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

Scientific Name:

Rana luteiventris

Common Name:

Columbia Spotted frog

Lead region:

Region 8 (California/Nevada Region)

Information current as of:

04/15/2011

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

___ Candidate Removal

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___ Taxon is more abundant or widespread than previously believed or not subject
___ Taxon not subject to the degree of threats sufficient to warrant issuance of
___ Range is no longer a U.S. territory
___ Insufficient information exists on biological vulnerability and threats to su
___ Taxon mistakenly included in past notice of review
___ Taxon does not meet the definition of "species"
___ Taxon believed to be extinct
___ Conservation efforts have removed or reduced threats
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Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 05/11/2004

90-Day Positive:05/11/2005

12 Month Positive:05/11/2005

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Idaho, Nevada, Oregon
- **US Counties**: Owyhee, ID, Elko, NV, Eureka, NV, Lander, NV, Nye, NV, Harney, OR, Lake, OR, Malheur, OR
- **Countries**: United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Idaho, Nevada, Oregon
- **US Counties**: Ada, ID, Canyon, ID, Elmore, ID, Owyhee, ID, Twin Falls, ID, Elko, NV, Eureka, NV, Nye, NV, Grant, OR, Harney, OR, Lake, OR, Malheur, OR
- **Countries**: United States

Land Ownership:

An estimated 90 percent of all known habitat for Columbia spotted frog (Great Basin Distinct Population Segment (DPS)) occurs on lands managed by the Forest Service and Bureau of Land Management (BLM). The Humboldt-Toiyabe National Forest (HTNF) in Nevada is the only national forest which has occupied Columbia spotted frog habitat. Occupied habitat on BLM managed lands include the Elko and Battle Mountain District Offices in Nevada; Lakeview, Burns, and Vale District Offices in Oregon; and Jarbidge, Bruneau, and Owyhee Field Offices in Idaho. The Malheur National Wildlife Refuge in south central Oregon currently has a small population. Columbia spotted frogs are known to occur on the Yomba-Shoshone Reservation in central Nevada and the Duck Valley Reservation straddling the border of Nevada and Idaho. The State of Idaho manages a 275 hectare (680 acre) parcel at Sam Noble Springs which Columbia spotted frogs occupy. The remaining known or suspected occupied sites occur on private lands.

Lead Region Contact:

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Lead Field Office Contact:

Nevada Fish & Wildl Ofc, Chad Mellison, 7758616300, chad_mellison@fws.gov

Biological Information

Species Description:

Ranids typically are characterized as slim-waisted, long-legged, smooth-skinned jumpers with webbed hind feet and usually with a pair of dorsolateral folds (glandular folds) that extend from behind the eyes to the lower back. Adult Columbia spotted frogs measure between 5 and 10 centimeters (cm) (2 to 4 inches (in)) from snout to vent, with females being larger than males (Tait 2007, pp. 17-18). Dorsal color and pattern include a light brown, dark brown, or gray, with small spots (Stebbins 2003, pp. 66, 229-230). Ventral coloration can differ among geographic population units and may range from yellow to salmon; however, very young individuals may have very pale, almost white, ventral surfaces (Stebbins 2003, pp. 66, 229-230). The throat and the ventral region are sometimes mottled. The head may have a dark mask with a light stripe on the upper jaw, and the eyes are turned slightly upward. Adult male frogs have swollen thumbs with darkened bases (Stebbins 2003, pp. 66, 229-230).

Taxonomy:

Spotted frogs (*Rana pretiosa*) were first described by Baird and Girard (1853, pp. 378-379) and later split into two subspecies, *R. pretiosa pretiosa* and *R. pretiosa luteiventris* (Thompson 1913, pp. 53-56). The Service accepts species-specific genetic and geographic differences in Columbia spotted frogs based on previous work by Green *et al*. (1996, pp. 377-388; 1997, pp. 2- 7), Bos and Sites (2001, pp. 1505-1511), and more recently by Funk *et al*. (2008, pp. 201-202) which define populations in western Washington and Oregon and northeastern California as Oregon spotted frogs (*R. pretiosa*) and the remainder of the populations as Columbia spotted frogs (*R. luteiventris*). Based on further geographic and genetic characterization, Columbia spotted frogs in southwest Idaho, southeast Oregon, and northeast and central Nevada are part of the Great Basin population of Columbia spotted frogs (Funk *et al*. 2008, pp. 201-202). It was previously thought that populations in northeast Oregon were part of the Great Basin population; however, Funk *et al*. (2008, pp. 201-202) found that these populations belong to the Northern population. A small population on the eastern border of White Pine County, Nevada, and Toole County, Utah, has been determined through phylogenetic data to be part of the Utah population of Columbia spotted frogs (Funk *et al* . 2008, pp. 201-202). The Committee on Standard and Scientific Names recently changed the genus name for many North American frogs from *Rana* to *Lithobates*; however, Columbia spotted frogs maintained the genus name *Rana* (Crother *et al*. 2008, pp. 7, 11). We have carefully reviewed available taxonomic information to reach the conclusion that the species *R. luteiventris* is a valid taxon.

Habitat/Life History:

Columbia spotted frogs are found closely associated with clear, slow-moving or ponded surface waters, with little shade, and relatively constant water temperatures (Munger *et al*. 1996, p. 8; Reaser 1997a, pp. 32-33; Reaser and Pilliod 2005, p. 561; Welch and MacMahon 2005, p. 477). Reproducing populations have been found in habitats characterized by springs, floating vegetation, and larger bodies of pooled water (e.g., oxbows, lakes, stock ponds, beaver-created ponds, seeps in wet meadows, backwaters) (Reaser and Pilliod 2005, p. 560). A deep silt or muck substrate may be required for hibernation and torpor (a state of lowered physiological activity, usually occurs during colder months) (Bull 2005, p. 12; Reaser and Pilliod 2005, p. 561). In colder portions of their range, Columbia spotted frogs will use areas where water does not freeze, such as spring heads and undercut streambanks with overhanging vegetation (Bull 2005, p. 12; Reaser and

Pilliod 2005, p. 561); however, they can overwinter underneath ice-covered ponds (Tattersall and Ultsch 2008, pp. 122-123).

Males become sexually mature 1-2 years earlier than females, usually at age 2 or 3 (Reaser and Pilliod 2005, p. 561). Columbia spotted frogs employ a scramble mating system in which males race for access to females and there is little opportunity for female choice or male combat (Greene and Funk 2009, p. 244). Females usually lay egg masses in the warmest areas of a pond, typically in shallow water (10-20 cm, 4-8 in), and clutch sizes vary (150-2,400 eggs) (Bull 2005, pp. 8 and 11; Reaser and Pilliod 2005, p. 560; Pearl *et al*. 2007a, pp. 87-89). Successful egg production and the viability and metamorphosis of Columbia spotted frogs are dependent on habitat variables such as temperature, depth, and pH of water, cover, and the presence or absence of predators (Munger *et al*. 1996, p. 8; Reaser 1997b, pp. 21-22; Bull 2005, p. 7; Reaser and Pilliod 2005, pp. 561-562). Tadpoles usually metamorphose by mid to late summer; however, they have been observed in the tadpole stage as late as October (Bull 2005, p. 7; Reaser and Pilliod 2005, p. 560). Once they become adults, male Columbia spotted frogs have lower survival rates than females (Turner 1962, p. 328). While the oldest frogs documented were 12-13 years old, most males live 3-4 years while females typically survive 5-8 years (Reaser 2000, pp. 1161-1162; Bull 2005, p. 27).

Adult Columbia spotted frogs are opportunistic feeders, consuming many types of insects, mollusks, and even other amphibians (Bull 2005, pp. 16-19; Reaser and Pilliod 2005, p. 561). Bull (2005, pp. 16-19) conducted a diet analysis for populations in northeast Oregon where the most common insects consumed were beetles (21 percent), ants or wasps (21 percent), and flies (10 percent). Tadpoles are grazers which consume algae and detritus (Reaser and Pilliod 2005, p. 560).

Historical Range/Distribution:

Current and Historical Range/Distribution-Nevada

Columbia spotted frogs in Nevada are found in the central (Nye County) and northeastern (Elko and Eureka Counties) parts of the State, usually at elevations between 1,700 and 2,650 meters (5,600 and 8,700 feet), although they have been recorded historically in a broader range including Lander County in central Nevada and Humboldt County in northwest Nevada (Reaser 2000, p. 1159). The Great Basin population of Columbia spotted frogs in Nevada is geographically separated into three subpopulations: Jarbidge-Independence Range, Ruby Mountains, and Toiyabe Mountains. The Nevada Wildlife Action Plan defines these areas as the Great Basin and Columbia Plateau Ecoregions (NDOW 2006, p. 66). The largest of Nevada's three subpopulation areas is the Jarbidge-Independence Range in Elko and Eureka Counties. This subpopulation area is formed by the headwaters of streams in two major hydrographic basins. The South Fork Owyhee River, Owyhee River, Bruneau River, and Salmon Falls Creek drainages flow north into the Snake River basin. Mary's River, North Fork Humboldt River, and Maggie Creek drain into the interior Humboldt River basin. Columbia spotted frogs occur in the Ruby Mountains in tributaries to the South Fork Humboldt River including Green Mountain, Smith, Corral, and Rattlesnake Creeks on lands in Elko County managed by the HTNF. In the Toiyabe Mountains, Columbia spotted frogs are found in seven drainages in Nye County, Nevada--the Reese River (Upper and Lower), Cow and Ledbetter Canyons, and Cloverdale, Stewart, Illinois, and Indian Valley Creeks (NDOW 2003b, p. S-8). The Toiyabe Mountains subpopulation is geographically isolated from the Ruby Mountains and Jarbidge-Independence Range subpopulations by a large gap in suitable habitat and represents the southern-most extremity of the species' range.

Current and Historical Range/Distribution-Idaho and Oregon (Owyhee subpopulation)

Prior to 1995, only six historical sites were known in the Owyhee Mountain range in Idaho (Munger *et al*. 1996, pp. 2-3, 16) and only 22 sites were known in southeastern Oregon in Malheur County (Munger *et al*. 1998, pp. 6-7). Currently, Columbia spotted frogs appear to be widely distributed throughout southwestern Idaho (Owyhee County) and southeastern Oregon, but local populations within this general area appear to be isolated from each other by either natural or human-induced habitat disruptions (Smyth 2004, pp. 3-7; Bull 2005, pp. 2-3; Engle 2006, p. 20; Lohr and Haak 2010, p. 5; Pearl *et al*. 2010, pp. 5-8, 17). The Idaho Comprehensive Wildlife Strategy defines this area as the Owyhee Uplands (Idaho Department of Fish and Game (IDFG) 2005, pp. 1-8). In southeastern Oregon, the historical and current range of Columbia spotted frogs include, but are not limited to, the Owyhee and Steens Mountains in Harney and Malheur Counties (Munger *et al*. 1998, pp. 3-4; Smyth 2004, pp. 3-7; Funk *et al*. 2008, p. 202; Pearl *et al*. 2010, pp. 5-8). The Oregon Conservation Strategy defines this area as the Northern Basin and Range Ecoregion (Oregon Department of Fish and Wildlife (ODFW) 2006, pp. 204-221).

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Figure 1. Geographic distribution of Oregon spotted frogs (*Rana pretiosa*) and Columbia spotted frogs (*Rana luteiventris*) (Funk *et al*. 2008, p. 202).

