences in ecological setting among the three populations of the Arizona treefrog are significant from an evolutionary perspective. The Huachuca/Canelo population is the only known remaining Madrean Archipelago Arizona treefrog population from wetter and cooler times when mesic woodland habitats and their associated species were more widespread. Pollen samples from Willcox Playa, Arizona, and other lake deposits (Martin 1963a, pp. 439-444), as well as fossil pollen and macrofossils from packrat middens in southern Arizona (Van Devender 1995, pp. 75-95; Van Devender 2000, p. 66) provide evidence that at the height of the last glacial period (~18,000 years before present), valleys in southeastern Arizona likely supported extensive pine and spruce forests that could have served as a bridge for montane flora and fauna to move among what are now montane woodland sky islands separated by grassland and desert communities. During this period, Arizona treefrog populations from the Sierra Madre Occidental and the Mogollon Rim were likely connected via these valleys. About 11,000-13,000 years ago, winter rains decreased and temperatures increased, leading to retreat of montane woodland communities upslope into the mountains where they are found today (Betancourt 2005, p. 45; Van Devender 1995, pp 80-81). Arizona treefrog populations presumably moved upslope with this community, disappearing from the valley bottoms and apparently most mountain ranges, as well. The Huachuca/Canelo population is likely a relict from the last glacial period. This hypothesis regarding the biogeographical history of the Arizona treefrog is consistent with Gergus et al. (2004, p. 767) who found that the three geographic divisions of *H. wrightorum* have likely been evolving independently for approximately the same amount of time (estimated 11,000-700,000 years). A similar biogeographical pattern is likely for other sky island herpetofauna that are today limited to montane woodlands, such as ridge-nosed rattlesnakes (*Crotalus willardi*), mountain spiny lizards (*Sceloporus jarrovi*), and Madrean alligator lizards (*Elgaria kingii*). For instance, a fossil ridge-nosed rattlesnake was found at the Lehner Ranch in the upper San Pedro River Valley, a site which is today semi-desert grassland that is unsuitable as habitat for this species. Molecular sequences of Mountain spiny lizards in southeastern Arizona mountain ranges suggest isolation from each other for tens to hundreds of thousands of years (Kaplan 2002, p. 21), similar to the three divisions of the Arizona treefrog. Similar to the Arizona treefrog, populations of the narrow-headed gartersnake (*Thamnophis rufipunctatus*) occur in the Sierra Madre Occidental and the Mogollon Rim; however, no intervening sky island populations remain (Rossman et al. 1996, pp. 241-248).

In regard to (4) (evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics) and as discussed above under "Condition (1)" for Discreteness, the population differs from other Arizona treefrog populations in its genetic characteristics. Most notably, only the G haplotype has been found in the Huachuca/Canelo population, that haplotype has been found nowhere else, and is one of only seven known for the species. The G haplotype is considered a sister lineage to the other six haplotypes. As such, its loss would represent a significant loss to the genetic diversity of the species. Furthermore, the existence of a single, unique mtDNA haplotype in the Huachuca/Canelo populations indicates a significant history of separation from other Arizona treefrog populations, during which other evolutionarily significant differences are likely to have

evolved.

The loss of the Huachuca/Canelo population would also represent a significant gap in the range of the species (criterion 2) from an evolutionary perspective. The population is intermediate between the Mogollon Rim and Sierra Madrean populations in regard to morphology, vocalizations, and derivation (Mogollon Rim versus Sierra Madrean) of plant species within its habitats. As discussed above, the Huachuca/Canelo population is an apparent relict from the last glacial period. Its loss would represent not only a gap in the range of the species, but also a significant gap in the species' evolutionary history.

In summary, based on three of four criteria we find that the Huachuca/Canelo population of the Arizona treefrog is significant to the taxon *Hyla wrightorum* because (1) it occurs in an ecological setting that is unique to the taxon, (2) it exhibits genetic characteristics that are markedly different from the other two populations and important to the overall genetic diversity of the species, and (3) the loss of this population would represent a significant gap in the range of the species from an evolutionary perspective.

THREATS

The most significant threats to the existence of the Huachuca/Canelo population of the Arizona treefrog are, in order of importance: habitat loss or degradation and direct mortality due to catastrophic fire; loss of populations due to drought or floods, which may be exacerbated by climatic extremes; predation by introduced species; and habitat degradation caused by livestock grazing, off-highway vehicles, and environmental contamination. The effects of these threats are exacerbated by small population sizes and low genetic diversity. Threats are summarized in Table 1.

Table 1: Threats Summary

Stresses – Altered Key Ecological Attributes	**Severity**	**Scope**
Habitat loss or degradation due to catastrophic fire	Very High	High
Habitat loss or degradation due to drought and floods	High	Very High
Habitat loss or degradation due to livestock grazing	Moderate	Moderate
Habitat loss or degradation due to off-highway vehicles	Very High	Low
Predation by	High	Medium

introduced species		
Habitat loss or degradation due to contaminants	Medium/Low	High
Small population sizes and low genetic diversity	High	Very High