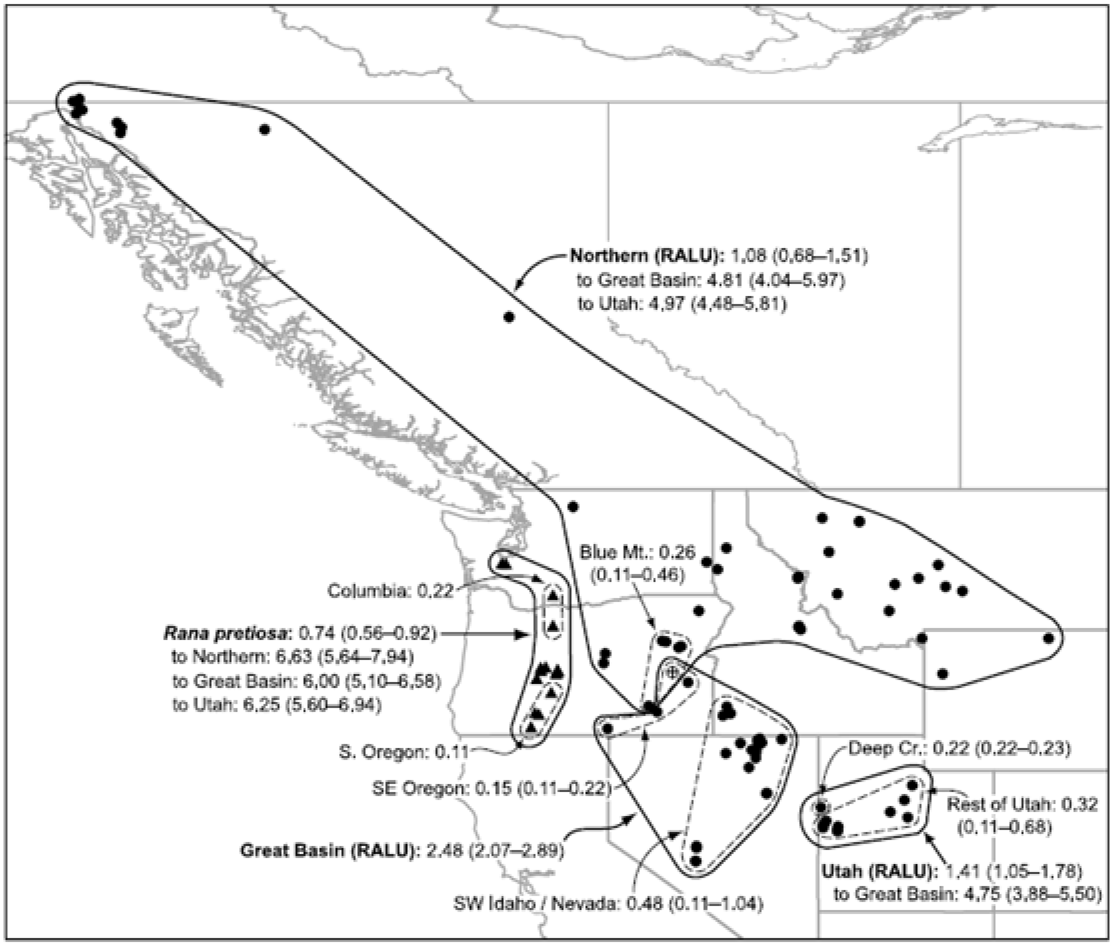

Fig. 3. Geographic distribution of major clades (solid black lines) and nested clades (dashed lines) identified in the phylogenetic analyses, with mean percent corrected sequence divergence (and ranges in parentheses) shown within and among clades. Clade names correspond to those used in Fig. 2 and Tables 1–3. Triangles = *R. pretiosa*; circles = *R. luteiventris*. The open circle with a cross is Kingsbury Gulch (site 59), where haplotypes from the northern clade and Great Basin clade were found.

Population Estimates/Status:

Status-Nevada: Declines of Columbia spotted frog populations in Nevada have been recorded since 1962 when it was observed that in many Elko County localities where Columbia spotted frogs were once numerous, the species was nearly extirpated (Turner 1962, pp. 326-327). Extensive loss of habitat was found to have occurred from conversion of wetland habitats to irrigated pasture and from spring and stream dewatering by mining and irrigation practices. In addition, there was evidence of extensive impacts on riparian habitats due to intensive livestock grazing. Researchers in Nevada have documented the loss of historically occupied sites, reduced numbers of individuals within local populations, and declines in the reproduction of those individuals (Turner 1962, pp. 326-327; Hovingh 1990, p. 6; Reaser 1997a, pp. 30-33; Hatch *et al*. 2002, pp. 47-50; Wente *et al*. 2005, p. 99). Between 1994 and 1996, Reaser (1997a, pp. 30-31) resurveyed 41 (45 percent) of 91 previously occupied sites identified between 1912 and 1992. Of the 41 previously occupied sites visited, 14 (34 percent) were still occupied while 27 (66 percent) were unoccupied (Reaser 1997a, pp. 30-31).

Between 2002 and 2006, USFS crews in northeastern Nevada resurveyed previously surveyed sites that were identified during the 1993-1998 efforts by Reaser and others (Amy 2003, pp. 1-6). Of the 625 sites visited, Columbia spotted frogs were present at 136 sites (22 percent) and were not detected at the remaining 489 sites (78 percent) (Amy 2003, p. 2; 2004, p. 2; Meneks 2005a, p. 3; 2005b, p. 5; 2006, p. 7). Within the Ruby Mountains, Jarbidge, and Mountain City Ranger Districts and the BLM Elko District Office in northeast Nevada, there are approximately 256 6th code hydrologic units (HUCs). Survey priority was given to 200

HUCs associated with perennial water. Upon completion of a HUC survey, the HUC is identified as either occupied (frogs are detected), absent (no frogs and insufficient habitat), or unknown (no frogs but more surveys needed). From 2000 to present, the USFS and NDOW have conducted presence-absence surveys in 74 HUCs (29 percent) and Columbia spotted frogs have been detected in 55 (74 percent) of the HUCs sampled (NDOW 2010a, p. 3). Additionally, presence-absence surveys were conducted by the Service and Tribal members on the Nevada portion of the Duck Valley Indian Reservation during 2004 and 2005, where the species was found in 7 out of 16 locations surveyed (Service 2005). In 2004, the USFS initiated an intensive mark-recapture survey at two sites, Green Mountain Creek, Ruby Mountains Ranger District and Tennessee Gulch, Mountain City Ranger District (and added a third site in 2005, Pole Creek, Jarbidge Ranger District), as part of an effort to determine population estimates, mortality, juvenile-to-adult recruitment, movement, and habitat preference (Meneks 2005a, pp. 1-3). Between 2004 and 2009, a total of 2,211 frogs were captured from all three sites, 1,816 of which were marked using Passive Integrated Transponder (PIT) tags (Meneks 2009, pp. 2-10). Between 2006 and 2009, the number of adult frogs captured (n = 49) at the Green Mountain Creek site was relatively stable and remained approximately double the numbers captured from 2004 and 2005; however, juvenile numbers have shown a more variable trend (Meneks 2009, pp. 2-4). Adult numbers captured at Tennessee Gulch between 2005 and 2009 were similar; however, in 2009, females (n = 107) outnumbered males (n = 46) in the population by 2 to 1, and juvenile numbers remained low for the third year in a row (Meneks 2009, pp. 5-8). The number of adult frogs captured at the Pole Creek site between 2005 and 2007 averaged 200 individuals; however, in 2009, only 73 adults were captured. Additionally, juvenile numbers remained low with a total of 8 captured between 2006 and 2007 and no documented recruitment in 2008 and 2009, compared to 72 juveniles captured in 2005 (Meneks 2009, pp. 8-12).

During the summers of 2000 and 2001, mark-recapture surveys of the Toiyabe Mountains subpopulation were conducted by the University of Nevada, Reno. Preliminary estimates of frog numbers in the Indian Valley Creek drainage were approximately 5,000 breeding individuals, which was greater than previously believed (Hatch et al. 2002, p. 3). However, during the 2000-2001 winter, Hatch *et al*. (2002, p. 23) noted a large population decrease, ranging between 66 and 86.5 percent at several sites. Survey results suggested poor winter habitat contributed to the winterkill (Hatch *et al*. 2002, pp. 25-27). In an effort to document population dynamics within the Toiyabe Mountains subpopulation, a large mark-recapture study using PIT tags was initiated in 2004 and has continued annually. During this period, approximately 3,000 frogs have been PIT tagged. Results from the 2010 monitoring are discussed below (NDOW 2011, pp. 1-19). Total discrete adult frog captures (total number marked plus total number of recaptures from previous years) were higher in 2010 (n = 1,112) than in 2009 (n = 907), 2008 (n = 628) and 2007 (n = 674). Total recaptures in 2010 were the highest recorded since monitoring began with 525 individuals captured from previous years. Juvenile frog counts in 2010 were substantially higher (n =1,003) than previous years. In 2009 (n = 633), 2008 (n = 634), and 2007 (n = 646) juvenile numbers were similar, and substantially higher, compared to juvenile numbers captured in 2006 (n = 251), 2005 (n = 92), and 2004 (n = 68) surveys. In general, capture numbers seem stable or increasing; however, population estimates for the Toiyabe Mountains subpopulation are not available at this time. The lack of standardized and extensive monitoring and routine surveying has prevented dependable determinations of frog population numbers or trends across Nevada. However, since the signing of the CASs in 2003 (NDOW 2003a, pp. 1-43; b, pp. 1-51), long-term monitoring plans aimed at standardizing monitoring locations and protocols have been developed and implemented for both the Toiyabe Mountains and Northeast subpopulations (NDOW 2004b, pp. 1-25; 2009, pp. 1-21).

Status-Idaho: Extensive surveys since 1996 throughout southwestern Idaho have substantially increased the number of sites known to be occupied by Columbia spotted frogs. Many of the occupied sites support small numbers of frogs relative to other portions of the species range. Surveys conducted in 2001 of the 49 known local populations in southwestern Idaho, found 61 percent had 5 or fewer adult frogs (Engle 2002, p. 3). Frogs from these smaller occupied sites likely interact with individuals from other occupied sites forming metapopulations. There are many metapopulations in southwest Idaho that are isolated from other metapopulations primarily due to large areas of unsuitable habitat. Connectivity between metapopulations in southwest Idaho is being further assessed using genetic techniques. Results from this work are being analyzed and should be available in 2011.

One of the largest known local populations of Columbia spotted frogs occurs at Sam Noble Springs in the Rock Creek drainage of Owyhee County (Service 2006, p. 3); however, larger populations likely exist on private lands (e.g., upper Reynolds Creek) (LaFayette 2010, pp. 3, 14-15). Long-term monitoring from Sam Noble Springs shows high annual variation in area-wide population estimates and is not known to be representative of all frog populations in southwest Idaho (Lohr and Haak 2010, pp. 10-12). Monitoring of the adult frog population at Sam Noble Springs has occurred annually since 1998 and as many as 144 and as few as 65 adult frogs have been captured in any single year (Lohr and Haak 2010, p. 10). Annual fluctuation of frog captures at many of the 10 individual ponds of Sam Noble Springs has been documented, but is not well understood. Despite the inability to estimate population size in some years due to inconsistencies in data collection, it appears that the adult frog population at Sam Noble Springs suffered a brief, but substantial decline in 2003, followed by a generally increasing yet variable trend until 2010 which showed the second lowest population estimate since monitoring began (Lohr and Haak 2010, p. 12). We do not have a plausible explanation for this pattern.

In 2009 and 2010, some private lands in southwest Idaho were surveyed for the first time since 2002 or earlier, while other private lands had never been surveyed (La Fayette 2010, pp. 1-46). The primary purpose of the survey was to detect the presence of Columbia spotted frogs; however, there are some inferences that can be made regarding relative density. There are areas on surveyed private lands where observed densities were similar to densities observed at Sam Noble Springs. Columbia spotted frogs were present in most areas where they were previously documented, as well as in some locations which had never been surveyed or at least where frogs had not been previously documented (La Fayette 2010, p. 46). This work has resulted in improved relationships with landowners, identification of and progress toward implementing on-the-ground conservation measures for frogs, as well as increased knowledge of the species distribution and relative abundance on private lands. More private lands are scheduled for surveys in 2011.

Extensive egg mass surveys at four sentinel sites in southwest Idaho have occurred since 2000 (Lohr and Haak 2010, pp. 13-14). Results indicate variable fluctuations in the number of egg masses based on the site and size of the population (Lohr and Haak 2010, pp. 13-14). The overall population at one sentinel site, Stoneman Creek, has dramatically increased due to beaver (*Castor canadensis*) related habitat improvements with 2010 having the highest number of egg masses encountered since monitoring began (Munger and Lingo 2003, pp. 1-7; Lohr and Haak 2010, p. 13). Continued annual monitoring at sentinel sites is needed to understand population fluctuations and to document trends. Starting in 2007, a proportion of area occupied study was implemented in Owyhee County as a method to obtain a better understanding of the species trend as it relates to occupancy of catchment basins (Moser 2007, pp. 9-10). Columbia spotted frogs occupied about 77 percent (90 percent confidence interval = 65-89 percent) of the study area with a 100 percent probability of detecting frogs within catchment basins within two visits (Lohr and Haak 2010, p. 14).

Status-Oregon: In southeastern Oregon, surveys conducted in 1997 reconfirmed a population of Columbia spotted frogs in the Dry Creek drainage in Malheur County (Munger *et al*. 1998, pp. 3-4). Detailed population estimates using PIT tags have occurred in Dry Creek since 2001 (Meyer 2010, pp. 1-356). During this period, 2,536 frogs have been PIT tagged. Total discrete adult frog captures were higher in 2010 (n = 197) than in 2009 (n = 164) and 2008 (n = 63). Subadult frog counts in 2010 (n = 1,086), 2009 (n = 628), and 2008 (n = 317) were much higher than counts from previous years which ranged from 20 to 119 individuals. Based on Lincoln-Petersen estimates, the total population size has generally increased since 2001 (n = 74), with large increases detected in 2008 (n = 493), 2009 (n = 890), and 2010 (n = 1,632) (Meyer 2010, p. 12); however, survival rates of adults are low (Meyer 2010, pp. 28-35).

The U.S. Geological Survey (USGS) has performed annual monitoring of the Kingsbury Gulch site since 2002, and they have documented a sharp decline in this population (no detections the past 2 years) most likely due to habitat alteration (Adams *et al*. 2010b, pp. 11-12). Presence-absence monitoring has occurred in the Steens Mountains area, Harney County, in which small isolated populations of Columbia spotted frogs have been located (Smyth 2004, pp. 3-7). Between 2000 and 2003, the USGS compared current regional distributions of amphibians with occurrence patterns suggested in historical data (Adams *et al*. 2006, pp. 1-21). Visual encounter surveys were used to determine presence-absence of Columbia spotted frogs on public lands in eastern Oregon and northern Nevada. Based on occupancy models, the USGS estimated that Columbia spotted frogs occupied 53 percent of the 30 historical sites in the area surveyed (Wente *et al*. 2005, p. 99). Between 2000 and 2003, 6 of 16 sites proximal to historical sites were occupied (Wente *et al*. 2005, p. 99). Additionally, 187 sites in southeastern Oregon were randomly selected for presence-absence surveys of which only 3 sites were occupied; however, variability in occupancy between the 3 years was problematic (Wente *et al*. 2005, pp. 99-106). More recently, USGS crews sampled 42 historical locations in southeastern Oregon and found Columbia spotted frogs at nearly 60 percent of the target sites or in nearby habitat (Pearl *et al*. 2010, pp. 2-9). The authors caution interpretation of the results because the survey was conducted in one year (2009), sites were only visited once, many of the historical records contained just a few adult frogs, and many of the historical records contained poor location data (Pearl *et al*. 2010, pp. 7-8).

In summary, monitoring efforts are being implemented throughout the range of the Columbia spotted frog in Idaho, Nevada, and Oregon; however, lack of consistency in survey protocols and monitoring efforts make it difficult to estimate population sizes and understand the status of the species across its range. Furthermore, deciphering historical data collected throughout the 1900's and comparing these data to current occupancy rates has been problematic. A range-wide effort to determine historical and current occupancy is needed to better track the status of this species.

Distinct Population Segment(DPS):

Discreteness

The DPS policy standard for discreteness allows an entity given DPS status under the ESA 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.

Columbia spotted frogs in Nevada, southwestern Idaho, and most populations in the southeastern Oregon portion of the Great Basin are geographically separate from the remainder of the species; however, one isolated site in southeastern Oregon (Kingsbury Gulch) showed genetic evidence of an overlap between the Northern and Great Basin populations (Funk *et al*. 2008, p. 204) (Figure 1). For management purposes, populations within the Great Basin have been divided into four subpopulations. The largest of Nevada's three subpopulation areas is the Jarbidge-Independence Range in Elko and Eureka Counties. This subpopulation area is formed by the headwaters of streams in two major hydrographic basins. The South Fork Owyhee River, Owyhee River, Bruneau River, and Salmon Falls Creek drainages flow north into the Snake River basin while the Marys River, North Fork Humboldt River, and Maggie Creek drain into the interior Humboldt River basin. A smaller subpopulation of Columbia spotted frogs is located in the Ruby Mountains about 80 kilometers (km) (50 miles (mi)) south of the Jarbidge-Independence Range subpopulation. However, these two subpopulations are isolated by lack of suitable habitat and hydrologic connectivity. The Toiyabe Mountains subpopulation is isolated nearly 320 km (200 mi) southeast of the Ruby Mountains and Jarbidge-Independence Range subpopulations and represents the southern-most extremity of its range. The Owyhee subpopulation of Columbia spotted frogs appears to be widely distributed throughout southwestern Idaho (Owyhee County) and southeastern Oregon (Lake, Malheur, and Harney Counties), but local populations within this area are generally small, with a few exceptions, and appear to be isolated from each other and from subpopulations in northeastern Nevada by either natural or human-induced habitat disruptions.

All four Great Basin subpopulations are geographically isolated and separate from the main continuous Northern population of Columbia spotted frogs in the central mountains of Idaho by the Snake River Plain and adjacent lowlands in eastern Oregon. The Owyhee subpopulation in southwestern Idaho is approximately 160 km (100 mi) from the Northern population in central Idaho. Occupied habitat in the Northern population is characterized by conifer forests and high elevation lake environments while habitat for the Great Basin population is characterized by sagebrush steppe and their associated stream and pond environments. Furthermore, the Great Basin population is both hydrologically and geographically separated from isolated populations in Utah. The subpopulation in the Ruby Mountains (Lahontan Basin) is approximately 145 km (90 mi) from the West Desert population (Bonneville Basin) near Ibapah, Utah. As detailed below, geographic isolation of the Great Basin population is supported by genetic analyses.

Three earlier genetic studies were conducted on Columbia spotted frogs which have improved our knowledge on the distribution and genetic structure of the species (Green *et al*. 1996, pp. 374-390; Green *et al*. 1997, pp. 1-8; Bos and Sites 2001, pp. 1499-1513). Unfortunately, these studies did not adequately sample populations in southwestern Idaho and eastern Oregon. Because the distribution of distinct subpopulations within the Great Basin DPS was unresolved, the USGS initiated a genetic evaluation of the Great Basin DPS (USGS 2006, pp. 1-3). Objectives of the study included: 1) determine the distribution of distinct subpopulations within the Great Basin DPS; 2) determine whether Columbia spotted frog populations from southeastern Oregon and southern Idaho are part of the Great Basin DPS; 3) determine whether Columbia spotted frog populations from northeastern Oregon are part of the Great Basin DPS or instead, part of the large, contiguous portion of the species' range in the northern Rocky Mountains; and 4) examine population genetic structure and status in the Great Basin DPS of Columbia spotted frog. Results from this study are presented below.

The strongest genetic evidence that Columbia spotted frog populations in the Great Basin are genetically discrete from other Columbia spotted frogs comes from Funk *et al*. (2008, pp. 198-210) who examined mitochondrial DNA (mtDNA) sequence variation throughout the extant range of Columbia spotted frogs. These data indicate three distinct major clades (a clade is a group of taxa sharing a closer common ancestry with one another than with members of any other clade): Northern, Great Basin, and Utah (Funk *et al*. 2008, pp. 201-202) (Figure 1). The three clades are nearly as divergent from each other as they are from Oregon spotted frog, a closely related but separate species (Funk *et al*. 2008, p. 202). Additionally, within each major clade, well-defined nested clades are also evident. The Great Basin clade has two well-defined nested clades in southwestern Idaho-Nevada and southeastern Oregon (Funk *et al*. 2008, p. 202) (Figure 1). These two nested clades are also the most divergent among the nested clades indicating the effects of small isolated populations in southeastern Oregon (Funk *et al*. 2008, p. 205). The authors also found one location in southeastern Oregon in which there is an overlap between the Northern and Great Basin clades (Funk *et al*. 2008, p. 204) (Figure 1). This area of southeastern Oregon has been identified as a natural zone of hybridization for other species, such as butterflies and birds (Remington 1968, pp. 321-428). More genetic analyses is being conducted in southeastern Oregon to further define the phylogeographic break between the Northern and Great Basin populations.

Significance

Under our DPS policy, once we have determined that a population segment is discrete, we consider its biological and ecological significance to the larger taxon to which it belongs. This consideration may include, but is not limited to, evidence of the persistence of the discrete population segment in an ecological setting that is unique for the taxon; evidence that loss of the population segment would result in a significant gap in the range of the taxon; 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; and evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

We have found substantial evidence that two of these significance factors are met by the Great Basin population of the Columbia spotted frog. The extinction of the Nevada, southwestern Idaho and southeastern Oregon portion of the range of the Columbia spotted frog would likely result in the loss of a significant genetic entity and the curtailment of the range of the species. Particularly, the work of Funk *et al*. (2008, pp. 198-210) indicates that Columbia spotted frogs in the Great Basin differ genetically from Columbia spotted frogs sampled in other portions of the range to a significant degree. Additionally, loss of Columbia spotted frogs in Nevada, southwestern Idaho and southeastern Oregon would eliminate the southern extent of the species' range.

Conclusion

We evaluated the Great Basin population of Columbia spotted frogs, addressing the two elements which our policy requires us to consider in deciding whether a vertebrate population may be recognized as a DPS and considered for listing under the ESA. We conclude that the Great Basin population is discrete, as per our policy, based on its geographic separation and genetic divergence from the isolated populations in Utah and the main continuous populations in central and northern Idaho, northeastern Oregon, eastern Washington, western Montana, northwestern Wyoming, and southeast Alaska, and British Columbia and Alberta, Canada. We conclude that the Great Basin population of the Columbia spotted frog is significant because the loss of the species from this area would result in a significant reduction in the species' range and would constitute loss of a genetically divergent portion of the species. Because the population segment meets the discreteness and significance criteria of our DPS policy, the Great Basin population of the Columbia spotted frog constitutes a DPS which qualifies for consideration for listing.