A. <u>The present or threatened destruction, modification, or curtailment of its habitat or range</u>.

Catastrophic Wildfire

The greatest threat to the Huachuca/Canelo population in Arizona is catastrophic wildfire and subsequent erosion, sedimentation, and ash flow through the habitats of this frog. Fire frequency and intensities in southwestern forests are much altered from historical conditions (Dahms and Geils 1997, pp. 34-35). Before 1900, surface fires generally occurred at least once per decade in montane forests with a pine component. Beginning about 1870-1900, these frequent ground fires ceased to occur due to intensive livestock grazing that removed fine fuels coupled with effective fire suppression in the mid to late 20th century that prevented frequent, widespread ground fires (Swetnam and Baisan 1996, pp. 20-25). Absence of ground fires allowed a buildup of woody fuels that precipitated infrequent but intense crown fires (Swetnam and Baisan 1996, Danzer et al. 1997, pp. 30-33). Lack of vegetation and forest litter following intense crown fires exposed soils to surface erosion during storms, often causing high peak flows, sedimentation, and erosion in downstream drainages (DeBano and Neary 1996, pp. 70-75). As an example, leopard frogs (either Chiricahua or Ramsey Canyon leopard frogs) apparently disappeared from Miller Canyon in the Huachuca Mountains following the 1977 Carr Peak Fire in the upper canyon and subsequent erosion and scouring of the canyon during storm events (67 FR 40802). Leopard frogs were historically known from many localities in the Huachuca Mountains; however, natural pools and ponds are now largely absent and the only breeding leopard frog populations occur in artificial tanks and ponds. The absence of pool and pond leopard frog habitats may be due in part to post-fire erosion and sedimentation. Bowers and McLaughlin (1994, pp. 137-139) compiled a flora of the Huachuca Mountains, but could not locate six riparian plant species that had been found by previous investigators (*Dryopteris filix-mas, Aster coerulescens, Monarda fistulosa, Oenothera kunthiana, Rubus arizonensis,* and *Glyceria borealis*). They believed these species might have been eliminated from the Huachuca Mountains as a result of floods and debris flow following destructive fires. They also noted catastrophic declines of *Lilium parryi* as a result of recent flooding. These observations provide further evidence of the currently degraded conditions in montane canyons of the Huachucas, and highlight the threats to Arizona treefrogs from post-fire flooding, erosion, and sedimentation.

Of the southeastern Arizona sky island mountain ranges, the Huachucas have been relatively hard hit by recent catastrophic wildfire (Table 2). Most of these fires have burned in the southern portions of the range. Fort Huachuca has established numerous fire breaks on ridgelines and between the grasslands and the mountains, which keeps the size of wildfires there relatively small.

Table 2: Major[1] wildfires from 1977 to the present within the range of the Huachuca/Canelo population of the Arizona treefrog

Wildfire/Year	Acres/Hectares	Location	Treefrog Habitat Affected?
Carr Peak Fire 1977	9,800/3,970	Carr and Miller canyons	Yes
Peak Fire 1988	3,700/1,500	Coronado Memorial, Ash Cyn	No
Miller Fire 1994	2,950/1,190	Hunter, Miller canyons, east side	Yes
Ryan Fire 2002	38,000/15,400	Canelo Hills and adjacent areas	No
Merritt Fire 2002	2,650/1,070	Merritt and adjacent canyons, west side of Huachuca Mtns.	No
Oversite Fire 2002	2,189/887	Oversite, Miller, Ramsey and adjacent canyons	Yes
103 Fire 2006	1,778/720	Ash and Copper canyons, Coronado National Memorial	No
Montezuma I Fire 2006	3,939/1,595	SE San Rafael Valley on both sides of the border	No

[1] Only fires of 1000/405 acres/hectares or more are listed. Small fires, often no more than an acre or two, are not uncommon, but are typically suppressed rapidly or burn out on their own.

Many wildfires are started by people, including campfires that escape containment, discarded cigarettes, catalytic converters, and other sources. However, fires also start as a result of lightning, particularly at the beginning of the monsoon season when "dry" lightning strikes precede storms. The Huachucas receive much use by illegal immigrants and smugglers, some of whom start fires. The population of Sierra Vista and adjacent areas east of the Huachuca Mountains is rapidly growing. The 1980 population of Sierra Vista and Fort Huachuca was 24,937, but grew to 38,740 in 2001. In 2000, an additional 14,348 people lived in the unincorporated area south of Sierra Vista (City of Sierra Vista 2002, pp. 2-3). Development is occurring to the eastern base of the mountains and into the eastern canyons. Development and associated recreational use increase the likelihood of fire starts.

The effects of these fires on habitat and thus on the Huachuca/Canelo population have not been studied, although some fires have burned through areas where the species has been reported, or through the watersheds of those localities. The 2002 Oversite Fire burned through portions of Oversite Canyon, which is a locality for the treefrog. We are not aware of any recent surveys for the frog in that canyon, nor of any observations of the species there since Holm and Lowe (1995) reported it there. We discussed effects of the 1977 Carr Peak Fire in the upper portions of Miller Canyon on leopard frogs. Effects to treefrogs are unknown, but the species still persists in the south fork of Miller Canyon. The Miller Fire in 1994 and the 2002 Oversite Fire also burned in Miller Canyon. The 2002 Merritt Fire burned through or close to the locality in a tributary to Scotia Canyon/Hannah Tank.

Although the effects of wildfire on populations of the Arizona treefrog have not been studied, apparent loss of pool habitats, leopard frogs, and riparian plant species, as well as observations

of scouring in canyon bottoms (Taylor 1991, e.g. pp. 9, 10, 12, 15, 16, 18, 20, and 54) suggest that treefrog populations are at risk of post-fire flooding, erosion, scouring, and sedimentation impact that have and are expected to continue to destroy or modify habitat, at least in montane habitats. Where precise localities for breeding populations are known, all U.S. populations are in canyon bottoms that are particularly susceptible to post-fire events.

Another consequence of altered fire regimes in the sky islands has been invasion of trees into wet meadows (Bahre 1991, p. 184). Livestock grazing and a lack of frequent ground fires has allowed germination and growth of conifers into meadows that were historically kept free of trees by fire. This invasion combined with post-fire scouring and sedimentation of canyon bottoms where the meadows occurred likely reduced habitat for Arizona treefrogs, which are often found in boggy meadow or cienega situations.