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Habitat modification and destruction has been implicated in the majority of amphibian declines (Bishop *et al*. 2003, pp. 209-210; Young *et al*. 2004, pp. 31-32; Bradford 2005, pp. 919, 921-922; Vredenburg and Wake 2007, p. 5; Wells 2007, pp. 817-825; Chanson *et al*. 2008, pp. 39-42). Isolated populations of amphibians, as seen throughout the range of Columbia spotted frogs in the Great Basin, are particularly susceptible to habitat modification (Noss *et al*. 2006, p. 230; Tait 2007, p. 26). Columbia spotted frog habitat degradation and fragmentation is a combined result of past and current land use influences from agricultural development, intensive livestock grazing, spring development, urbanization, mining activities, and climate change. Small upland streams and meadows found throughout the central Great Basin, including occupied habitat within the Toiyabe Mountains subpopulation, are inherently unstable and have been prone to incision for at least the last 400-500 years (Germanoski and Miller 2004, p. 117). Land use activities in these sensitive areas have initiated or accelerated the incision process which has changed the hydrologic function of meadow systems (Jewett *et al*. 2004, pp. 152-155). These changes in the hydrology of meadows, mainly the lowering of the water table, can cause the vegetation communities to shift from wet meadow communities (*Carex* sp.) to dry upland plant communities (*Artemisia* sp.) (Chambers *et al*. 2004a, pp. 201-205). The loss of meadow complexes limits the available habitat for Columbia spotted frogs to the incised channel which may cause a crowding effect (Noss *et al*. 2006, p. 223). Natural fluctuations in environmental conditions (e.g., drought) tend to magnify the detrimental effects of land use activities, just as the land use activities may compound the detrimental effects of natural environmental events (Boone *et al*. 2003, pp. 138-142).

Springs provide a stable, permanent source of water for frog breeding, feeding, shelter, and winter refugia (IDFG *et al*. 1995, p. 9; Patla and Peterson 1996, pp. 16-17; Munger 2003, p.13). Analyzing 10 different threats that influence the abundance and distribution of taxa associated with spring systems in the Great Basin, Sada and Vinyard (2002, p. 280) found that spring developments were associated with the greatest number of taxa being affected. Most spring developments include the installation of a pipe or box to fully capture the water source and direct water to another location such as a livestock watering trough. Loss of this permanent source of water in semi-arid ecosystems can also lead to the loss of associated riparian habitats and wetlands used by Columbia spotted frogs. Developed spring pools could be functioning as attractive nuisances for frogs, concentrating them into isolated groups, increasing the risk of disease and predation (Noss *et al*. 2006, p. 223). In contrast, some springs developed into ponds for watering livestock appear to provide high quality breeding and rearing sites in southwestern Idaho (La Fayette 2009, p. 18). Many of the springs in southwestern Idaho, eastern Oregon, and Nevada have been developed for agricultural use.

Fragmentation of habitat may be one of the most significant barriers to Columbia spotted frog recovery and population persistence (Semlitsch 2002, pp. 620-623; Green 2003, pp. 340-341; Opdam and Wascher 2004, pp. 285-297; Funk *et al*. 2005a, pp. 14-15; Tait 2007, p. 26). Studies in Idaho indicate that Columbia spotted frogs exhibit breeding site fidelity (Pilliod *et al*. 2002, pp. 1853-1859; Engle and Munger 2003, pp. 9-10). Movement of frogs from hibernation ponds to breeding ponds may be impeded by zones of unsuitable habitat which can lead to local population declines or extinctions (Engle and Munger 2003, pp. 12-13; Funk *et al*. 2005a, p. 15; Funk *et al*. 2005b, p. 494). Local populations will become increasingly isolated as movement corridors become more fragmented through loss of stream flow within riparian or meadow habitats (Bull and Hayes 2001, pp. 120-122; Pilliod *et al*. 2002, pp. 1853-1859; Engle and Munger 2003, pp. 12-13; Munger 2003, pp. 4-9; Funk *et al*. 2005a, p. 15; Funk *et al*. 2005b, p. 494; Semlitsch 2008, pp. 260-265). Vegetation and surface water along movement corridors provide relief from high temperatures and arid environmental conditions, as well as protection from predators. Loss of vegetation and lowering of the water table as a result of the above mentioned activities can pose a significant threat to frogs moving from one area to another. Likewise, fragmentation and loss of habitat can prevent frogs from colonizing suitable sites elsewhere (Gibbs 2000, pp. 316-317; Semlitsch 2002, pp. 621-623; Storfer 2003, pp. 154-156; Funk *et al*. 2005b, p. 494; Pringle 2006, pp. 243-246).

The current state of small isolated populations throughout the range of Columbia spotted frogs in the Great Basin DPS indicates they are susceptible to extinction events. Isolated populations are vulnerable to extinction through demographic stochasticity (random fluctuations in birth and death rates); environmental stochasticity (random variation in environmental attributes) and catastrophes; loss of genetic heterozygosity (genetic diversity) and rare alleles (inherited forms of a genetic trait); and human disturbance (Hedrick and Kalinowski 2000, pp. 140-142; Lande 2002, pp. 18-35; Reed and Frankham 2003, pp. 233-234; Frankham 2005, pp. 135-136). Modification and destruction of Columbia spotted frog habitat which have further increased fragmentation and isolation of populations pose a substantial threat to many of the Columbia spotted frog populations within the Great Basin DPS.

Livestock Grazing

According to Minshall *et al*. (1989, p. 118), riparian and stream ecosystems are the most threatened ecosystems in the Great Basin. Behnke and Zarn (1976, p. 5) identified livestock grazing as the greatest threat to the integrity of stream habitat in the western United States. Grazing occurs throughout the range of Columbia spotted frogs and has been cited as detrimental to Columbia spotted frog habitat (Munger *et al*. 1996, p. 9; Reaser 1997a, pp. 37-38; Engle 2002, pp. 44-55; Service 2006, pp. 4-5). Though direct correlation between Columbia spotted frog declines and livestock grazing is limited, the effects of heavy grazing on riparian areas are well documented (Kauffman *et al*. 1983a, pp. 684-685; 1983b, pp. 686-689; Kauffman and Kreuger 1984, pp. 432-434; Schulz and Leininger 1990, pp. 297-299; Belsky *et al*. 1999, pp. 425-428).

Bull and Hayes (2000, pp. 292-294) found no impacts of cattle grazing on the reproductive success of Columbia spotted frogs in ponds in northeastern Oregon; however, there was high variability in their results and grazing intensity and timing was not evaluated. Adams *et al*. (2009, pp. 135-137) found no significant short-term effects of cattle exclosures on the number of Columbia spotted frog egg masses, larval survival, size of metamorphs, or water quality measurements. Moreover, nutrient levels often associated with negative impacts to amphibians, were very low to non-detectable (Adams *et al*. 2009, pp. 136-137). In contrast, Gray *et al*. (2007, pp. 99-100) found higher levels of Ranavirus (an emerging pathogen implicated in many amphibian declines) in green frogs (*Lithobates* (formerly *Rana*) *clamitans*) within ponds accessed by cattle. Howard and Munger (2003, p. 10) found lower survival of Columbia spotted frog larvae in their high livestock waste treatment; however, the high waste treatment larvae that survived had higher growth rates. Schmutzer *et al*. (2008, pp. 2617-2619) found significantly larger green frog, bullfrog (*L. catesbeiana*), and pickerel frog (*L. palustris*) larvae in ponds with cattle grazing; however, larval abundance for all three species was significantly higher in ponds with no cattle grazing. Additionally, water quality measurements including turbidity, specific conductivity, and dissolved oxygen, were significantly higher in ponds with grazing (Schmutzer *et al*. 2008, pp. 2618-2619). Capture probabilities of post-metamorphic green frogs were significantly higher in ungrazed ponds versus grazed ponds; however, the opposite was found for American toads (*Anaxyrus* (formerly *Bufo*) *americanus*) indicating species-specific impacts to amphibians from cattle grazing (Burton *et al*. 2009, pp. 272-273). In a behavioral study, Shovlain *et al*. (2005, pp. 10-12) found that Oregon spotted frogs increased their use of grazing exclosures compared to areas under heavy grazing pressure while no preferences were found between exclosures and areas under a light grazing regime. Jansen and Healey (2003, pp. 211-218) found that amphibian species diversity declined and habitat condition decreased with increasing grazing intensity along a river in southeastern Australia. We conclude that improper grazing is an ongoing threat to Columbia spotted frogs because grazing occurs in nearly all populations; however, there is uncertainty regarding the magnitude of this threat.

Beaver Management

The reduction of beaver populations has been noted as an important feature in the reduction of suitable habitat for Columbia spotted frogs (Reaser 1997a, p. 39; NDOW 2006, p. 163; ODFW 2006, p. 288). Beaver are important in the creation of small pools with slow-moving water that function as habitat for frog reproduction and create wet meadows that provide foraging habitat and protective vegetation cover (Amish 2006, p. 9; Cunningham *et al*. 2007, pp. 2520-2523; Stevens *et al*. 2007, pp. 6-11). Amish (2006, pp. 28-32) found significantly higher amounts of lentic habitat and breeding sites in watersheds containing beaver than watersheds without beaver. Beaver trapping is relatively common in Idaho, and there is no bag limit; however, harvest is restricted from November to March for the IDFG Regions where Columbia spotted frogs occur (IDFG 2011, pp. 39-40). Oregon allows harvest of beavers in Lake, Harney, and Malheur Counties with a season from November 15 to March 15, and no bag limit (ODFW 2010, p. 2); however, the Oregon Conservation Strategy encourages allowing beaver to contribute to wetland creation and maintenance when compatible with existing land uses (ODFW 2006, p. 312). In Nevada, beaver trapping is allowed from October 1 through March 31 and there is no bag limit (NDOW 2010b, p. 2). As indicated above, permanent ponded waters are important in maintaining spotted frog habitats during severe drought and winter periods. Removal of beaver in 1992 and the subsequent deterioration of the associated beaver dam on Stoneman Creek in Idaho is believed to be directly related to the decline of a spotted frog population there (Lingo and Munger 2003, pp. 3-6; Munger and Oelrich 2006, pp. 5-8). Intensive surveying of Stoneman Creek documented only one adult Columbia spotted frog in 2000 (Engle 2000, p. 4). In 2001, a beaver reintroduction project was started on Stoneman Creek (Munger and Lingo 2003, pp. 3-4). Since beaver reintroduction, annual egg mass surveys have shown a sharp increase (0 egg masses in 2000 and 167 in 2010), and Stoneman Creek may now be one of the largest known breeding sites in the Owyhee subpopulation (Lohr and Haak 2010, p. 13). We conclude that past beaver management practices have negatively influenced Columbia spotted frog habitat. There is a growing body of evidence linking the positive habitat influence of beaver to the presence of Columbia spotted frogs in the Great Basin DPS which should be investigated further.

Mining

The effects of mining on Great Basin Columbia spotted frogs have not been specifically studied, but the adverse effects of mining activities on water quality and quantity, other wildlife species, and amphibians in particular have been addressed in professional scientific forums (Nelson *et al*. 1991, pp. 425-458; Ripley *et al*. 1996, pp. 49-111; Lefcort *et al*. 1998, pp. 449-452; Burkhart *et al*. 2003, pp. 111-128; Unrine *et al*. 2004, pp. 2966-2969; Bridges and Semlitsch 2005, pp. 89-92). Mining can contribute toxic substances into waterways, alter stream morphology, and dewater streams completely (Nelson *et al*. 1991, pp. 429-446; Service 2008, pp. 30-33). Up until 2001, Nevada had the second-highest level of atmospheric mercury releases in the nation (Miller 2004, p. 1). According to Toxic Release Inventory data from the Environmental Protection Agency (USEPA), major precious metal mining facilities in Nevada released between 5,443.1 and 5,896.7 kilograms (12,000 and 13,000 pounds) of mercury directly into the atmosphere from 1998 to 2001; however, mercury emissions have declined sharply since 2001 (USEPA 2011). Despite these reduced emissions, a recent advisory was issued by the Nevada State Health Division (NSHD) that recommends limiting human consumption of fish from six northern Nevada waters due to elevated methylmercury levels (NSHD 2007, pp. 1-2). In 2008, the Service published an assessment of trace-metal exposure to aquatic biota from historical mine sites in the western Great Basin (Service 2008, pp. 1-59). The study looked at five different streams across the western Great Basin with various levels of mining impacts (Service 2008, p. 11). The authors found low pH and increased concentrations of certain trace-metals in some streams which pose a significant threat to aquatic biota, increased concentrations of trace-metals in stream sediment, and bioaccumulation of trace-metals in macroinvertebrates and fish (Service 2008, pp. 30-33).

In November 2006, a perched aquifer in the headwaters of the North Fork Humboldt River began to drain due to deep core drilling during mineral exploration at the Big Springs Mine (HydroGeo 2008, p. 62). Sammy Creek, a tributary to the North Fork Humboldt River, and portions of the North Fork Humboldt River have gone dry annually since 2007 due to the drained aquifer (HydroGeo 2008, p. 50; HydroGeo 2010, pp. 4-14). In addition to a decrease in the amount of water in the North Fork Humboldt River, water quality has also been negatively impacted with elevated levels of several constituents including arsenic and sulfate being recorded (HydroGeo 2010, pp. 14-36). Columbia spotted frogs have historically (prior to the drainage event) been found within this impacted stream reach (USFS 2004, p. 10); however, individuals were only located downstream of the impacted reach in 2010 and the population level impacts are largely unknown (NDOW 2010c). Mining is an overall low threat to Columbia spotted frogs on a rangewide basis; however, it is locally important in several watersheds as mentioned above. Due to the current high price of gold, we expect this threat to intensify and expand into other areas.

In summary, Columbia spotted frog populations have been and continue to be impacted by habitat destruction and modification causing increased habitat fragmentation and isolation. Current land uses continue to negatively alter or destroy important habitat throughout the range of the Columbia spotted frog which further fragments populations making them more susceptible to extinction (Wilcox *et al*. 2006, pp. 857-862). Despite reduced mercury emissions, recent advisories pertaining to mercury contamination indicate continuing risk to populations of Columbia spotted frogs downwind of large mining areas in northeastern Nevada. Based on our evaluation of on-going land use activities described above, we conclude there is sufficient information to develop a proposed listing rule for this species due to the present or threatened destruction, modification, or curtailment of its habitat and range.

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

B. Overutilization for commercial, recreational, scientific, or educational purposes.

We have no information to support that overutilization is a threat to Great Basin Columbia spotted frogs at this time. See Factor D for a discussion of regulatory mechanisms influencing the potential for overutilization.

C. Disease or predation:

Predation by Nonnative Species

The impact of nonnative invasive species on native species, communities, and ecosystems has been severe (Sakai *et al*. 2001, pp. 305-332). The introductions of nonnative salmonid (*Oncorhynchus*, *Salmo*, and *Salvelinus*) and centrarchid (*Micropterus*) species for recreational fishing have negatively affected amphibian species, including Columbia spotted frogs, throughout the United States (Pilliod and Peterson 2001, pp. 326-331; Bradford 2005, pp. 919-924; Tait 2007, pp. 32-33; Vredenburg and Wake 2007, pp. 5-6; Murphy *et al*. 2010; pp. 3640-3643). The effects of predation are difficult to document, particularly in stream systems. However, significant negative effects of predation on frog populations in lentic systems have been documented (Knapp and Matthews 2000, pp. 433-435; Pilliod and Peterson 2001, pp. 326-331; Kats and Ferrer 2003, pp. 99-108; Dunham *et al*. 2004, pp. 19-20; Bradford 2005, pp. 919-924; Knapp 2005, pp. 270-275). In the western United States, Lomnicky *et al*. (2007, p. 1086) found that 52 percent of stream lengths surveyed contained nonnative vertebrates. They also found that the most common nonnative vertebrates were brook trout (*Salvelinus fontinalis*) (17 percent of all nonnative vertebrates present), brown trout (*Salmo trutta*) (16 percent), and rainbow trout (*Oncorhynchus mykiss*) (14 percent) (Lomnicky *et al*. 2007, p. 1086). Using the same dataset, Whittier and Peck (2008, p. 1889) analyzed the surface area occupied by nonnative vertebrates and found that 75 percent of the waters sampled were occupied by nonnatives. They also found there is a greater likelihood of finding nonnative vertebrates in larger streams (Whittier and Peck 2008, p. 1889). When surface area is considered, the most common nonnative vertebrates are rainbow trout, carp (*Cyprinus carpio*), brown trout, and smallmouth bass (*Micropterus dolomieu*) (Whittier and Peck 2008, p. 1890). The existence of nonnative fish species throughout the historical range of Columbia spotted frogs further fragments populations making it difficult to recolonize habitat or exchange genetic material (see Factor A above). To date, no State fish and game agencies have altered nonnative fish stocking rates or locations in order to benefit Columbia spotted frogs directly; however, conservation efforts for native salmonids may indirectly benefit Columbia spotted frogs due to overlapping distributions.

The American bullfrog, a native ranid species to much of central and eastern North America, now occurs within the range of Columbia spotted frog in the Great Basin (Casper and Hendricks 2005, pp. 540-541). Bullfrogs are known to compete with and prey on other frog species (Moyle 1973, pp. 19-21; Pearl *et al*. 2004, pp. 16-18; Casper and Hendricks 2005, pp. 543-544; Monello *et al*. 2006, p. 406; Tait 2007, pp. 32-33). They rarely co-occur with Columbia spotted frogs (one known site in Nevada), but whether this is an artifact of competitive exclusion or predation is unknown at this time. Bullfrogs are important vectors for spreading many types of diseases and parasites to healthy populations of native amphibians (Johnson and Lunde 2005, p. 130).

We conclude that nonnative species of fish and amphibians are a significant threat to Columbia spotted frogs rangewide because: (1) nonnative species have had documented negative effects on Columbia spotted frog populations; (2) efforts required to reduce or eliminate nonnative species are not currently being conducted on a rangewide basis; (3) nonnative species occur throughout the majority of historical habitat; (4) nonnative species continue to be stocked and managed for within historical Columbia spotted frog habitat; and (5) the number of streams and lakes that need treatment to control or eradicate nonnative species exceeds the capabilities of resource managers at their current staffing and funding levels.

Chytridiomycosis

Although a diversity of microbial species is naturally associated with amphibians, it is generally accepted that they are rarely pathogenic to amphibians except under stressful environmental conditions. Chytridiomycosis (chytrid), caused by the pathogenic fungus *Batrachochytrium dendrobatidis*, is an emerging panzootic fungal disease in the United States and globally (Daszak *et al*. 2003, pp. 143-148; Blaustein *et al*. 2005, pp. 1464-1465; Briggs *et al*. 2005, pp. 3156-3158; Ouellet *et al*. 2005, pp. 1433-1438; Rachowicz *et al*. 2006, pp. 1676-1682; Pounds *et al*. 2006, pp. 161-167; Pearl *et al*. 2007b, pp. 146-148; Vredenburg and Wake 2007, p.

6). Clinical signs of amphibian chytrid and diagnosis are described by Daszak *et al*. (1999, p. 737) and include abnormal posture, lethargy, and loss of righting reflex. Gross lesions, which are usually not apparent, consist of abnormal epidermal sloughing and ulceration; hemorrhages in the skin, muscle, or eye; hyperemia of digital and ventrum skin, and congestion of viscera. Diagnosis is by identification of characteristic intracellular flask-shaped sporangia and septate thalli within the epidermis. Chytrid can be identified in some species of frogs by examining the oral discs of tadpoles which may be abnormally formed or lacking pigment (Fellers *et al*. 2001, pp. 946-947).

Chytrid was confirmed in Columbia spotted frogs at the Circle Pond site, Idaho, where long term monitoring (since 1998) indicated a strong decline in the population between 2000 (Engle 2002, pp. 15-19) and 2010 (Lohr and Haak 2010, p. 13). It is unclear what role, if any, chytrid played in the decline of this population. Columbia spotted frogs at sites in Oregon and northern Idaho have also tested positive for chytrid (Bull 2006, pp. 3-4; Engle 2006, p. 16; Pearl *et al*. 2007b, pp. 146-148; Adams *et al*. 2010a, pp. 294-298; Russell *et al*. 2010, pp. 226-227). Chytrid has also been found in the Wasatch Columbia spotted frog DPS (Semon *et al*. 2005, pp. 11-12; Wilson *et al*. 2005, pp. 2-3). Chytrid has not been found in Columbia spotted frog populations in Nevada; however, chytrid has been found in two bullfrog populations. Along the Owyhee River in northern Elko County, one population of Columbia spotted frogs (which have not been tested) co-occur with infected bullfrogs (Green 2006, p. 1); the other infected bullfrog population is near Beatty, Nevada, which is approximately 225 km (140 mi) to the south of the Toiyabe Mountains subpopulation (USGS 2005, p. 1).

Chytrid has not been associated with large die-offs of Columbia spotted frogs which have plagued other amphibian species (Rachowicz *et al*. 2006, pp. 1676-1682; Adams *et al*. 2010a, p. 300). Some evidence suggests that Columbia spotted frogs produce antimicrobial peptides in their skin which may inhibit chytrid infection (Rollins-Smith *et al*. 2002, pp. 473-476; Rollins-Smith *et al*. 2005, pp. 137-142); however, further understanding of how chytrid affects Columbia spotted frogs is needed (Russell *et al*. 2010, pp. 228-229).

Malformations

Malformations found in amphibian populations can be caused by several different factors including pesticides, high ultraviolet-B (UV-B) radiation exposure, and parasites and pathogens (Carey *et al*. 2003, pp. 194-197; Ankley *et al*. 2004, pp. 9-13; Johnson and Lunde 2005, pp. 125-138; Sutherland 2005, pp. 109-123). Pesticides and UV-B radiation are discussed further below in Factor E. The larvae of the trematode *Ribeiroia ondatrae* has been associated with higher than normal levels of malformations in populations of several species of amphibians, including Columbia spotted frogs (Johnson *et al*. 2002, pp. 155-162); however, there is high variability in resistance to infection among amphibian species (Johnson and Hartson 2009, pp. 194-198). Malformed frogs have higher mortality rates than non-malformed individuals and mortality can be caused directly through infection or indirectly through reduced fitness and predation (Johnson and Lunde 2005, p. 136). The life cycle of *R. ondatrae* includes three hosts: snails of the genus *Planorbella*, amphibians or fish, and finally a bird or mammal (Johnson and Lunde 2005, p. 126). In a study covering five western states, the presence and abundance of *Planorbella* snails was the only variable related to the presence and abundance of *R. ondatrae* (Johnson *et al*. 2002, pp. 160-161). *Planorbella* snails were more associated with wetlands of human origin and higher orthophosphate levels (Johnson *et al*. 2002, pp. 160-161; Johnson and Lunde 2005, pp. 133-135; Johnson *et al*. 2007, pp. 15781-15784) indicating that stock ponds could be acting as a source for *Planorbella* snails. High prevalence of malformed Columbia spotted frogs outside the Great Basin DPS have been documented (Johnson *et al*. 2002, pp. 157-159); however, within the Great Basin DPS, there has been no evidence of above background level malformations reported (typically less than 5 percent of the population). Increased levels of malformations may be an expanding threat to Columbia spotted frogs as *Planorbella* snail species are being recorded at sites beyond their previously known ranges (Johnson *et al*. 2002, p. 161).

In summary, nonnative fish (i.e., salmonids or bass) and amphibian (bullfrog) predators occur throughout the range of Columbia spotted frogs. These predators can eliminate or reduce populations or restrict movement of individuals, thus, increasing fragmentation and not allowing metapopulation dynamics to occur. Nonnative fish and amphibians can also be vectors for parasites or pathogens (i.e., chytrid fungus) which may increase deformities and can increase mortality rates. Based on our evaluation of predation and disease described above, we conclude there is sufficient information to develop a proposed listing rule for this species.