Amphibians can also be directly affected by the heat and smoke of wildfire. During the pre-monsoon period when fire danger is greatest, Arizona treefrogs are probably in the uplands in rock outcrops, under logs or debris piles, or in other cover. Many of these locations are susceptible to fire, and smoke and heat may kill frogs in rock outcrops. If the frogs are at water or breeding, smoke diffusion into water and ash flow can result in high levels of phosphorus and nitrogen (Spencer and Hauer 1991, pp. 24-30) with potentially toxic effects to frogs and tadpoles. Suppression activities may also affect frogs via fire retardants. Each year, millions of gallons of fire retardants and suppressants are broadly applied aerially and from the ground to wildlands in the Western United States. Contamination of aquatic sites can occur via direct application or runoff from treated uplands. These chemicals are ammonia-based, which in itself can be potentially toxic; however, many formulations also contain yellow prussiate of soda (sodium ferrocyanide), which is added as an anticorrosive agent. Such formulations are toxic to a variety of aquatic and other organisms, including frogs. Toxicity of these formulations is typically found to be low in the laboratory, but in the field toxicity to the southern leopard frog (*Lithobates sphenocephala*) and rainbow trout has been found to be photoenhanced by ambient UV radiation (Calfee and Little 2003, pp. 1529-1533).

Garden Canyon is a location where Arizona treefrogs were found in 1998. General Wildlife Services (undated, pp. 96-97) suggest that Garden Canyon "is perhaps primed for a catastrophic fire that could lead to major erosion and debris flow on the mid-elevations of the watershed and possible flooding and channel scouring in the lower drainage." They note that there have been no recent fires on the Garden Canyon watershed, fuels are relatively dense, the watershed probably has a deep "regolith" (a layer of loose, heterogeneous material covering solid rock) available for debris flow, and the watershed is large enough to collect a sizeable runoff from a major storm event. Fort Huachuca has begun fuels management in Garden Canyon, but the area is still at risk.

Arizona treefrogs are extant in Scotia Canyon, which is another area that has not burned in recent years, and could burn catastrophically. Sky Island Alliance, the Coronado National Forest, U.S. Fish and Wildlife Service, and Arizona Game and Fish Department have submitted a proposal to the Arizona Water Protection Fund to restore cienega conditions and remove bullfrogs from the canyon, including long-term planning for fuels management. But even if

funding is available, it will likely be several to many years before a plan can be developed, all compliance can be completed, and projects implemented on the ground to protect the area from most catastrophic fires. These projects take time and much coordination to plan and execute.

The Greater Huachuca Mountains Fire Management Group, a coalition of public land managers, land owners, and private partners, has prepared a fire management plan for the Huachuca Mountains and surrounding areas. Their objective is cross-jurisdiction collaboration on wildland fire use, suppression of unwanted fire, prescribed fire, and non-fire means to reduce fuels. The Coronado National Forest, Fort Huachuca, and The Nature Conservancy have begun prescribed fires and fuel reduction projects to reduce the likelihood of catastrophic fire. The plan is a voluntary collaboration among private and public partners, but does not take the place of individual agency planning efforts or authorities. The plan is not funded and is not a decision document, but rather is a framework for collaboration and a spring board for obtaining fire and fuels management funding by the partners in the plan. Because of limited funding, the thousands of acres needing treatment (the planning area is 500,000 acres/202,500 hectares), the extensive coordination and compliance needed for each project, and inadequacy of funding and other resources to treat all areas in a short period of time, it will likely be many years before the plan is fully implemented and the area is protected from most catastrophic fires. Until this or other similar planning efforts are implemented, habitats of the Arizona treefrog will continue to be at risk.

Livestock Grazing

Arizona treefrogs are typically found in well-vegetated wetlands. Eggs are usually attached to vegetation or debris in the water. Livestock can remove shoreline or aquatic vegetation through browsing or trampling. Livestock could also trample tadpoles or eggs. Trampling of other anuran species by livestock has been documented (Bartelt 1998, p. 96; Ross et al. 1999, p. 163). Predatory fishes and bullfrogs may be more efficient at preying upon treefrogs at sites where cover is absent or scarce as would be the case in heavily grazed areas. In addition, Arizona treefrogs could potentially be adversely affected by degraded water quality caused by cattle urine and feces. A die-off of Chiricahua leopard frogs (*Lithobates chiricahuensis*) at a site in the Chiricahua Mountains was attributed to cattle-associated water quality problems, and the species has been extirpated from the site since the die-off occurred (Sredl et al. 1997, p. 18; U.S. Fish and Wildlife Service 2002a, p. 40801). Larval frogs may be particularly susceptible to nitrogenous compounds that can be associated with grazing (Schepers and Francis 1982, pp. 351-354; Boyer and Grue 1995, pp. 353-356). Toxicity could result from high concentrations of un-ionized ammonia (Schuytema and Nebeker 1999, pp. 2252-2256), particularly in combination with primary-production induced elevation in pH. Livestock grazing currently occurs in and near populations of the Arizona treefrog on the Coronado National Forest, but is excluded from Fort Huachuca and Rancho Los Fresnos.

Grazing activities may benefit the Arizona treefrog if ranchers maintain stock ponds that are suitable for breeding by treefrogs. The pond in Scotia Canyon where the frogs breed is a livestock impoundment. However, in Scotia Canyon the frogs only breed in that particular pond, which is ephemeral. The other four impoundments do not support breeding, presumably because they are perennial. Collins (1994, pp. 5-6) suggested earthen stock tanks constructed to increase

water permanency often allow invasion of predators that decrease the suitability of wetland habitats for Arizona treefrogs. Consistent with that hypothesis, the perennial impoundments in Scotia Canyon have allowed invasion and breeding by bullfrogs, which now threaten the treefrog population. No grazing occurs in Garden, south of Scheelite, or Huachuca canyons (Fort Huachuca); however, all other sites are grazed at least seasonally. Whiner and Hannah tanks, both treefrog localities, are also cattle waters. In August 2005, Whiner Tank lacked aquatic vegetation and marshy conditions characteristic of Arizona treefrog habitat, apparently due in part to livestock grazing and trampling of the shoreline of the tank. No treefrogs were found at the site (Rorabaugh 2005).