D. The inadequacy of existing regulatory mechanisms:

There are several Federal and State laws and regulations that are pertinent to candidate species, each of which may contribute in varying degrees to the conservation of non-listed species. These laws, most of which have been enacted in the past 30-40 years, have reduced or eliminated the threats of habitat destruction and overutilization. These laws are discussed below.

Federal Protections

National Environmental Policy Act (NEPA): The NEPA (42 U.S.C. 4371 *et seq*.) provides some protection for candidate species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation alternatives that would offset those effects (40 C.F.R. 1502.16). Mitigation usually provides some protection for candidate species. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public.

National Forest Management Act (NFMA): The NFMA (36 C.F.R. 219.20(b)(i)) requires the USFS to incorporate standards and guidelines into Land and Resource Management Plans, including provisions to support and manage plant and animal communities for diversity and for the long-term, range-wide viability of native species. The Intermountain Region (Region 4) of the USFS considers the Columbia spotted frog a sensitive species. Therefore, as part of USFS policy, the analysis related to planning under the NFMA and conducted by the USFS to evaluate potential management decisions under NEPA includes a biological evaluation which discloses potential impacts to sensitive species at both the forest planning level and on a project-by-project basis. Under USFS policy (Forest Service Manual 2620 and 2670), projects must not result in contributing to a trend towards Federal listing of species. The USFS must develop and implement management practices to ensure that species on the sensitive species list do not become threatened or endangered because of USFS actions. Management objectives must be met in cooperation with the States when projects on National Forest System lands may have a significant effect on sensitive species population numbers or distributions. Furthermore, for Federal candidate species, management objectives must be implemented in cooperation with the Service.

Federal Land Policy and Management Act of 1976 (FLPMA): The BLM is required to incorporate Federal, State, and local input into their management decisions through Federal law. The FLPMA (Public Law 94-579, 43 U.S.C. 1701) was written "to establish public land policy; to establish guidelines for its administration; to provide for the management, protection, development and enhancement of the public lands; and for other purposes." Section 102(f) of the FLPMA states that "the Secretary [of the Interior] shall allow an opportunity for public involvement and by regulation shall establish procedures … to give Federal, State, and local governments and the public, adequate notice and opportunity to comment upon and participate in the formulation of plans and programs relating to the management of the public lands." Therefore, through management plans, the BLM is responsible for including input from Federal, State, and local governments and the public.

In addition, BLM policies direct management to consider candidate species on public lands under their jurisdiction. Consistent with existing laws, the BLM shall implement management plans that conserve candidate species and their habitats and shall ensure that actions authorized, funded, or carried out by the

BLM do not contribute to the need for the species to become listed. Specifically, BLM policy 6840 requires the development, cooperation with, and implementation of range-wide or site-specific management plans, conservation strategies, and assessments for candidate species that include specific habitat and population management objectives designed for conservation, as well as management strategies necessary to meet those objectives. The BLM should request technical assistance from the Service, and other qualified sources, on any planned action that may contribute to the need to list a candidate species as threatened or endangered.

Clean Water Act: Under section 404, the U.S. Army Corps of Engineers (USACE) regulates the discharge of fill material into waters of the United States, which include navigable and isolated waters, headwaters, and adjacent wetlands (33 U.S.C. 1344). In general, the term "wetland" refers to areas meeting the USACE's criteria of hydric soils, hydrology (either sufficient annual flooding or water on the soil surface), and hydrophytic vegetation (plants specifically adapted for growing in wetlands). Any action with the potential to impact waters of the United States must be reviewed under the Clean Water Act, NEPA, and ESA. These reviews require consideration of impacts to listed species and their habitats, and recommendations for mitigation of significant impacts.

The USACE interprets "the waters of the United States" expansively to include not only traditional navigable waters and wetlands, but also other defined waters that are adjacent or hydrologically connected to traditional navigable waters. However, recent Supreme Court rulings have called into question this definition. On June 19, 2006, the U.S. Supreme Court vacated two district court judgments that upheld this interpretation as it applied to two cases involving "isolated" wetlands. Currently, USACE regulatory oversight of such wetlands (i.e., vernal pools) is in doubt because of their "isolated" nature. In response to the Supreme Court decision, the USACE and the USEPA have recently released a memorandum providing guidelines for determining jurisdiction under the Clean Water Act. The guidelines provide for a case-by-case determination of a "significant nexus" standard that may protect some, but not all, isolated wetland habitat (USEPA and USACE 2007, pp. 4-11). The overall effect of the new permit guidelines on loss of isolated wetlands is not known at this time.

The Lacey Act: The Lacey Act (Public Law 97-79), as amended in 16 U.S.C. 3371, makes unlawful the import, export, or transport of any wild animals whether alive or dead taken in violation of any United States or Indian Tribal law, treaty, or any law or regulation of any State. The Lacey Act further makes unlawful the selling, receiving, acquisition or purchasing of any wild animal, alive or dead. The designation of "wild animal" includes parts, products, eggs, or offspring.

Endangered Species Act of 1973, as amended (ESA): The threatened Lahontan cutthroat trout (*Oncorhynchus clarkii henshawi*) (LCT) historically occurred throughout the Nevada portion of Columbia spotted frog's range and their distribution still overlaps in some watersheds. One Recovery Unit (Upper Snake Recovery Unit) for the threatened bull trout (*Salvelinus confluentus*), including their designated critical habitat, overlaps currently occupied Columbia spotted frog habitat in northeastern Nevada and southwestern Idaho and eastern Oregon. Some recovery efforts and regulatory protection measures for these threatened salmonid species should benefit Columbia spotted frogs in some riverine environments where their habitats overlap.

Only species that have been proposed for listing are covered by the conference provision under section 7(a)(4) of the ESA. However, Service policy requires candidate species be treated as proposed species for purposes of intra-Service consultation where the Service's actions may affect candidate species (e.g., candidate species on National Wildlife Refuges). This provides some measure of protection for the Columbia spotted frog on the Malheur National Wildlife Refuge and from Service activities.

Under the authority of section 10 of the ESA, the Service adopted policy and regulations for voluntary conservation of candidate species (64 FR 32726; June 17, 1999). Candidate Conservation Agreements (CCAs) are voluntary conservation agreements between the Service and one or more public or private parties. The Service works with its partners to identify threats to candidate species, plan the measures needed to address the threats and conserve these species, identify willing landowners, develop agreements, and design and implement conservation measures and monitor their effectiveness. Candidate Conservation Agreements with Assurances (CCAAs) expand on the success of traditional CCAs by providing non-Federal landowners with additional incentives for engaging in voluntary proactive conservation through assurances that limit future conservation obligations. One of the primary reasons for developing the CCAA program was to address landowner concerns about the potential regulatory implications of having a listed species on their land. The CCAA program specifically targets non-Federal landowners and provides them with the assurance that if they implement various conservation activities, they will not be subject to additional restrictions if the species becomes listed under the ESA. These assurances are only available to non-Federal entities for actions on non-Federal lands. Two Conservation Agreements and one CCAA have been implemented for Columbia spotted frogs within the Great Basin DPS (see Conservation Measures Planned or Implemented section below).

Tribal

Tribal governments within the Great Basin with Columbia spotted frogs do not have regulatory or protective mechanisms in place to protect spotted frogs. The status of local populations of Columbia spotted frogs on Yomba-Shoshone and Duck Valley Indian Reservation tribal lands is generally unknown.

State Protections

Columbia spotted frogs are classified as a protected amphibian by the State of Nevada under Nevada Administrative Code (NAC) 503.075(3)(a). Per NAC 503.090(1) there is no open season on those species of amphibian classified as protected. Per NAC 503.093 a person shall not hunt or take any wildlife which is classified as protected, or possess any part thereof, without first obtaining the appropriate license, permit or written authorization from the NDOW. NAC 503.094 authorizes issuance of permits for the take and possession of any species of wildlife for strictly scientific or educational purposes. Idaho law allows up to four native amphibians and reptiles of a given species to be captured alive, held in captivity, killed, or possessed at any one time by holders of a valid Idaho hunting license (Idaho Administration Procedures Act 2010, p. 4). Columbia spotted frogs are on the non-game protected wildlife list for the State of Oregon (Oregon Administrative Rule 635-044-0130, pp. 8-9); moreover, they are listed on Oregon’s sensitive species list which is used as an early warning system and encourages voluntary actions to improve the status of species on the list (ODFW 2008, pp. 1, 11). All three States include Columbia spotted frogs in their State Wildlife Action Plans as a species of conservation concern (IDFG 2005, p. 71; NDOW 2006, pp. 328-329; ODFW 2006, p. 337).

Lands administered by the USFS and BLM are interspersed with and surround private parcels on which intensive grazing management, irrigation (diversions), agriculture, and mining activities likely typify the land-use practices. There are generally fewer State regulatory mechanisms to address activities on private lands. Grazing of private lands could exacerbate the adverse effects of actions on public lands to Columbia spotted frogs, as described previously. Irrigation, agriculture, and mining practices could dewater streams, create migration barriers, or negatively affect water quality. Ongoing or reasonably foreseeable future activities on private lands within the range of Columbia spotted frogs will continue to affect Columbia spotted frogs and their habitat but the extent of that impact is unknown at this time.

In summary, regulatory mechanisms exist for the Columbia spotted frog; however, consistency in applying these mechanisms is unclear. Federal agency policy requires that management activities do not lead to a trend to list candidate species as threatened or endangered. While policies exist to protect Columbia spotted frogs and their habitat on public lands, there is no mechanism to show the effectiveness of these policies. Other federally-listed species occur within the range of Columbia spotted frogs; however, the extent of this overlap and its effectiveness in protecting Columbia spotted frogs and their habitat is unknown. There are no known Tribal regulatory mechanisms in place to protect Columbia spotted frogs. Although all three States include Columbia spotted frog in their State Wildlife Action Plans as a species of conservation concern, Idaho and

Oregon still allow some take. Nevada does not allow take of the species without a permit; however, enforcement is lacking and harvest levels are unknown. Private lands could be very important to the conservation of Columbia spotted frogs due to their frequent locations on or near waterways, but protective measures for the species in these areas are generally lacking. Based on our evaluation of the inadequacy of existing regulatory mechanisms described above, we conclude there is sufficient information to develop a proposed listing rule for this species.

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

Climate Change

Warming trends due to climate change seen over the past 50 years in the United States are predicted to continue to increase (Field *et al*. 2007, pp. 626-627); however, the magnitude varies spatially across the continent, is most pronounced during spring and winter months, and has affected daily minimum temperatures more than daily maximum temperatures (Field *et al*. 2007, p. 620). Other effects of climate change include, but are not limited to, changes in types of precipitation (Knowles *et al*. 2006, p. 4557; Seager *et al*. 2007, pp. 1181-1184), earlier spring run-off (Stewart *et al*. 2005, p. 1152), longer and more intense fire seasons (Brown *et al*. 2004, pp. 375-385; Westerling *et al*. 2006, pp. 941-942; Bachelet *et al*. 2007, pp. 16-17), and more frequent extreme weather events (Diffenbaugh *et al*. 2005, pp. 15775-15777; Rosenzweig *et al*. 2007, p. 109; Kunkel *et al*. 2009, pp. 6207-6214). Climate change is predicted to have several effects on cold water habitat including: (1) increased water temperature; (2) decreased stream flow; (3) change in the hydrograph; and (4) increased frequency and severity of extreme events such as drought and fire (see below) (Stewart *et al*. 2005, pp. 1140-1154; Ficke *et al*. 2007, pp. 583-593; Bates *et al*. 2008, pp. 102-106; Webb *et al*. 2008, pp. 909-911; Kaushal *et al*. 2010, pp. 462-466). These changes in climate and subsequent effects can be attributed to the combined effects of greenhouse gases, sulphate aerosols, and natural external forcing (Karoly *et al*. 2003, p. 1203; Barnett *et al*. 2008, p. 1082; Serreze 2010, pp. 11-13).

The Intergovernmental Panel on Climate Change (IPCC) states that of all ecosystems, freshwater ecosystems will have the highest proportion of species threatened with extinction due to climate change (Kundzewicz *et al*. 2007, p. 192). Species with narrow temperature tolerances and cold-water species (e.g., amphibians) will likely experience the greatest effects from climate change, and it is anticipated that populations located at the margins of the species' hydrologic and geographic distributions will be affected first (Bates *et al*. 2008, p. 104). Researchers in Italy have documented amphibian declines and have associated these declines with decreases in water availability and increases in temperature associated with climate change (D'Amen and Bombi 2009, pp. 3063-3066). Even in relatively pristine areas (e.g., Yellowstone National Park), biologists are documenting amphibian declines and are linking these declines to long-term, large-scale climatic trends (McMenamin *et al*. 2008, pp. 16988-16990). In contrast, McCaffery and Maxell (2010, pp. 8645-8647) found that decreasing winter severity associated with warmer drier winters increased the population viability of Columbia spotted frogs in a high elevation wilderness area in Idaho (Northern DPS).

Past climate scenarios have shaped Great Basin ecosystems (Tausch *et al*. 2004, pp. 24-40). Great Basin ecosystems and their associated riparian areas are expected to be highly sensitive to any future changes in climate (Sala *et al*. 2000, pp. 1772-1773; Fleishman *et al*. 2004, pp. 248-251; Field *et al*. 2007, pp. 627-630). Ecological consequences of climate change to amphibians may include changes in population dynamics, timing of reproduction, changing geographic range, and broader community and ecosystem level changes (Hansen *et al*. 2001, pp. 766-773; McCarty 2001, pp. 321-325; Carey and Alexander 2003, pp. 116-118; Inkley *et al*. 2004, p. 9; Corn 2005, pp. 61-62; Parmesan 2006, pp. 637-669; Rahel and Olden 2008, pp. 522-531; Lawler *et al*. 2010, pp. 46-48). Amphibians are sensitive to changes in precipitation and temperature which may increase the risk of extinction for this group of organisms (Boone *et al*. 2003, pp. 131-136; Corn 2005, pp. 59-64; Noss *et al*. 2006, p. 236; Pounds *et al*. 2007, pp. 19-20; Vredenburg and Wake 2007, pp. 6-7).

The impacts to Columbia spotted frogs from climate change are not known with certainty. Predicted outcomes of climate change imply that negative impacts will occur through increased stream temperatures, decreased stream flow, changes in the hydrograph, and increased frequency of extreme events. Water temperatures are expected to increase in the future; however, impacts from rising water temperature are not known for Columbia spotted frogs. Rising stream temperatures may allow nonnative species to expand their current ranges into Columbia spotted frog occupied habitat (Rahel *et al*. 2008, pp. 553-554). Reductions in streamflow are predicted to have a negative impact on Columbia spotted frog populations because of the fragmented nature of populations, the small size of most populations, and the close association of recruitment and survival to the amount of water available. Degraded aquatic systems exhibit greatly reduced resiliency to accommodate natural disturbances such as floods, fire, and drought, thereby exacerbating the effects of those events, which further reduces the persistence of these populations (Wilcox *et al*. 2006, pp. 860-862). These degraded conditions, combined with variability in Columbia spotted frog numbers, place greater importance on the quantity and quality of the habitat needed for survival and recovery of Columbia spotted frogs. These impacts associated with climate change will likely intensify the threats to Columbia spotted frogs previously described under Factors A and C.

Drought

Drought has been an important natural disturbance in the western United States since the early Holocene (Cook *et al*. 2004, p. 1017; Mensing *et al*. 2008, pp. 80-84). Cook *et al*. (2004, p. 1016) report the percentage of the western United States in drought conditions has gradually increased over the last century and that the current drought rivals the drought conditions in the 1930's; however, these more recent droughts (i.e., in the last century) pale in comparison to conditions found 700-1,100 years before present in terms of duration and severity. These historic drought conditions likely negatively impacted Columbia spotted frog populations throughout their range. Due to dispersal abilities, metapopulation dynamics, and unimpaired connected habitat in which they evolved, Columbia spotted frogs were able to persist and repopulate areas when conditions became favorable, despite these severe recurring drought conditions (Lake 2003, pp. 1166-1167; Wilcox *et al*. 2006, p. 859). Since most populations are now fragmented and isolated, recolonization after extirpation or input of genetic material from other populations cannot occur naturally. With more frequent and severe droughts likely accompanying climate change, we conclude that drought is a threat to Columbia spotted frogs throughout the Great Basin DPS.

Fire

Fire has been one of the dominant factors shaping ecosystems for millennia (Miller and Rose 1999, pp. 555-558). Fire regimes in the Great Basin differ by the three main vegetation types: sagebrush shrublands, desert shrublands, and pinyon-juniper woodlands. Prior to European settlement, fire regimes in sagebrush shrublands of the Great Basin have been characterized as a combination of mixed-severity and stand-replacing fires with return intervals ranging anywhere from 10 to 70 years (Rice *et al*. 2008, p. 154). Desert shrubland vegetation types are characterized by infrequent, stand-replacement fires with fire return intervals between 35 years to several centuries (Rice *et al*. 2008, p. 155). Pinyon-juniper woodlands are characterized as a mixed fire regime; however, fire histories in pinyon-juniper woodlands are difficult to reconstruct (Paysen *et al*. 2000, p. 130). Return intervals in pinyon-juniper woodlands range from 10 to over 300 years depending on site productivity and plant community structure (Rice *et al*. 2008, p. 162). Fire regimes in the Great Basin have become more frequent due to wildfire exclusion, historical grazing practices, and the introduction of invasive nonnative plant species (Rice *et al*. 2008, p. 141). More frequent fires favor the establishment of nonnative plants (e.g., *Bromus tectorum* (cheatgrass)), which results in the loss of sagebrush and other native plant species (Rice *et al*. 2008, p. 154).

Riparian areas are also subject to fires; however, return intervals and fire regimes may be different than the adjacent uplands. The scant information available on fire in riparian areas indicates that return intervals and fire regime type depend on the width of the riparian area and the fuel type adjacent to the riparian area (Dwire and Kauffman 2003, pp. 62-63; Pettit and Naiman 2007, pp. 675-677). Smaller riparian areas are more similar to the adjacent upland areas while larger riparian areas tend to have longer return intervals and lower fire intensity (Dwire and Kauffman 2003, pp. 62-63; Pettit and Naiman 2007, pp. 675-677). Streamside vegetation has adapted to disturbance which contributes to the relatively rapid recovery of riparian habitat following fire; however, recovery rates depend on the condition of the riparian area prior to the fire, fire severity, post-fire flooding, and post-fire management (Miller 2000, pp. 16-22; Bond and Midgley 2003, pp. S103-S112; Dwire and Kauffman 2003, pp. 67-71; Pettit and Naiman 2007, pp. 680-682; Halofsky and Hibbs 2009, pp. 1355-1358; Jackson and Sullivan 2009, pp. 27-31).

Changing climate has affected summer temperatures and the timing of spring snowmelt, which have contributed to increasing the length of the wildfire season, wildfire frequency, and the size of wildfires (McKenzie *et al*. 2004, pp. 893-897; Westerling *et al*. 2006, p. 941). Westerling *et al*. (2006, p. 942) conclude that there are robust statistical associations between wildfire and climate in the western United States and that increased fire activity over recent decades reflects responses to climate change.

Direct mortality of amphibians due to fire is thought to be rare and of minor importance to most populations (Russell *et al*. 1999, pp. 374-379; Smith 2000, pp. 20, 29-30; Pilliod *et al*. 2003, pp. 165-175; Hossack and Corn 2007, pp. 1406-1409); however, few studies have documented fire effects to aquatic amphibians in the western United States (Bury 2004, pp. 970-973). Most negative effects to aquatic species after wildfire are due to the immediate loss or alteration of habitat and indirect effects such as post-fire hydrologic events (Gresswell 1999, pp. 199-211; Benda *et al*. 2003, pp. 107-117; Miller *et al*. 2003, pp. 121-136; Wondzell and King 2003, pp. 75-84; Dunham *et al*. 2007, pp. 340-344). In addition, fire suppression activities, including construction of fire lines, back burning, application of water from pumps or aerial drops, and use of fire retardants and suppressant foams, could negatively affect amphibians (Little and Calfee 2002, p. 3; Backer *et al*. 2004, pp. 937-944).

Although Columbia spotted frogs evolved in a fire-prone environment, increases in wildfire frequency and severity due to increased fuel loads, exotic species, and effects from climate change (Westerling *et al*. 2006, p. 941) have increased the threats due to wildfire. Current wildfires are a larger threat to Columbia spotted frogs because of existing habitat loss and the current fragmented and isolated state of occupied habitat. While we have no studies documenting negative impacts of wildfires to Columbia spotted frog populations in the Great Basin DPS, we attribute this to no known studies of populations which have been impacted by recent fires. Impacts from recent fires on Columbia spotted frog populations should be investigated further.

UV-B Radiation

Increases in UV-B radiation from depletion of stratospheric ozone have been suggested as a possible threat to amphibian populations (Blaustein *et al*. 1997, pp. 13735-13736; Adams *et al*. 2005, pp. 493-498; Blaustein and Belden 2005, pp. 87-88; Bancroft *et al*. 2008, pp. 990-993). UV-B mainly decreases egg survivorship and increases deformities in developing metamorphs (Blaustein *et al*. 1997, pp. 13735-13736). Columbia spotted frogs are a species that could be susceptible to increases in UV-B radiation because they are a basking species and lay their eggs in shallow water. However, Blaustein *et al*. (1999, pp. 1102-1104) found that Columbia spotted frogs in the embryonic stage were resistant to UV-B because of high levels of photolyase (a photoreactivating enzyme) and Adams *et al*. (2005, p. 497) found ambiguous results on the effects of UV-B on Columbia spotted frogs. There is insufficient information to conclude that UV-B radiation is currently a threat; however, we agree with (Adams *et al*. 2005, p. 497) who suggests that the relationship should be investigated further.

Pesticides

Amphibians are sensitive to chemical contaminants due to their habitat requirements (terrestrial and aquatic), complex life history, and their unique anatomy and physiology (Burkhart *et al*. 2003, pp. 111-112). Chemicals are the third most implicated factor in amphibian declines in the United States (Bradford 2005, p. 919). Evidence of direct mortality of amphibians is relatively sparse due to the low concentrations of individual chemicals in the environment; however, sublethal impacts, such as decreased growth, reduced fitness, or increased susceptibility to predation, may lead to population declines (Bridges and Semlitsch 2005, p. 89). Additionally, complex mixtures of various chemicals have been shown to be more toxic than individual chemicals acting alone (Burkhart *et al*. 2003, pp. 112-115; Relyea 2009, pp. 367-374).

Use of pesticides for control of grasshoppers (*Melanoplus* sp.) and crickets (*Anabrus simplex*), as well as use of herbicides to treat weeds and other vegetation, may be impacting some populations of Columbia spotted frogs, particularly on private property. While we have no evidence to suggest frogs have been directly affected in the past, we do know substantial amounts of pesticides (e.g., carbaryl), herbicides (e.g., Tordon®), and other chemicals are being used in close proximity to occupied sites in Oregon, Nevada, and Idaho (Idaho State Department of Agriculture 2010, pp. 1-6; Pearl *et al*. 2010, pp. 94-96; U.S. Department of Agriculture 2011, pp. 1-75). There is insufficient information to conclude that pesticides are currently a threat; however, due to the application of chemicals known to cause negative impacts to amphibians being applied near occupied habitat, this potential threat should be investigated further.