Off-highway Vehicles

For many years, Scotia and Gardner canyons have been popular with off-highway vehicle enthusiasts because of the rugged nature of the roads. Until the late 1990s, it was possible to drive from Sierra Vista through Garden Canyon and over the crest of the mountain into and through Scotia Canyon. This route was rough and challenging. Some drivers would take the opportunity to drive through muddy livestock tanks and impoundments along the route in mud bog fashion. In the late 1990s Fort Huachuca closed Gate #7 at the crest of the mountain to prevent vehicle passage and also lined upper Garden Canyon pond with boulders to prevent off-highway vehicles from driving through it. This has probably reduced vehicle use in adjacent Scotia Canyon, but off-highway vehicle enthusiasts still drive into Scotia Canyon from the west (Rorabaugh 2007). In April 2005, we observed vehicle tracks through the ephemeral pond in Scotia Canyon where the treefrogs breed. If such activity occurred during the breeding season, frogs, egg masses, and tadpoles could be crushed, and eggs and tadpoles could be buried or smothered in mud or turbid waters.

Airborne Pollutants and Acidic Rainfall from Copper Smelters

Precipitation collected in 1984-5 in southeastern Arizona had a depth-weighted mean pH of 4.63 and carried high levels of sulfate, arsenic, cadmium, copper, lead, and zinc. High acidity and sulfate concentration occurred when upper-level winds were from the directions of copper smelters, particularly those at Douglas, Arizona, and Cananea, Sonora (Blanchard and Stromberg 1987, pp. 2376-2381). Hale and Jarchow (1988, pp. 25-37) suggested that cadmium resulting either from airborne sources or leached from streamside rocks or soils by acidic rainfall may have contributed to the decline of the Tarahumara frog (*Lithobates tarahumarae*) in southern Arizona. Stock tanks with pHs of less than four were noted in the late 1990s on the western slope of the Huachuca Mountains, which is near the smelter at Cananea (U.S. Fish and Wildlife Service 2002a, pp. 40804). No data on acid tolerance is available for the Arizona treefrog, but the LC_{50} (the concentration of the chemical in air that kills 50% of the test animals in a given time) for the similar Pacific treefrog is a pH of 4.3 (Bradford et al. 1994, pp. 156). These results suggest that precipitation may have been acid enough to affect Arizona treefrog survival at some sites. Small aquatic systems, such as stock tanks, which could be swamped by runoff during heavy rainfall events, are most likely to be affected. The smelters at Douglas and Cananea are now closed, thus we would expect a reduction or cessation of contaminant laden or acidic rainfall. How long it might take for residual elevated levels of cadmium, arsenic, and other smelter-related contaminants in the environment to disperse is unknown.

B. Overutilization for commercial, recreational, scientific, or educational purposes. We are not aware of overutilization of the Huachuca/Canelo population of the Arizona treefrog. As discussed above under "Condition (2)" of "Discreteness", ten Arizona treefrogs may be collected or in possession, live or dead, per person annually under a fishing or combination hunting/fishing license. Although it is an attractive treefrog (Figure 1), we are not aware of it being particularly collectable by amphibian enthusiasts. Anglers may occasionally collect frogs for bait, which, given the typically small populations of this species in the Huachucas and Canelo Hills, could be detrimental to population viability. Stebbins (1966, p. 70) noted a collection of an Arizona treefrog outside of its range on the lower Colorado River at Picacho, Yuma County, Arizona. He attributed this record to escaped fish bait. Use of treefrogs as live bait in the Huachuca/Canelo area is prohibited by Arizona Game and Fish Commission regulations.

C. Disease or predation. Predation by nonnative organisms such as American bullfrogs, sport fishes, and crayfish are a serious threat to many native amphibians in the western USA, including the threatened Chiricahua leopard frog (U.S. Fish and Wildlife Service 2002a, pp. 40802-40803), endangered Sonora tiger salamander (U.S. Fish and Wildlife Service 2002b, pp. 8-9), and others (see reviews in Rosen and Schwalbe 2002 and Keisecker 2003). Effects of nonnatives may extend beyond predation to resource competition, spread of infectious diseases, and changes in habitats and habitat use by native amphibians. These effects are often exacerbated by anthropogenic habitat alteration (Keisecker 2003, pp. 123-125).

Bullfrogs are voracious, opportunistic predators that will eat most anything that moves and will fit into their large mouths. In their review, Casper and Hendricks (2005, pp. 544) noted nine species of frogs and toads in the recorded diet of the bullfrog, including spring peepers (*Pseudacris crucifer*) and the eastern gray treefrog (*Hyla versicolor*), both of which are similar to the Arizona treefrog in size and behaviors. Holm and Lowe (1995, pp. 26) noted that predation by bullfrogs is a potential threat to the Arizona treefrog population in Scotia Canyon because of the close proximity of a breeding bullfrog population to the pond where Arizona treefrogs breed. However, in general, Arizona treefrogs breed in shallower, more ephemeral waters than those frequented by bullfrogs, and thus are less likely to be the victims of bullfrog predation than, for instance, native leopard frogs. In addition to Scotia Canyon, bullfrogs are known from Hannah Tank, but also from lower Garden Canyon and Turkey Creek near Canelo at or near Arizona treefrog localities. Bullfrogs are widespread at Rancho Los Fresnos, but have not been found specifically in the same habitats as Arizona treefrogs.

Again, because Arizona treefrogs typically use shallow, ephemeral aquatic habitats for breeding, they are also less susceptible to predation by introduced crayfish (crayfish are not native to Arizona) and introduced fishes, such as mosquito fish (*Gambusia affinis*), green sunfish (*Lepomis cyanellus*), bluegill sunfish (*Lepomis macrochirus*), black bullheads (*Ameirus melas*), and largemouth bass (*Micropterus salmoides*), all of which have been found in the San Rafael Valley or the Huachuca Mountains (U.S. Fish and Wildlife Service 2002b, pp. 8-9). Green sunfish are widespread, and black bullhead occur locally, in permanent waters at Rancho Los Fresnos (U.S. Fish and Wildlife Service 2006a, p. 2-4; U.S. Fish and Wildlife Service 2006b, pp. 2-3; U.S. Fish and Wildlife Service 2006c, p. 5). Crayfish occur in several drainages and streams in the area, including Bear Canyon, Garden Canyon, at Parker Canyon Lake, and at

several localities at Rancho Los Fresnos. Crayfish have also been documented at Hannah Tank (Arizona Game and Fish Department Heritage Data Management System 2005, p. 1). Although the habitats used by Arizona treefrogs are not preferred by these nonnative predators, any elevated predation levels could threaten the small breeding aggregations (2-30 breeding adults) characteristic of the Huachuca/Canelo population.

Fernandez and Rosen (1998, p. 5) compared streams with and without introduced crayfish and found that, in the former, snails were eliminated, leopard frogs were eliminated or rare, and the diversity and biomass of aquatic plants and native invertebrates was significantly reduced. Laboratory studies suggested that crayfish caused these changes. Crayfish are often central components of freshwater ecosystems, and may be dominant consumers of invertebrates, detritus, and aquatic plants; while also serving as prey for fishes. Thus, their presence can cause large changes in fish populations and aquatic biodiversity (see review in Lodge et al. 2000, pp. 8-15), with potential repercussions to treefrog populations.

Arizona treefrog tadpoles with deformed rear limbs and erratic swimming behaviors were collected in Navajo County, Arizona, in 1998 (Healy and Sredl 1999, p. 1). These collections are similar to those from a variety of anuran species and locales in North America, particularly over the last 15 years (Johnson and Lunde 2005, pp. 124-128). For example, at two ponds in northern California, 10–25 percent of larval and post-metamorphic Pacific treefrogs exhibited abnormalities; and of those, more than 60 percent were severe malformations involving extra hindlimbs, femoral projections, and skin webbings that probably reduced survivorship (Johnson et al. 2001, pp. 336-352). The cause or causes of the Arizona deformities are unknown, but UV-B radiation, retinoid exposure, genetic mutation, pesticide contamination, predation, microbes, and trematode parasites can result in limb deformities such as those observed (see Van Valen 1974, , Sessions et al. 1999, pp 800-801; Johnson et al. 2001, pp. 336-352). In the western United States, deformities are often associated with infections of a trematode (*Ribeiroia ondatrae,* Johnson and Lunde 2005, p. 124). Dispersal of the trematode is likely enhanced by human introductions of nonnative bullfrogs and fishes, which can be trematode vectors, and transportation of snails, which are an intermediate host of the trematode. Creation of cattle ponds, impoundments, and reservoirs has likely benefited the snail host. Furthermore, cattle ponds are often eutrophic and harbor dense, healthy populations of snails with a greater potential for *Ribeiroia* infections of resident frogs (Johnson and Lunde 2005, pp. 133-136). Deformations resulting from trematodes or other causes are a potential threat to the Huachuca/Canelo population, but have not been documented to date.

Chytridiomycosis, an apparently introduced fungal skin disease, has affected viability of anuran populations in the Southwest and around the globe (Bradley et al. 2002, pp. 206-207; Weldon et al. 2004, p. 2100). The disease is known from four populations of the Ramsey Canyon leopard frog (*Lithobates chiricahuensis*, formerly *L. subaquavocalis*) on the eastern slope of the Huachuca Mountains (Ramsey Canyon Leopard Frog Conservation Team 2006; p. 28); however, it is not known whether the Huachuca/Canelo population of the Arizona treefrog contracts the disease or is affected by it. Adult Arizona treefrogs from the Mogollon Rim generally appear to avoid infection by the disease in the wild, but can be infected in the laboratory (Miera et al. 2005, p. 19).

D. The inadequacy of existing regulatory mechanisms.

ARIZONA. As discussed above, under Arizona Game and Fish Commission rules, ten Arizona treefrogs may be collected or in possession, live or dead, per person annually under a fishing or combination hunting/fishing license. Given the small observed size of breeding populations (2-30 frogs), collection to legal limits could decimate a population. Introduction of nonnative fishes, bullfrogs, and crayfish into the habitats of this frog are constrained by prohibitions on the use of live bait in the range of this frog. Live fish, frogs, and tiger salamanders are prohibited as live bait. Use of live crayfish as bait in the range of this frog is prohibited except for live crayfish used at the place of capture. The Lacey Act (16 U.S.C. 3371 *et seq*.), as amended in 1982, tends to reinforce the State regulations. This Act prohibits the import, export, sale, receipt, acquisition, purchase, and engagement in interstate or foreign commerce of any species taken, possessed, or sold in violation of any law, treaty, or regulation of the United States, any tribal law, or any law or regulation of any State.

Most or all U.S. populations of the treefrog in the Huachuca/Canelo area are on Federal lands. The Huachuca, Garden, and south of Scheelite canyon localities are on Fort Huachuca, all other specific localities (Robber's Roost and "Miller Canyon" are the exceptions) are on the Coronado National Forest. The Federal Land Policy Management Act of 1976 (FLPMA, 43 U.S.C. 1701 *et seq*.) and the National Forest Management Act of 1976 (NFMA, 16 U.S.C. 1600 *et seq*.) direct Federal agencies to prepare programmatic-level management plans to guide long-term resource management decisions. Wetland values and water quality of aquatic sites inhabited by the Arizona treefrog are afforded varying protection under the Federal Water Pollution Control Act of 1948 (33 U.S.C. 1251-1376), as amended; and Federal Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands). In addition, the Forest Service is required to manage habitat to maintain viable populations of existing native and desired nonnative vertebrate species in planning areas (36 CFR 219.19).

The National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321-4370a) requires Federal agencies to consider the environmental impacts of their actions. NEPA requires Federal agencies to describe the proposed action, consider alternatives, identify and disclose potential environmental impacts of each alternative, and involve the public in the decision-making process. Federal agencies are not required to select the alternative having the least significant environmental impacts. A Federal action agency may select an action that will adversely affect sensitive species provided that these effects were known and identified in a NEPA document. Most actions taken by the Forest Service and Fort Huachuca, or other Federal agencies that may affect the Arizona treefrog, are subject to the NEPA process.

In compliance with FLPMA and NFMA, the Coronado National Forest prepared a Forest Plan in 1986 to guide management on the forest. An objective within the Plan is maintenance of viable populations of all native species through improved habitat management. The Forest Plan further designates management indicator species, but the Arizona treefrog is not among them. Fort Huachuca recently adopted an Integrated Natural Resource Management Plan (INRMP). In regard to management of amphibians and reptiles, the INRMP adopts the recommendations of

Sredl and Wallace (2000, pp. 19-22), which has specific recommendations for management of Arizona treefrogs. These recommendations include monitoring of populations, maintenance of habitats, removal of nonnative species, buffering of habitats from catastrophic fires, reduction of OHV impacts, environmental education and outreach, and research. The INRMP also addresses wetland protection, water quality, fire protection and suppression, environmental education and public regulations, and other management issues that are important to conservation of Arizona treefrogs.

The Huachuca/Canelo population receives some protection incidental to management and protection of other species listed as threatened or endangered under the Act. The endangered Huachuca water umbel (*Lileaopsis schaffneriana* var. *recurva*) and its critical habitat overlap the distribution of the frog in Scotia Canyon. Management and conservation that benefits the water umbel and its habitat are likely to also benefit Arizona treefrogs. Arizona treefrogs also occur with the endangered Sonora tiger salamander at Whiner and Hannah tanks. Again, management that benefits tiger salamanders and their habitat will often enhance habitat for Arizona treefrogs (although tiger salamanders are likely predators of Arizona treefrogs). Efforts to protect the woodland habitats (including critical habitat) of the threatened Mexican spotted owl (*Strix occidentalis lucida*), such as suppression of catastrophic fire, fuels management, and the development and implementation of the Huachuca Mountains Fire Plan, also benefit Arizona treefrogs.

Arizona Game and Fish Department included the Huachuca/Canelo population of the Arizona treefrog on their draft list of species of concern (Arizona Game and Fish Department 1996); however, this designation affords no legal protection to the species or its habitat. State of Arizona Executive Order Number 89-16 (Streams and Riparian Resources), signed on June 10, 1989, directs State agencies to evaluate their actions and implement changes, as appropriate, to allow for restoration of riparian resources. Implementation of this regulation may reduce adverse effects of some State actions on the habitat of the treefrog.

The protection afforded by these and other laws and regulations discussed herein have reduced some threats and increased protection of the Huachuca/Canelo population of the Arizona treefrog in the United States. However, significant threats to the Huachuca/Canelo population remain, particularly in regard to catastrophic wildfire as well as climate change and climatic extremes that exacerbate the dynamics of small populations; these factors are not especially responsive to regulatory mechanisms.

SONORA: The Arizona treefrog is not listed as a threatened or endangered species in Mexico (SEMARNAT 2001), and is thus not protected by law. However, Rancho Los Fresnos is owned and managed by Naturalia, a Mexican environmental non-governmental organization dedicated to conservation of biodiversity and rare species. Grazing was conservative on the ranch for many years, and recently Naturalia removed all cattle from the ranch. The grasslands and associated ciénegas are in exceptionally good condition. So, although no laws or regulations protect the species, the management policies of Naturalia provide substantial protection to the frog's habitat.

E. Other natural or manmade factors affecting its continued existence.

Dynamics of Small Populations: Observed breeding populations of the Huachuca/Canelo population in Arizona are typically only 2-30 frogs (Gergus et al. 2005, p. 462). Only individual frogs were found at Rancho Los Fresnos (U.S. Fish and Wildlife Service 2006a-c). Small populations are subject to extirpation from random variations in such factors as the demographics of age structure or sex ratio, and from disease and other natural events (Wilcox and Murphy 1985, p. 881). Inbreeding depression and loss of genetic diversity may also occur in small populations of less than a few hundred individuals; such loss may reduce fitness and the ability of the population to adapt to change (Soule and Wilcox 1980, pp. 135-149). Both of these genetic considerations result in an increased likelihood of extirpation (Lande and Barrowclough 1987, pp. 87-123). Gergus et al. (2004, p. 766) found a single, unique haplotype in the Huachuca/Canelo population and suggested that this lack of diversity has resulted from the isolated nature and small population sizes exhibited by the population. The authors also found that of the three geographic groupings of the Arizona treefrog (Mogollon Rim, Huachuca/Canelo, and Sierra Madre), the Huachuca/Canelo population exhibited the lowest genetic diversity (the lowest heterozygosity and lowest percentage of polymorphic loci). These findings heighten our concern that small populations and low genetic diversity may pose a risk to the Huachuca/Canelo population.

Arizona treefrog populations in some areas (e.g., Rancho Los Fresnos) likely form metapopulations where interchange among populations occurs. If a local population within a metapopulation goes extinct, it can be recolonized from an adjacent local population, if habitat remains suitable. The dispersal abilities of Arizona treefrogs are unknown; however, these small frogs are probably not able to move long distances overland through dry terrain. Species accounts for all Hylid frogs in the U.S. were compiled by Lannoo (2005), which include discussions of migrations and movements. Although movements of small frogs are difficult to study, no movements greater than one mile (1.7 km) are described in those accounts. Based on this information, the Rancho Los Fresnos populations or metapopulation are likely isolated from those in Arizona. Within Arizona, some populations, such as those in Scotia and adjacent Gardner and Sunnyside canyons may form a metapopulation. However, others such as at Canelo, are probably isolated. If isolated populations go extinct, they are not likely to be recolonized via immigration because of their isolation.

Climatic Extremes: Mean annual temperatures rose 2.0-3.1 ^{0}F (1.1-1.7 ^{0}C) in the American Southwest in the 20th century, and are predicted to rise 8.1-11.0 ^{0}F (4.5-6.1 ^{0}C) in the 21st century. Predictions of changes in precipitation are less certain; however, some models predict as much as a doubling of annual precipitation, with the largest increases in winter precipitation (Southwest Regional Assessment Group 2000, p. 15). But these predictions contrast with current trends of a warming North Atlantic and cooling tropical Pacific, with associated changes from a relatively wet period to drought, insect outbreaks in Southwestern forests, and increasing wildfires (Patterson 1997, pp. 1-2; Betancourt 2005, p. 45). Some models predict dramatic changes in Southwestern vegetation communities as a result of climate change (Thompson et al. 1997, p. 7). Climate change can occur abruptly, with associated major changes in the environment (NAS 2002, p. 1-9).

The summer drought and delayed monsoon in 1993 apparently resulted in a lack of breeding by Arizona treefrogs in Scotia Canyon (Holm and Lowe 1995, p. 26). The longevity of Arizona treefrogs is unknown (Gergus et al. 2005, p. 463), but if similar to other North American treefrogs, most individuals likely do not live longer than a few years (see species accounts in Lannoo 2005). Thus, populations could be at risk of extended summer drought. Perhaps of more concern is the possible increased likelihood of fire and vegetation community type changes as a result of drought and related insect outbreaks and fire. Devastating crown fires and insect outbreaks over the last decade are altering the woodland communities atop the southeastern Arizona sky islands. The mixed conifer and subalpine forests in the Pinaleno, Santa Catalina, and Santa Rita mountains of southeastern Arizona, in particular, have been devastated recently by these events and it will be centuries before these communities fully recover (if they recover). The high elevation forests of the Huachuca and Chiricahua mountains have also been affected. As discussed, with warmer, drier conditions over the past 11,000-13,000 years, the Huachuca/Canelo population and other montane woodland species have retreated upslope and are now primarily isolated on the mountains of southeastern Arizona where mesic woodlands have persisted (the species also persists in grassland ciénegas at Rancho Los Fresnos, as well). However, additional warming and drying resulting from climate change or climatic extremes, with associated insect outbreaks and fire could further reduce or eliminate these relict mesic woodland communities, as dramatically shown in the Pinaleno and Santa Catalina mountains. A similar scenario of mesic montane faunal loss was documented in the mountains of Costa Rica, where 40 percent of the amphibian species were decimated in the late 1980s and early 1990s during which the dry season became warmer and drier, and the mists associated with the cloud forest moved upslope (Pounds and Crump 1994, pp. 80-83; Pounds et al. 1999, pp. 611-615). Frogs dependent on water for breeding were most affected (Pounds et al. 1999, pp. 613-615), and in addition to the amphibian decline, two species of lizards disappeared and 15 species of birds shifted their distributions upslope where conditions were wetter (Still et al. 1999, pp. 608-610). Reaser and Blaustein (2005, p. 61) hypothesized that amphibian populations most at risk due to climate change are those that: 1) are already at the upper limit of their physiological tolerance to temperature and/or dryness, 2) depend on small, ephemeral wetlands, and/or 3) are bound by barriers to dispersal. The Huachuca/Canelo population of the Arizona treefrog breeds in small, ephemeral wetlands located in relatively mesic, relict montane woodlands and valley ciénegas. The only likely barriers to treefrog dispersal are arid environments, but if increasingly arid and warm conditions persist or worsen, relictual mountain top moist forests and ciénegas may decline or disappear leaving no place to which the frogs can disperse or establish new populations.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

Sredl and Wallace (2000, pp. 19-22) recommended protective management actions and monitoring for this species on Fort Huachuca, which were adopted by the Fort in their INRMP. These recommendations should help protect the species at the three known localities and any other localities at which the frog may be found on Fort Huachuca. The Greater Huachuca Mountains Fire Management Group has developed a fire management plan for the Huachuca Mountains area, including the range of the Huachuca/Canelo population. Once implemented, it

is expected to reduce the likelihood of catastrophic fire through cross-jurisdiction collaboration on wildland fire use, suppression of unwanted fire, prescribed fire, and non-fire means to reduce fuels. However, it will likely be many years before the risk of catastrophic fire will be significantly reduced through this or other planning efforts. In 2005 and 2006, we applied with other partners for a grant from the Arizona Water Protection Fund to restore ciénega conditions in Scotia Canyon, including removal of bullfrogs. Long-term planning also included fire management. This project would have lessened some threats and helped protect the Arizona treefrog population in that canyon; however, the proposal was not funded. We intend to seek funding from other sources. No other management or conservation planning specifically targeting this species has occurred. See "Inadequacy of Existing Regulatory Mechanisms" for additional information.

SUMMARY OF THREATS

ARIZONA: There is no firm evidence that the frog has disappeared from any of the three general localities from which it is known in Sonora or its 13-16 known localities in Arizona, but in the last 10 years it has only been observed at eight sites in Arizona. Breeding populations are small (2-30 adults observed per site), and the species uses a specialized habitat for breeding, which in Arizona is typically located in canyon bottoms subject to post-fire flooding, scouring, ash flow and sedimentation. Although no extirpations of the frog are known to have been caused by such events, several fires have burned through the habitats of this frog in recent years, and populations of wetland plants and leopard frogs have apparently been eliminated due to post-fire events. In recent years, warm, dry conditions and associated insect outbreaks and fires have resulted in dramatic changes in high elevation southeastern Arizona sky island woodlands. Scientists predict a continued warming trend, which may result in further drying and degradation of the woodlands where this frog occurs in Arizona. The frog also faces risks from nonnative predators, such as bullfrogs and crayfish, as well as impacts to habitat and populations from OHV activities, livestock grazing, and potentially contaminants and low pH due to historical airborne emissions from nearby copper smelters. Small breeding populations, low genetic diversity, and, in some cases, lack of metapopulation structure make the Huachuca/Canelo population particularly sensitive to these threats.

SONORA: The three known localities in Sonora occur on a ranch protected from many threats by the landowner. The localities are in plains grasslands, rather than montane canyons, so threats due to wildfire and subsequent scouring and sedimentation are much reduced. The primary threat to Sonoran populations are likely non-native predators, which may limit the frog to ephemeral wetlands, drought and warming trends that could reduce the suitability of those ephemeral wetlands as breeding sites, and the dynamics of small populations. In Sonora, the Arizona treefrog may have been affected in recent times by airborne emissions from copper smelters.

For species that are being removed from candidate status:

____Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

RECOMMENDED CONSERVATION MEASURES: Sredl and Wallace (2000, pp. 19-22) and Fort Huachuca's INRMP contain management recommendations for conservation of Arizona treefrogs at Fort Huachuca. These recommendations include monitoring of populations, maintenance of ephemeral pond habitats, keeping habitats free of nonnative predators, buffering habitats from catastrophic fire, reducing potential for OHV and other recreational impacts to treefrogs, education and outreach, and research. Specific monitoring protocols need to be developed for this species. Other conservation measures not specific to the Arizona treefrog, but which could benefit the species, are included in the INRMP. These recommendations could be adapted and expanded to sites on the Coronado National Forest. Livestock grazing should also be addressed, as grazing does not occur on Fort Huachuca and therefore was not addressed by Sredl and Wallace or in the INRMP. Funding to implement the Huachuca Mountains Fire Plan and restore habitats in Scotia Canyon could also be an important part of reducing the threats to this population.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	**Imminent**	Monotypic genus	1
		Species	2
		Subspecies/population	3*
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: Because only 13-16 known localities are known in Arizona (all of which are small and localized and only eight of which have yielded observations of frogs in the past decade), observed breeding populations of 2-30 individuals, and threats due to catastrophic wildfire, drought, floods, and climatic extremes; nonnative predators; and other factors; the threat magnitude for the Huachuca/Canelo population in Arizona is high. In particular, a large catastrophic wildfire atop the Huachuca Mountains, such as those that have recently occurred in the Pinaleno, Santa Rita, and Santa Catalina mountains, could result in loss of a majority of

populations through post-fire flooding, scouring, sedimentation, and ash flow. Frogs could also be killed directly by such fires. The small populations and their locations in canyon bottoms make them especially susceptible to fire effects. In Arizona, introduced predators occur with Arizona treefrogs at two or more sites and are a threat at several other localities. Other factors, including contaminants and low pH, low genetic diversity, OHV activities, and livestock grazing, also threaten the Huachuca/Canelo population. Existing regulatory mechanisms are not effective in controlling the most serious threats. Although planning is underway to manage fire in the Huachuca Mountains, it will likely be many years before the potential effects of catastrophic fire are significantly reduced.

Populations in Sonora are probably more robust to some threats, such as fire; however, only a few individuals have been found in three areas of Rancho Los Fresnos. Introduced predators are widespread at Los Fresnos and may limit breeding locations for the treefrog.

Imminence: Catastrophic wildfire is a serious, immediate, and imminent threat to the Huachuca/Canelo population in Arizona. Three large fires hit the Huachuca Mountains in the drought year of 2002, and two others burned in or near Arizona treefrog habitats in 2006 following a very dry winter. Key habitats for the frog, such as Scotia, Sunnyside, and Garden canyons have yet to be affected, but could be devastated by a wildfire, which are most likely to occur during drought. Predation by bullfrogs in Scotia Canyon and Hannah Tank, by crayfish in Garden Canyon and Hannah Tank, and by several introduced predators at Rancho Los Fresnos are ongoing threats occurring today, as are threats from OHV activities and livestock grazing at some sites in Arizona. These threats are exacerbated by increased likelihood of extirpation due to small population size and low genetic diversity, coupled with possible adverse effects of climatic extremes.

__x__ Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed? Yes.

Is Emergency Listing Warranted? No. The level of threats is not so great as to cause extinction or loss of substantial recovery potential in the immediate future.

DESCRIPTION OF MONITORING: In regard to monitoring at Fort Huachuca, Sredl and Wallace (2000, p. 19) recommended monitoring of the Arizona treefrog at Garden and Huachuca canyons, two sites where they are known to occur on the Fort. The Army adopted this recommendation in their INRMP, although specific monitoring protocols have not been developed. Except for the monitoring plan at Fort Huachuca, no other regular monitoring is conducted for this population. Periodic visits to localities occur by U.S. Fish and Wildlife Service, Arizona Game and Fish Department, Forest Service, and other biologists. Monitoring for Sonora tiger salamanders at Whiner and Hannah tanks or for Chiricahua leopard frogs in the region may result in incidental observations of Arizona treefrogs.

In regard to monitoring or compiling information about the species, we have contacted Eric Gergus at Glendale Community College, who is an expert on the taxonomy and biology of the species, we have talked to others working in the area such as Sheridan Stone at Fort Huachuca

and Eric Wallace at University of Arizona, and we contacted the Arizona Game and Fish Department for a copy of the latest locality and other information in their Heritage Data Management System concerning this population. A recently published detailed species account (Gergus et al. 2005) and the published taxonomic analysis (Gergus et al. 2004) provided a contemporary and comprehensive view of the biology and geographic variability within the species.

COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: Arizona. As described above, the Arizona Game and Fish Department provided a copy of information available on the species from their Heritage Data Management System. Over the years, we have also contacted several of their biologists about this species (e.g., Valerie Boyarski, Tom Jones, Mike Pruss, Mike Sredl, and Eric Wallace). A draft of this species assessment and listing priority assignment form is currently in review at AGFD. The Huachuca/Canelo DPS is not specifically addressed in the AGFD's "Arizona's Comprehensive Wildlife Conservation Strategy: 2005-2015"; however, the species (*Hyla wrightorum*), a larger entity including the Huachuca/Canelo DPS and the Arizona Mogollon Rim populations, is considered a category 1c, which is a vulnerable species, but one with low impact stressors. AGFD did not propose conservation actions for 1c species.

Indicate which State(s) did not provide any information or comments: None

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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: _____ 4/24/2008
Deputy Regional Director, Fish and Wildlife Service Date

Concur: _____
Director, Fish and Wildlife Service Date

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

Director's Remarks:

Date of review: March 2008
Conducted by: Jim Rorabaugh