Multiple Stressors

Many of the threats discussed above do not act alone. Multiple stressors can alter the effects of other stressors or act synergistically to affect individuals and populations (IPCC 2002, p. 22; Boone *et al*. 2003, pp. 138-143; Westerman *et al*. 2003, pp. 90-91; Opdam and Wascher 2004, pp. 285-297; Boone *et al*. 2007, pp. 293-297; Vredenburg and Wake 2007, p. 7; Lawler *et al*. 2010, p. 47). For example, Kiesecker and Blaustein (1995, pp. 11050-11051) describe how UV-B acts with a pathogen to increase embryonic mortality above levels shown with either factor alone. Interactions between current land uses and changing climate conditions are expected to cause shifts in populations, communities, and ecosystems (Hansen *et al*. 2001, p. 767), which may make certain species more vulnerable to extinction (IPCC 2002, p. 22). Additionally, chemicals may exist in the environment at sub-lethal levels; however, UV light may increase the toxicity of these chemicals or may increase an individual's susceptibility to infection, disease, or predation (Boone *et al*. 2003, pp. 138-142; Burkhart *et al*. 2003, pp. 116-120; Bancroft *et al*. 2008, pp. 990-993; Rohr *et al*. 2008, pp. 1235-1237; Relyea 2009, pp. 367-374).

In summary, climate change has and is expected to continue to affect Great Basin ecosystems; however, predictions are difficult to make (Fleishman *et al*. 2004, pp. 248-251; Botkin *et al*. 2007, pp. 227-234; Field *et al*. 2007, pp. 627-630). Corn (2005, pp. 59-64) describes many negative consequences of a changing climate to amphibian species and predicts that impacts from climate change may be the greatest challenge to conserving amphibians in the future. The current state of small fragmented populations of Columbia spotted frogs in the Great Basin DPS indicates a high probability of populations disappearing due to loss of habitat from predicted climate related impacts (Corn 2005, pp. 59-64; Wilcox *et al*. 2006, pp. 857-862). Recent research on the effects of multiple stressors such as climate change, habitat destruction, pesticides, and disease has shown compelling evidence of negative impacts to amphibians; however, due to variability among species, this discipline needs further research. Protecting or improving Columbia spotted frogs and their habitat so that they can adapt to expected changes in climate may be the most important conservation action (Chambers *et al*. 2004b, pp. 266-268; Seavy *et al*. 2009, pp. 331-333). Based on our evaluation of other natural or manmade factors affecting its continued existence described above, we conclude there is sufficient information to develop a proposed listing rule for this species.

Conservation Measures Planned or Implemented :

A 10-year Conservation Agreement and Strategy (CAS) was signed in September 2003 (NDOW 2003a, pp. 1-43; 2003b, pp. 1-55) for the Northeast (Jarbidge-Independence Range and Ruby Mountains) and the Toiyabe Mountains subpopulations in Nevada. Additionally, a Candidate Conservation Agreement with Assurances was completed in 2006 for the Owyhee subpopulation at Sam Noble Springs, Idaho (Service 2006, pp. 1-45). At the end of 2010, 13 percent of the identified tasks listed in the Northeast CAS were completed and an additional 81 percent of the tasks had been initiated at some level (NDOW 2010, p. 5). At the end of 2010, 29 percent of the identified tasks listed in the Toiyabe Mountains CAS were completed and an additional 64 percent of the tasks were initiated at some level (NDOW 2011, p. 17). Implementing the CASs also includes formulating future conservation actions aimed at alleviating threats to the species. For example, adequate habitat was identified as a limiting factor in the Toiyabe Mountains subpopulation. A habitat enhancement project was completed in 2004 which included the construction or augmentation of 22 ponds in Indian Valley Creek (NDOW 2004a, pp. 4-6). An additional 14 ponds were constructed near Indian Valley Creek in 2009 along with plug and pond restoration techniques within Indian Valley Creek to arrest headcutting within the meadows. Habitat enhancement and beaver reintroduction projects are also being planned for Columbia spotted frog populations within the Jarbidge-Independence subpopulation. Effectiveness monitoring of these habitat enhancement projects as well as the effectiveness of the CASs as a conservation tool is ongoing. In Idaho, 14 ponds were constructed on private land in 2010 to increase breeding habitat and connectivity between existing populations (Service 2010, pp. 4-5). Some ponds were created adjacent to older ones which were filling in with sediment and appeared to have a reduction of use by Columbia spotted frogs. Pre (2009-2010) and post pond construction monitoring is occurring to assess effectiveness of these conservation measures. In addition, approximately seven beavers were released on private land at the request of a landowner in 2010 (Lohr 2010, pp. 1-9). Additional pond projects and beaver transplants are planned for private lands in Idaho.

To minimize the effects of grazing on Columbia spotted frog habitat, many grazing allotment closures and grazing exclosure projects have been implemented throughout the frog’s range including on Cloverdale Creek and Indian Valley Creek (Toiyabe Mountains subpopulation), and Dry Creek and Sam Noble Springs (Owyhee subpopulation), as well as study sites in northeastern Oregon (Bull 2005, pp. 2, 35-36). Effectiveness monitoring of these projects is vital in determining the impacts of grazing on Columbia spotted frogs in these areas and the validity of these management actions in protecting and enhancing Columbia spotted frog habitat. Additional genetic research is being conducted to clarify the boundary between the Northern and Great Basin clades in southeastern Oregon. Active monitoring, research, and habitat improvement projects are occurring or are planned throughout the range of the Great Basin DPS of Columbia spotted frogs, which are increasing our knowledge of life history characteristics, population fluctuations, genetics, and threats to the species.

Summary of Threats :

Small, highly fragmented populations, characteristic of the majority of existing populations of Columbia spotted frogs in the Great Basin, are highly susceptible to extinction processes. Poor management of Columbia spotted frog habitat including water development, improper grazing, mining activities and nonnative species have and continue to contribute to the degradation and fragmentation of habitat. Emerging fungal diseases such as chytridiomycosis and the spread of parasites may be contributing factors to Columbia spotted frog population declines throughout portions of its range. Effects of climate change such as drought and stochastic events such as fire often have detrimental effects to small isolated populations and can often exacerbate existing threats. Based on our evaluation of the five listing factors affecting the continued existence of Columbia spotted frogs in the Great Basin described above, we conclude there is sufficient information to develop a proposed listing rule for this species. We find that this DPS is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

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 :

RECOMMENDED CONSERVATION MEASURES:

- Identify and reduce threats to Columbia spotted frogs and their habitat
- Maintain, enhance, and restore populations of Columbia spotted frogs and their habitat throughout their current and historical range
- Further define the phylogeographic break between the Northern and Great Basin populations
- Conduct genetic analyses to determine the impacts of small isolated populations
- Assess the abundance of Columbia spotted frogs, trends, habitat conditions, and existing and potential threats in a consistent manner throughout their range. Long-term datasets exist for many populations. Detailed analyses should be performed using this data
- Conduct research that directly supports conservation and management of Columbia spotted frogs and their habitats (e.g., UV-B, chytridiomycosis, parasites, climate change, synergistic threats, habitat enhancement)
- Sampling for the presence of chytridiomycosis should occur in Nevada populations of Columbia spotted frogs. Further research should be performed to determine if chytrid is having negative impacts on Columbia spotted frog populations
- Effectiveness of habitat enhancement projects, via beaver reintroduction or pond construction, should be evaluated and reported

Priority Table

Magnitude	Immediacy	Taxonmomy	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	Monotype genus	10
		Species	11
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

We are not proposing to change the Listing Priority Number.

Magnitude:

Magnitude:
Columbia spotted frog habitat degradation and fragmentation is a combined result of past and current land use influences from agricultural development, intensive livestock grazing, spring development, urbanization,

mining activities, and climate change. The current state of small isolated populations throughout the range of Columbia spotted frogs in the Great Basin DPS indicates they are susceptible to extinction events. The existence of nonnative predatory fish species throughout the historical range of Columbia spotted frogs further fragments populations making it difficult to recolonize habitat or exchange genetic material. Modification and destruction of Columbia spotted frog habitat pose a substantial threat to many of the Columbia spotted frog populations within the Great Basin DPS. The impacts to Columbia spotted frogs from climate change are not known with certainty; however, predicted outcomes of climate change imply that negative impacts will occur through increased stream temperatures, decreased stream flow, changes in the hydrograph, and increased frequency of extreme events. The ecological consequences of climate change to amphibians may include changes in population dynamics, timing of reproduction, changing geographic range, and broader community and ecosystem level changes. Many of these threats occur across the range of Columbia spotted frogs at various intensities, while others only impact local populations. Thus, the overall magnitude of threats is moderate.

Imminence :

Imminence:
Threats to the species' habitat have occurred for over 100 years and continue to threaten the species today. Nonnative species occur throughout the range of Columbia spotted frogs which are further fragmenting and isolating populations. Climate change and its associated extreme weather conditions are occurring now and are expected to increase in the future. Risks from mercury and other mining related impacts are continuing and may be increasing in northeast Nevada. Chytrid fungus is documented in Idaho and Oregon populations and while there are no catastrophic population declines associated with chytrid infection, its sub-lethal impacts to those populations is unknown. Above natural levels of malformations due to parasites have been documented in other parts of its range and may be a threat to Columbia spotted frogs in the Great Basin DPS in the future. Therefore, we regard these threats as imminent

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

While most threats to the species are imminent, the threats are affecting the species at varying magnitudes and intensities. The two CASs and the development of CCAAs should provide a roadmap towards recovery. Monitoring the effectiveness of these agreements and willingness of the participants to continue implementation will remain a priority. As a candidate species, Columbia spotted frogs are afforded higher protection by Federal land management agencies.

Description of Monitoring:

Numerous mark-recapture and presence-absence surveys are occurring throughout the range of the Great Basin DPS of Columbia spotted frogs. Monitoring and research is being conducted by Colorado State University, Boise State University, USGS, BLM, USFS, Service, IDFG, NDOW, and the Nevada Natural Heritage Program. Annual reports and research papers are obtained by the Service's Nevada Fish and Wildlife Office and summarized for the CNOR. A rangewide Columbia spotted frog meeting (initiated in 2002) is held every 2 years to discuss various research, monitoring, and conservation activities occurring throughout the entire range of the species. The last meeting was held on March 10, 2010, in Reno, Nevada. The next meeting will be in 2012 in Salt Lake City, Utah.

Substantial effort is needed to conserve this species because it is a wide ranging species and occupies diverse habitat. Because of this, there is a need to conduct a mid-level type of monitoring effort as described in the Amphibian Research and Monitoring Initiative (Muths *et al*. 2006, pp. 1-77). Mid-level monitoring documents trends in site occupancy that may be the most useful metric for assessing changes in amphibian status (Muths *et al*. 2006, pp. 5-6). Mid-level monitoring was conducted by USGS in southeast Oregon from 2000 to 2003 (Wente *et al*. 2005, pp. 99-106; Adams *et al*. 2006, p. 10). This effort should be reinstituted and expanded to the entire range of Columbia spotted frogs within the Great Basin DPS. In addition to mid-level monitoring, intensive surveys being conducted in southeastern Oregon, southwestern Idaho, northeast and central Nevada must continue. Like most aquatic species, amphibian populations fluctuate yearly due to climate variability (i.e., temperature, precipitation) (Corn 2005, p. 60). It is important to track population changes annually and for significant time periods to distinguish between anthropogenic effects to the species and its habitat and natural population fluctuations.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Idaho,Nevada

Indicate which State(s) did not provide any information or comment:

Oregon

State Coordination:

Nevada, Idaho, and Oregon comprise the extent of all historical and current Columbia spotted frog populations within the Great Basin DPS. The NDOW and IDFG contributed valuable information on the species for this CNOR.

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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: 05/27/2011
Date

Concur: 10/07/2011
Date

Did not concur: ____________________ ____________
Date

Director's Remarks: