SPECIES: Scientific [common]	*Rana luteiventris* [Columbia Spotted Frog]
Forest:	Bridger-Teton National Forest
Forest Reviewer:	Randall Griebel, James Wilder
Date of Review:	02/08/2018; updated 4/17/2025
Forest concurrence (or recommendation if new) for inclusion of species on list of potential SCC: (Enter Yes or No)	YES

FOREST REVIEW RESULTS:

1. The Forest concurs or recommends the species for inclusion on the list of potential SCC:
   Yes__X__ No____

2. Rationale for not concurring is based on (check all that apply):
   Species is not native to the plan area _____
   Species is not known to occur in the plan area _____
   Species persistence in the plan area is not of substantial concern _____

FOREST REVIEW INFORMATION:

1. Is the Species Native to the Plan Area? Yes_X__ No___

   If no, provide explanation and stop assessment.

2. Is the Species Known to Occur within the Planning Area? Yes_X__ No___

   If no, stop assessment.

Table 1. All Known Occurrences, Years, and Frequency within the Planning Area

Year Observed	Number of Individuals*	Location of Observations	Source of Information
1948-1960	3	Greys River Ranger District	Wyoming Natural Diversity Database; USFS Natural Resource Information System; WGFD (January 2018)
1999-2017	128		
NA	0	Kemmerer Ranger District	Wyoming Natural Diversity Database; USFS Natural Resource Information System; WGFD (January 2018)
2011, 2016	2		
Unknown	18	Pinedale Ranger District	Wyoming Natural Diversity Database; USFS Natural Resource Information System; WGFD (January 2018)
1998-2017	152; Hundreds of individuals		
1941-1950	3	Big Piney Ranger District	Wyoming Natural Diversity Database; USFS Natural Resource Information System; WGFD (January 2018)
1999-2017	130		
Unknown/ 1947-1986	10	Blackrock Ranger District	Wyoming Natural Diversity Database; USFS Natural Resource Information System; WGFD (January 2018)
1991-2017	658 records; Hundreds of individuals		
Unknown/ 1950-1986	12	Jackson Ranger District	Wyoming Natural Diversity Database; USFS Natural Resource Information System; WGFD (January 2018)
1991-2017	307; Hundreds of individuals		

**Numbers are approximations. Due to an overlap in data from multiple datasets, duplicate occupancy records are expected. This is avoided to the extent practicable. The number of records is provided as appose to the number of individuals. This is because the number of juveniles, metamorphs, and tadpoles in each dataset where too large to count accurately.*

a. Are all Species Occurrences Only Accidental or Transient?

Yes___ No_X__

If yes, document source for determination and stop assessment.

b. For species with known occurrences on the Forest since 1990, based on the number of observations and/or year of last observation, can the species be presumed to be established or becoming established in the plan area?

Yes_X__ No___

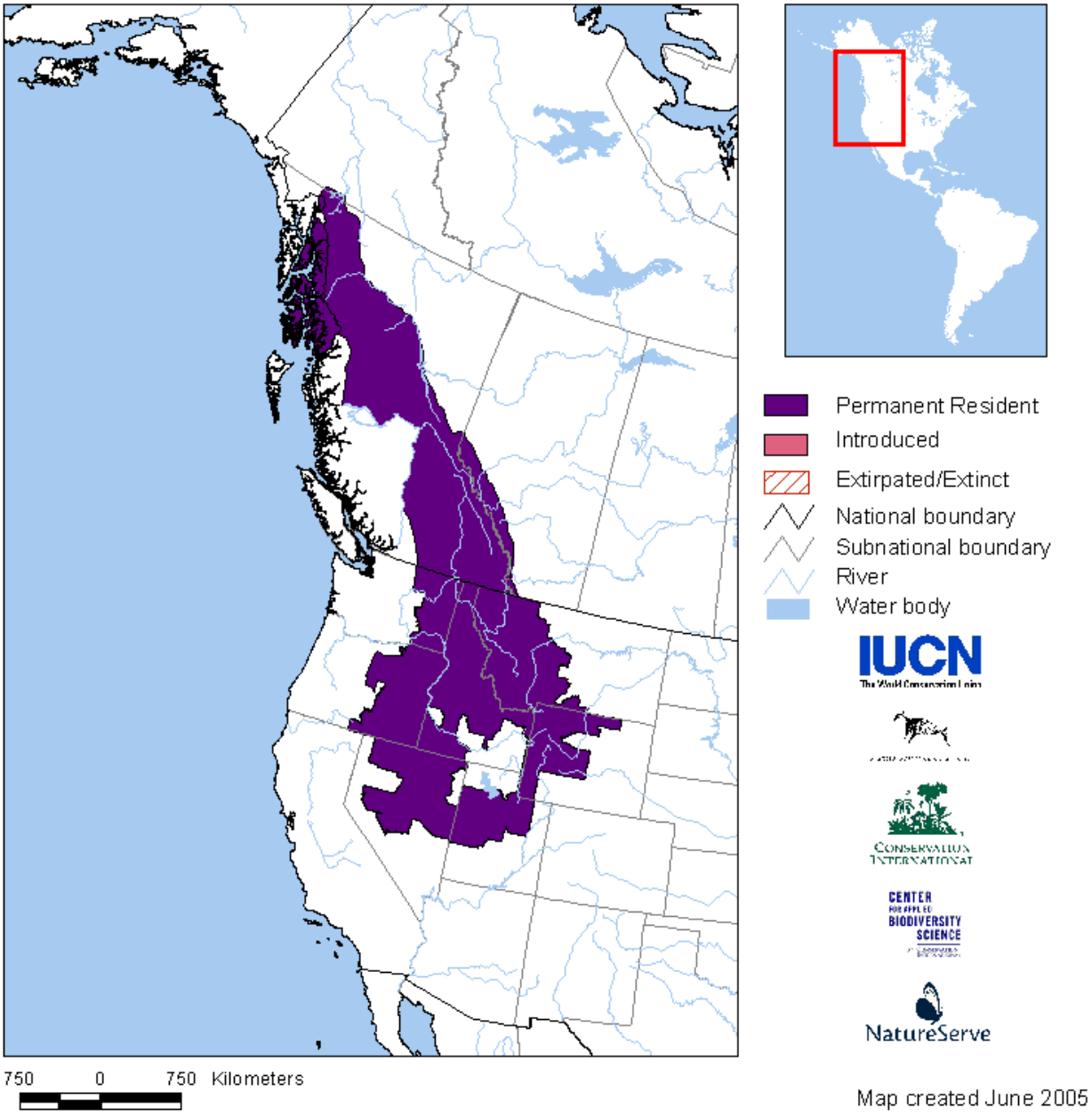
If no, provide explanation and stop assessment

c. For species with known occurrences on the Forest predating 1990, does the weight of evidence suggest the species still occurs in the plan area?

Yes_ X__ No___

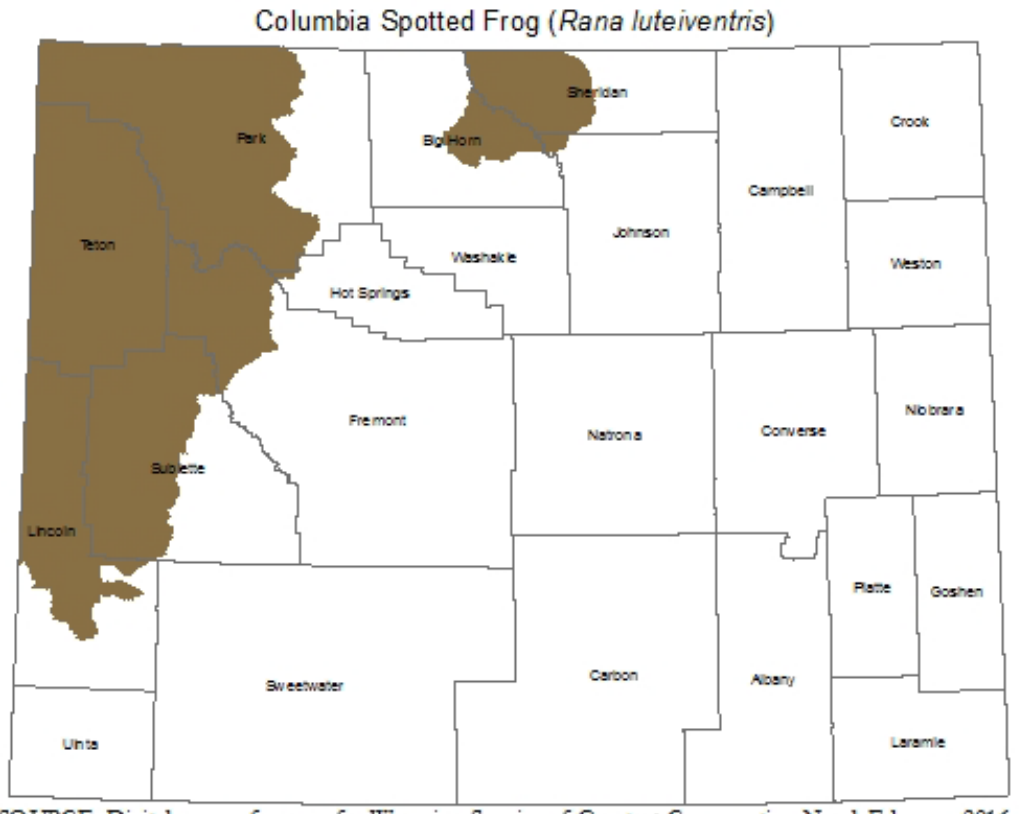
Provide explanation for determination; If determination is no, stop assessment

d. **Map 1**, Columbia spotted frog range map of North America



Nature Serve. Accessed January 2018. Columbia spotted frog (*Rana luteiventris*).

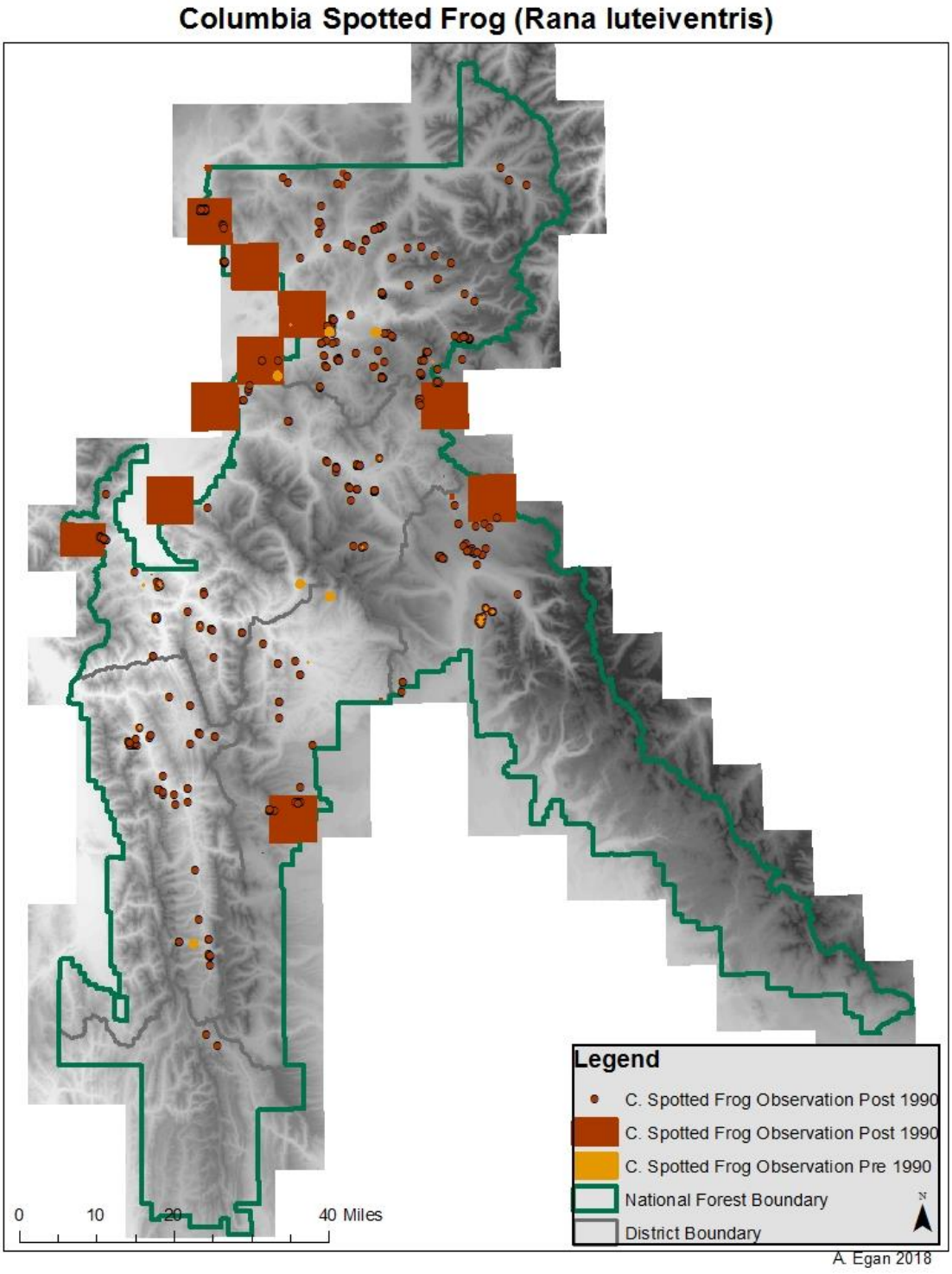
e. **Map 2**, Range and predicted distribution of *Rana luteiventris* in Wyoming.



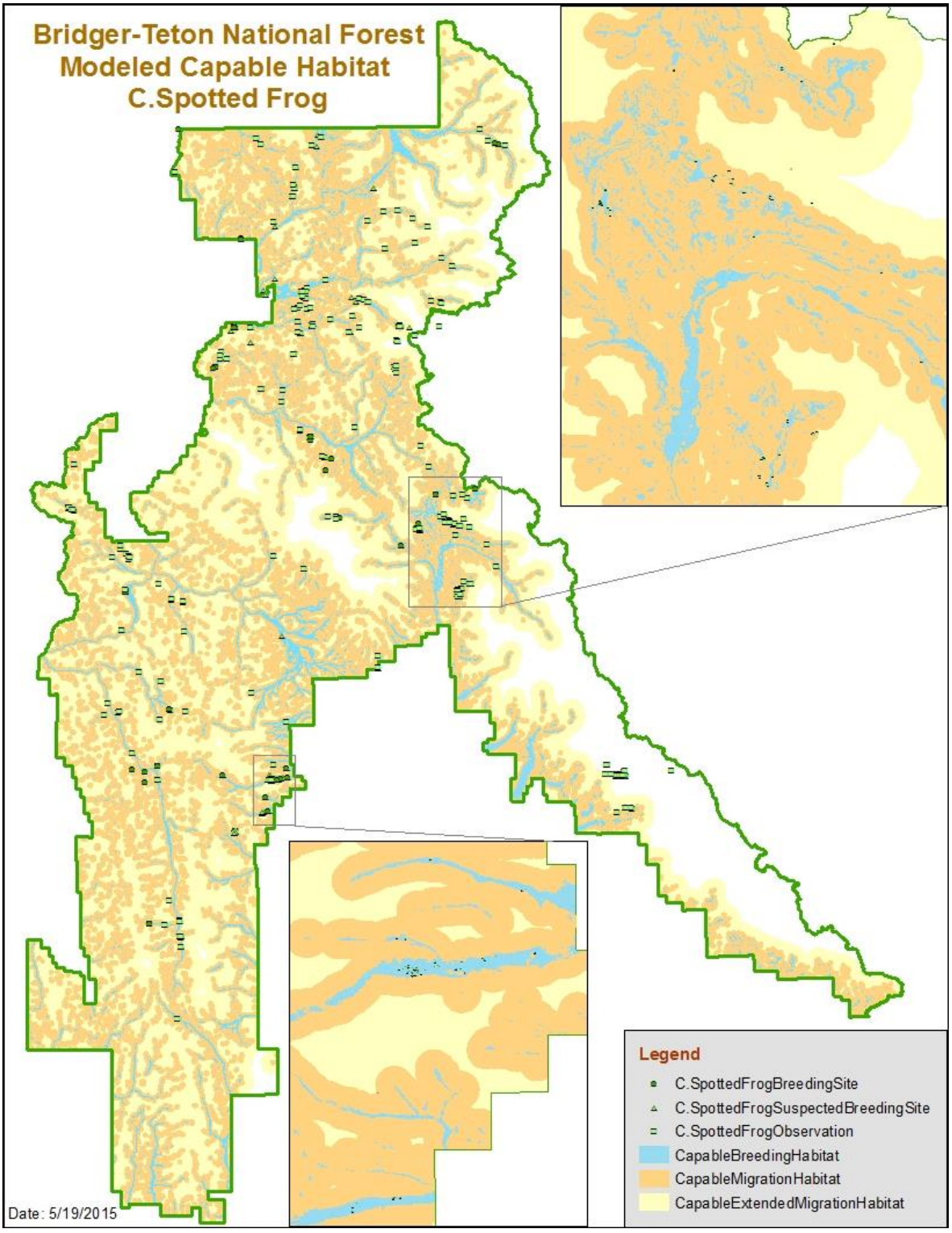
SOURCE: Digital maps of ranges for Wyoming Species of Greatest Conservation Need: February 2016. Wyoming Game and Fish Department. Note that brown indicates the current known range of the species.

Wyoming Game and Fish Department. 2017. State Wildlife Action Plan. Columbia spotted frog (Rana luteiventris).

f. **Map 3**, Map of Columbia spotted frog occurrences on the Bridger-Teton National Forest (Wyoming Natural Diversity Database, USFS Natural Resource Information System, & WGFD [January 2018])



g. **Map 4,** Modeled capable habitat for Columbia spotted frogs on the Bridger-Teton National Forest (Egan 2015)



3. Is There Substantial Concern for the Species' Capability to persist Over the Long-term in the Plan Area Based on Best Available Scientific Information?

Table 2. Status summary based on existing conservation assessments

Entity	Status/Rank (include definition if Other)
NatureServe Global Status	**G4— Apparently Secure** *Uncommon but not rare; some cause for long-term concern due to declines or other factors. Secure.*
NatureServe State Status	**S3— Vulnerable** *At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.*
WGFD	**NSS3 (Bb), Tier II** *Population Status: Vulnerable - Population size or distribution is restricted or declining but extirpation is not imminent* *Limiting Factors: Severe - Limiting factors are severe and not increasing significantly* *Tier II: Moderate priority* *[The WGFD's Species of Greater Conservation Need (SGCN) designation process is based upon its **Native Species Status (NSS)** classification system that compares population and limiting factor variables using a 16 cell matrix. As a species moves from a placement closest to the upper left corner of the matrix (Aa/NSS1) toward the lower right corner (Dd/NSS7) the species' population status in Wyoming is considered more secure. Numerical scores were assigned to each of these variables and summed to provide a total score (i.e. NSS3). SGCN were placed into one of three tiers based on their total score: Tier I – highest priority, Tier II – moderate priority, and Tier III – lowest priority.]* (WGFD - Wyoming Species of Greatest Conservation Need)
WYNDD	**Species of Concern** *Species vulnerable to extirpation at the global or state level due to:* *a. their rarity (e.g., restricted distribution, small population size, low population density)* *b. inherent vulnerability (e.g., specialized habitat requirements, restrictive life history)* *c. threats (e.g., significant loss of habitat, sensitivity to disturbances)* (Wyoming Natural Diversity Database - Species of Concern)

USDA Forest Service	**Region 4: Sensitive Species** *Those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by* *a. Significant current or predicted downward trends in population numbers or density.* *b. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.* (FSM 2670.5 – Threatened, Endangered & Sensitive Species)
UDI FWS	**No Special Status**
WY BLM	**Sensitive** *1. Sensitive species must be native species found on BLM-administrated lands for which BLM has the capability to significantly affect the conservation status of the species through management, and either:* *a. There is information that a species has recently undergone, is undergoing, or is predicted to undergo a downward trend such that the viability of the species or a distinct population segment of the species is at risk across all or a significant portion of the species range, or* *b. The species depends on ecological refugia or specialized or unique habitats on BLM-administrated lands, and there is evidence that such areas are threatened with alteration such that the continued viability of the species in that area would be at risk.* *2. All federally designated candidate species, proposed species, and delisted species in the 5 years following their delisting shall be conserved as Bureau sensitive species* (BLM Wyoming Sensitive Species Policy and List; March 31, 2010)
IUCN	**LC – Least Concern** *A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.* (IUCN – Red List Categories and Criteria)

Table 3. Status summary based on best available scientific information.

Species (Scientific and Common Name): ***Rana luteiventris [Columbia spotted frog]***		
Criteria	**Rationale**	**Literature Citations**
Distribution on Bridger-Teton National Forest	The Columbia spotted frog range overlaps parts of Alaska, northern British Columbia, and Canada south through Washington, eastern Oregon, Idaho, and western Montana to Nevada, southwestern Idaho, Utah, and western and north-central Wyoming (Map 1). In Wyoming, the Columbia spotted frog can be found in foothill and montane zones within pooled to flowing wetlands, small streams, lake margins, moist forests, and moist meadows (WGFD 2017). The range and predicted distribution for the Columbia spotted frog, as identified by WNDD (Map 2), shows a relatively small portion of potential suitable habitat for this species in the northwest corner of Wyoming, overlapping with the northwest portion of the BTNF. Much of the Pinedale and Kemmerer Ranger Districts on the BTNF are outside the range for this species. However, the Spotted frog is known to occur on all 6 of the ranger districts (Map 3). Columbia Spotted frogs remain close to water during the breeding season, but may wander after breeding is concluded (Patla and Keinath 2005 *in* WGFD 2017). The Columbia spotted frog is moderately common in the plan area, occupying ~15-30% of surveyed sites in the plan area; their occupancy is greater in the Teton and Grose Ventre mountain ranges than the higher-elevation wetlands in the Wind River Range (Wallace and Tronstad 2019, RMAP 2025). Spotted frogs were likely once common in suitable habitat on the BTNF, and they continue to be fairly common in parts of the BTNF while their distribution and abundance has declined in other parts (DeLong 2015). Surveys and compilations of incidental observations of amphibians on the BTNF reveal that Spotted frogs are relatively widespread and uncommon to common in the northern half of the BTNF and in the Greys River drainage, but are rare in the remainder of the BTNF (Patla 2000 and Map 3). Of the locations that were inventoried for spotted frogs, the species appears to be rare or absent from the southern half of the east slope of the Wyoming Range, Commissary Ridge, and Gannett Hills. W. Estes-Zumpf identified two places where there may be a decline in active spotted frog breeding sites: the upper Green River area and east slope of the	Delong, D. 2015. Literature Review and Analysis of Scientific Information for the Conservation Assessment for Columbia Spotted Frogs and Boreal Toads on the Bridger-Teton National Forest. Bridger-Teton National Forest, Jackson, Wyoming. Patla, D. 2000. Amphibians of the Bridger-Teton National Forest: species distributions and status. Unpublished report, prepared for the Bridger-Teton National forest. Herpetology Laboratory, Idaho State University, Pocatello. 44pp. Rocky Mountain Amphibian Project. 2025. Available at :https://www.wyomingbiodiversity.org/index.php/community-science/rocky-mountain-amphibian-project/results. (Accessed: March 20, 2025). Wallace, Z., and L. Tronstad. 2019. Factors affecting the distribution of amphibians in western Wyoming. Report prepared for Wyoming Game and Fish Department, Fisheries Division by University of Wyoming, Wyoming Natural Diversity Wyoming Game and Fish Department. 2017. State Wildlife Action Plan. Columbia spotted frog (*Rana luteiventris*). Wyoming Natural Diversity Database (January 2018)

Species (Scientific and Common Name): ***Rana luteiventris [Columbia spotted frog]***		
Criteria	**Rationale**	**Literature Citations**
	Wyoming Range (email dated March 3, 2014 *in* DeLong 2015). However, like Western Toads, preliminary results from the Rocky Mountain Amphibian Project in the Bridger-Teton do not show a consistent trend in species occupancy since 2014 (RMAP 2025).	
Abundance on the Bridger-Teton National Forest	While Spotted frog abundance on the BTNF is not currently well known, the likely cumulative impacts of stressors, as summarized in the "Vulnerability of Habitats on the Bridger-Teton National Forest" section below, provides further indication of a decline in distribution and abundance of Spotted frogs on the BTNF. Columbia spotted frog abundance throughout the state of Wyoming is considered to be "Rare" (WGFD 2017). See more details in next section "Population Trend on the Bridger-Teton National Forest".	Wyoming Game and Fish Department. 2017. State Wildlife Action Plan. Columbia spotted frog (*Rana luteiventris*).
Population Trend on the Bridger-Teton National Forest	Columbia spotted frogs are classified by Region 4 as a sensitive species on the Bridger-Teton National Forest (USFS 2011a), and they are also classified in Region 2 as a sensitive species (Patla and Keinath 2005). They are on the Wyoming Game and Fish Department's (WGFD's) list of Species of Greatest Conservation Concern with a NSS Cell rating of NSS3 (Bb), and is classified as a Tier II species, meaning that declining populations and/or habitat losses are not	Corn, P. S., Hossack, B. R., Muths, E., Patla, D. A., Peterson, C. R., and A. L. Gallant. 2005. Status of amphibians on the Continental Divide: surveys on a transect from Montana to Colorado, USA. Alytes 22:85–94.

Species (Scientific and Common Name): ***Rana luteiventris [Columbia spotted frog]***		
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	suspected. Spotted frog populations are considered vulnerable due to restricted distribution; However, populations appear stable, but declines have been documented in the states surrounding Wyoming (WGFD 2017). Columbia spotted frogs are also on the sensitive species list of the Wyoming Natural Diversity Database, and the statewide population is ranked as S3-vulnerable (NatureServe 2018). Vulnerable is defined as "At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. Such species are often rare or found locally in a restricted range." (NatureServe 2018). Significant declines have occurred in some areas of Utah and Wyoming (Nature Serve 2018), suggesting Spotted frog population declines are likely occurring on the BTNF, given the Forest overlaps with a significant portion of the species range. Recently, Hossack et al. (2015) studied population trends of amphibians in areas surrounding the BTNF, including Glacier, Yellowstone, Grand Teton, and Rocky Mountain National Parks. Their studies supported earlier work (Corn et al. 2005) documenting a decrease in amphibian abundance from north to south along the continental divide (Rocky Mountains) due to population declines over recent decades. While population trend data is lacking on the BTNF as of currently, this study suggests that based on nearby populations trends, Columbia spotted frogs on adjacent Forest lands are also in decline. Among the many factors that may be contributing to Spotted frog declines are habitat loss, habitat alteration, pollutants, climate change, and disease. See the "Threats to the Species and its Habitat on the Bridger-Teton National Forest" section below for more information on the stressors that are likely influencing Spotted frog population declines on the BTNF.	Hossack, B. R., Gould, W.R., Patla, D.A., Muths, E., Daley, R., Legg, K., and P. S. Corn. 2015. Trends in Rocky Mountain amphibians and the role of beaver as a keystone species. Biological Conservation 187:260–269. Nature Serve. Accessed 2018. Columbia spotted frog (*Rana luteiventris*). Patla, D. A. and D. Keinath. 2005. Columbia spotted frog (*Rana luteiventris* formerly *R. pretiosa*): a technical conservation assessment. Prepared for the USDA Forest Service, Rocky Mountain Region, Species Conservation Project. 87pp. USFS. 2011a. Intermountain Region (R4) threatened, endangered, proposed, and sensitive species: June 2011 update. USDA, Forest Service, Regional Office, Ogden, unpublished report. Wyoming Game and Fish Department. 2017. State Wildlife Action Plan. Columbia spotted frog (*Rana luteiventris*).
Habitat Trend on the Bridger-Teton National Forest	Spotted frogs breed in shallow waters of ponds, marshes, slow streams, river backwater channels, and along lake edges (Hammerson 1982, Patla 2000, Patla and Keinath 2005, Reaser and Pilliod 2005 *in* DeLong 2015). An important component of breeding sites appears to be emergent vegetation, especially	Delong, D. 2015. Literature Review and Analysis of Scientific Information for the Conservation Assessment for Columbia Spotted Frogs and Boreal Toads on the Bridger-Teton National Forest.

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	sedges, and/or floating vegetation (Bull and Hayes 2001, Bull 2005:11, Patla and Keinath 2005, Shive et al. 2010 *in* DeLong 2015). Nearly all breeding sites surveyed on the Greys River Ranger District and many on the Kemmerer Ranger District (as examples) by Patla (2000), McEachern and Brick (2008), McEachern (2010a), McEachern (2010b), and McEachern (2011) contained substantial amounts of cover of sedges, rushes, and/or grasses (DeLong 2015). Spotted frogs typically lay eggs just after snowmelt (Patla and Keinath 2005), which varies considerably from low to high elevations. In general, the breeding season typically begins in late April or early May (low elevations) to late June (high elevations), and metamorphosis occurs between mid July and late September, depending on elevation and other factors. Suitable Spotted frog breeding, summer and migration habitat has been mapped on the BTNF. Map 4 show the locations of known existing Columbia spotted frog observations and breeding sites on BTNF modeled capable breeding, summer and migration habitat*. A relatively large proportion of Spotted frogs have been found to migrate as far as 1½ miles (and further) between breeding sites and summer habitat. Because they tend to remain closer to water and because a majority remain within 1/3 mile of breeding sites, Map 4 shows migration habitat split between “Migration Habitat” (≤1/3 mile from capable breeding habitat) and “Extended Migration Habitat” (≤1½ miles from capable breeding habitat). Migration habitat currently includes all cover types. The Bridger-Teton National Forest provides a considerable amount of breeding, summer, and migration habitat for the Columbia spotted frog, as depicted in the capable habitat model for the Columbia spotted frog (Map 4). Currently on the BTNF, there is more suitable habitat available to Spotted frogs than what actually being used by the species. *Greater detail regarding the capable breeding habitat model for the Columbia spotted frog can be found	Bridger-Teton National Forest, Jackson, Wyoming. Patla, D. A. and D. Keinath. 2005. Columbia spotted frog (*Rana luteiventris* formerly *R. pretiosa*): a technical conservation assessment. Prepared for the USDA Forest Service, Rocky Mountain Region, Species Conservation Project. 87pp.

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	in DeLong 2015.	
Threats to the Species and its Habitat on the Bridger-Teton National Forest	Factors that appear to have caused or contributed to population declines of Columbia spotted frogs in the Rocky Mountains are disease, climate change, increased ultraviolet radiation, habitat loss, habitat alteration, motorized use and recreation, livestock grazing, and pollution. Adams et al. (2013) asserted that "Primary hypotheses to explain global amphibian declines are land use change, disease, global climate change, and interactions of these factors with each other or with other stressors like contaminants or habitat degradation (Collins and Crump 2009). These risk factors, as described in more detail below, are prevalent on the BTNF and are likely impacting local populations of spotted frogs. Patla and Keinath (2005) summarized the situation well: "Columbia spotted frogs are further vulnerable to disturbance and stochastic environmental fluctuations leading to population declines due to their dependence on specific habitat patches for survival and reproduction, and demographic factors including high variability in annual recruitment rates, long time period to reach reproductive age (four years in males and five to six years in females for some populations), tendency of females to breed every other year or less, and the likelihood that some populations act as "sinks", sustaining annual or intermittent breeding efforts but producing few if any recruits. Other characteristics that make spotted frogs vulnerable to declines are their attractiveness as prey for a large number of animals, and the potential for mass mortality due to disease outbreaks or habitat catastrophes when frogs are congregated at breeding or wintering sites. Exceptionally high rates of dispersal by juveniles suggests that isolation of populations through habitat fragmentation (e.g., roads, clear-cutting, and urbanization) may increase local extinction rates (Funk et al. 2005). In the event of repeated reproductive failures (which may be common in the highly variable conditions of mountain environments), high levels of adult mortality (or simply reaching the limits of longevity) will lead to local population extinctions within a decade or much	Adams, M. J., D. A. W. Miller, E. Muths, P. S. Corn, E. H. Campbell Grant, L. L. Bailey, G. M. Fellers, R. N. Fisher, W. J. Sadinski, H. Waddle, S. C. Walls. 2013. Trends in amphibian occupancy in the United States. PLOS ONE (http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0064347, accessed 7-5-2013). Adams, M. J., Pearl, C. A., McCreary, B., Galvan, S. K., Wessel, S. J., Wente, W. H., Anderson, C. W., and A. B. Kuehl. 2009. Short-term effect of cattle exclosures on Columbia spotted frog (*Rana luteiventris*) populations and habitat in northeastern Oregon. Journal of Herpetology 43:132-138. Bancroft, B. A., N. J. Baker, and A. R. Blaustein. 2008. A meta-analysis of the effects of ultraviolet B radiation and its synergistic interactions with pH, contaminants, and disease on amphibian survival. Conservation Biology 22:987-996. Bartelt, P. E. 1998. Natural history notes: *Bufo boreas* mortality. Herpetolocial Review 29:96. (*cited by Patla 2000, Patla and Keinath 2005*) Bartelt, P. E. 2000. A biophysical analysis of habitat selection in Columbia spotted frogs (*Bufo boreas*) in southeastern Idaho. PhD dissertation, Idaho State University, Pocatello, Idaho. (*cited by Patla 2000 and*

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	shorter time frame if recolonization cannot occur. While spotted frogs have demonstrated an ability to travel long distances (e.g., 6 km), some historical or current populations may be beyond the range of "rescue" in the mountainous landscapes of Region 2, with natural isolation exacerbated by human-caused habitat fragmentation, drought, and non-native fish introduction." <u>*Disease, Climate Change, and UV Radiation*</u> The disease status of Columbia spotted frogs in Wyoming is not well understood. These animals share habitat with the Western (boreal) toad, which is susceptible to chytrid fungus infections and appears to be one of the leading factors contributing to toad population declines throughout the western U.S. Of those in particular, chytrid fungus (*Batrachochytrium dendrobatidi*) is thought to be one of the main causes of amphibian declines across the Rocky Mountains, likely acting synergistically with other stressors. Chytrid disease was detected in 2000 among Western toads on the National Elk Refuge (NER) in Jackson Hole (Patla 2000b). Chytrid was found on 2 of 7 toad specimens, and was thought to be the first documentation of the disease in northwest Wyoming. Green cautions in his pathology report that "The diagnosis of chytridiomycosis has potentially direct implications for all species of frogs and toads in the NER and, possibly, western Wyoming" (D.E. Green, case report # 16918, 001, USGS National Wildlife Health Center, Madison, WI). Estes-Zumpf et al. (2014) sampled amphibians on the BTNF (using 280 samples skin swabs) for the presence of chytrid fungus, a pathogen now widely distributed on the Forest. The fungus was detected in Western (Boreal) toads, Columbia spotted frogs, and Boreal chorus frogs. Chytrid fungus was particularly prevalent among amphibians within the Wind River Range. Chytrid fungus appears to pose the largest threat on the BTNF and negative impacts have shown to be exacerbated where other stressors are affecting populations (DeLong 2015). Die-offs from this disease may occur over several months, manifested as steady mortality that is not easily detected unless weekly or bi-	*Keinath and McGee 2005*) Blaustein, A. R., Hoffman, P. D., Hokit, D. G., Kiesecker, J. M., Walls, S. C., and J .B Hays. 1994. UV repair and resistance to solar UV-B in amphibian eggs: a link to population declines? Proc. Natl. Acad. Sci. USA. 91: 1791-1795. Blaustein, A. R., Kiesecker, J. M., Chivers, D. P., Hokit, D. G., Marco, A., Belden, L. K., and Hatch, A. 1998. Effects of ultraviolet radiation on amphibians: field experiments. *Am. Zool.* 38: 799–812. Blaustein, A. R. and L. K. Belden. 2005. Chapter 14: ultraviolet radiation. Pages 87-88 *in* Lannoo, M. (ed.). Amphibian declines: the conservation status of United States species. University of California Press, Berkely, California. Bull, E. 2009. Dispersal of newly metamorphosed and juvenile Columbia spotted frogs (Rana luteiventris) in nertherstern Oregon, USA. herpetological conservation and biology. Pg.236-247. Burton, E. C., Gray, M. J., Schmutzer, A. C., and D. L. Miller. 2009. Differential responses of postmetamorphic amphibians to cattle grazing in wetlands. Journal of Wildlife Management 73:269-277. Collins JP, Crump ML (2009) Extinction in our times: global amphibian decline. New York: Oxford University Press USA.

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	weekly surveys are conducted on amphibians. Affected amphibian populations in other areas have declined >90% in one year, and there are no known cases of recovery of populations following decimation by the chytrid fungus. Chytrid fungus is common in the Rocky Mountains—Muths et al. (2008) detected the fungus at 64% of 97 study sites and in 23% of 1,151 Western (Boreal) toads– a species that shares much of it range and habitat with the spotted frog on the BTNF. Murphy et al. (2009) found the fungus at all of the 10 Western (Boreal) toad breeding sites sampled in the Jackson Hole area, with a mean prevalence of 64.5%. There are other diseases found throughout the Rocky Mountains that may be influencing the survival of amphibians in addition to chytrid fungus. Another fungal disease, a fish pathogen *Saprolegnia ferax*, is associated with hatchery fish. This disease has been found to cause very high mortality to toad embryos (Blaustein et al. 1994, Maxell 2000). New viral diseases have also been implicated as the cause of amphibian mass deaths, most often attacking tadpoles and salamander larvae; and some of these viruses affect both fish and amphibians (Daszak et al. 1999). A mass die-off of salamander larvae near Bondurant in northwest Wyoming in 1999 (Patla 2000a) may have been caused by a ranavirus (diagnosed by D.E. Green, case report #164 14, 001-005. USGS National Wildlife Health Center). Limb malformations in toads have been linked directly to trematode infections by *Ribeiroia ondatrae* (Johnson et al. 2001 & 2002 *in* Nature Serve 2018), although the impacts of these infections on reproduction, and the magnitude of the infections across the breeding range require further study (Nature Serve2018). Although more research is needed, analysis suggests that malformations may increase mortality in larval amphibians prior to and during metamorphosis.	Daszak, P. L., Berger, A. A., Cunningham, A. D., Hyatt, D. E., Green, and R. Speare. 1999. Emerging infectious diseases and amphibian population declines. Emerg. Infect. Dis. 5:735–748. Delong, D. 2015. Literature Review and Analysis of Scientific Information for the Conservation Assessment for Columbia Spotted Frogs and Boreal Toads on the Bridger-Teton National Forest. Bridger-Teton National Forest, Jackson, Wyoming. Donker, N. T., and J. M. Fryxell. 1999. Impact of beaver foraging on structure of lowland boreal forests of Algonquin Provincial Park, Ontario. For. Ecol. Manage 118:83–92. Duellman, W. E., and L. Trueb. 1986. Biology of amphibians. McGraw-Hill, New York. 670 pp. Estes-Zumpf, W., Z. Walker, and D. Keinath. 2014. Western amphibian monitoring initiative. State Wildlife Grant Final Completion Report. A report to the Wyoming Game and Fish Department. On file Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming, USA. Fleischner, T. L. 1994. Ecological costs of livestock grazing in western North America. Conservation Biology 8:629-644.

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	Climate change and increasing UV radiation are receiving increasing attention as possible contributing factors to the decline of amphibian populations, including Columbia spotted frogs (Hatch and Blaustein 2000, Blaustein and Beldon 2005, Reaser and Blaustein 2005, Muths 2005, Bancroft et al. 2008, McMenamin et al. 2008, Bull 2009). McMenamin et al. (2008) documented that "…recent climate warming and resultant wetland desiccation are causing severe declines in 4 once-common amphibian species native to Yellowstone. Climate monitoring over 6 decades, remote sensing, and repeated surveys of 49 ponds indicate that decreasing annual precipitation and increasing temperatures during the warmest months of the year have significantly altered the landscape and local biological communities." To the degree that warming and drying happens, wetlands will have lesser amounts of water, wetlands will dry quicker, herbaceous production may be lower, potential for desiccation will increase, larger acreages of forestland may burn, and there may be fewer acres of moist forestland (DeLong 2015). This results in reduced tadpole survival for the Columbia spotted frog and therefore, is likely contributing to population declines. In addition to climate changes, increased UV radiation and synergistic effects of UV radiation in combination with other factors including acidification, shallower waters, certain pathogens, lowered pH, fire retardant, and a polycyclic aromatic hydrocarbon, have also contributed to amphibian population declines. Results of studies on the effects of UV radiation on amphibians have been mixed. Most studies have examined the effects of UV-B radiation on developing embryos, and Blaustein and Belden (2005) concluded that "The results of field experiments strongly indicate that embryos of some amphibian species are adversely affected by ambient UV-B radiation." Hatch and Blaustein (2000 & 2003) demonstrated that UV-B radiation can influence the level of effects from other factors such as nitrate concentrations in breeding wetlands. Contrarily, several studies failed to detect effects of elevated levels of UV radiation. Reaser and Pilliod (2005) reported that "Studies by Blaustein et al. (1999) suggest that, at least at the embryonic stage,	Hatch, A.C. and A. R. Blaustein. 2000. Combined effects of UV-B, nitrate, and low pH reduce the survival and activity level of larval cascades frogs (*Rana cascadae*). Archives of Environmental Contamination and Toxicology 39(4):494-499. Hatch, A.C. and A. R. Blaustein. 2003. Combined effects of UV-B and nitrate fertilizer on larval amphibians. Ecological Applications 13:1083-1093. Lefcort, H., Meguire, R. A., Wilson, L. H., and W. F. Ettinger. 1998. Heavy metals alter the survival, metamorphosis, and antipredatory behavior of Columbia spotted frog (*Rana luteiventris*). Archives of Environmental Contamination and Toxicology 35:447-456 Loeffler, C. (ed.). 2001. Conservation plan and agreement for the management and recovery of the southern Rocky Mountain populations of the boreal toad (*Bufo boreas boreas*), Boreal Toad Recovery Team. Colorado Division of Wildlife, Denver, Colorado. Maxell, B. A. 2000. Management of Montana's amphibians: a review of factors that may present a risk to population viability and accounts on the identification, distribution, taxonomy, habitat use, natural history, and the status and conservation of individual species. Report to the U.S. Forest Service, Region 1. Order Number 43-0343-0-0224. University of Montana, Missoula, Montana.

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	Columbia spotted frog populations are not presently being limited by UV-B radiation." While these studies indicate that spotted frog populations are not being affected in some situations, this may not apply in all situations across the range of this species. Additionally, spotted frogs possess 2-5 times as much of a UV damage repair enzyme as Western (Boreal) toads and a few other amphibian species (Blaustein et al. 1998). Currently there are no mitigation measures to reduce these effects and there is no information showing these factors are not negatively affecting Columbia spotted frogs on the BTNF. <u>*Timber Harvest*</u> Amphibians are particularly vulnerable to timber harvesting impacts especially when the impacts occur within their dispersal range from breeding sites, and during the late-summer when adults migrate into upland forested habitats. The impacts of timber harvest on some amphibian species depends greatly on the timing, method, spatial extent, configuration and location of harvest activities relative to Columbia spotted frog habitats (Maxell 2000). Timber harvest and the removal or reduction of the canopy and downed woody debris decreases the amount of moist sites available to Spotted frogs, and therefore reduces toad habitat. This has implications to Columbia spotted frogs by limiting the areas in which they can find appropriate conditions to regulate body temperatures and conserve body fluid while foraging and dispersing. Due to tree removal, the structure and composition of shrub understories may be enhanced or reduced. Shrub understory structure is valuable because it provides important microhabitats for amphibians that assist in thermoregulation by providing water and heat energy (Bartelt 2000). In 18 studies reviewed by deMaynadier and Hunter (1995) they found that anurans were less abundant on 6-month-to-40 year old clearcuts as compared to abundance on uncut control plots (McGee and Keinath 2004). Limited amounts of timber removal may however be of some benefit to toads where the openings in the canopy of cool, closed forests creates or increases the	McGee M., and D. Keinath. 2004. Species assessment for boreal toad (*Bufo boreas boreas*) in Wyoming. United States Department of the Interior, Bureau of Land Management, Wyoming State Office, Cheyenne, Wyoming. 86pp. McMenamin, S. K., E. A. Hadley, and C. K. Wright. 2008. Climate change and wetland desiccation cause amphibian decline in Yellowstone National Park. PNAS 105:16988-16993. Murphy, P. J., St-Hilaire, S., Bruer, S., Corn, P. S., and C. R. Peterson. 2009. Distribution and pathogenicity of *Batrachochytrium dendrobatidis* in boreal toads from the Grand Teton area of western Wyoming. EcoHealth 6:109–120. Muths, E. 2005. *Bufo boreas* Baird and Girard, 185(b) Columbia spotted frog. Pages 392-396 *in* Lannoo, M. (ed.). Amphibian declines: the conservation status of United States species. University of California Press, Berkely, California. Muths, E., Pilliod, D. S., and L. J. Livo. 2008. Distribution and environmental limitations of an amphibian pathogen in the Rocky Mountains, USA. Biological Conservation 141:1484–1492. Nature Serve. Accessed 2018. Columbia spotted frog (*Rana luteiventris*). Patla, D. A. 2000a. Amphibians of the

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	number of basking sites. Timber removal and vegetation treatments also have the potential to disturb stream habitat due to an increase in sedimentation, and is one of the greatest impacts timber harvesting has on amphibian species. Additionally, timber removal activities typically include the development and maintenance of roads. These actions may increase erosion and sedimentation in adjacent streams and wetlands, resulting in negative impacts to the species. Soil compaction from harvesting activities may reduce rodent burrows, used by Columbia spotted frogs as over-wintering hibernacula. In general, any timber harvest activities, including those on the BTNF, that negatively affect the quality or quantity of wetlands within the current range of Columbia spotted frogs can have negative effects on the species. <u>*Roads and Motorized Trails*</u> During dispersal and migration, Columbia spotted frogs are likely to encounter roads and motorized trails throughout the Forest. Additionally, there are numerous system routes that are currently near breeding locations and non-system motorized routes are increasing across the Forest. An abundance of scientific information suggests there are negative impacts of roads, motor-vehicle trails, motorized use, and dispersed roadside camping on survival rates of amphibians due to crushing and increased potential for desiccation, reductions in habitat connectivity, altered hydrology, and reduction in water quality (DeLong 2015). Many amphibian researchers have noted amphibian mortality due to vehicle traffic (Maxell 2000, McGee and Keinath 2004, Patla and Keinath 2005). Patla (2001) and Bull (2009) show that national forest roads — similar to situations on the BTNF — have a reasonably high potential to increase mortality and reduce habitat connectivity, particularly where roads and motor-vehicle trails are near breeding wetlands. Other negative impacts from roads on Columbia spotted frogs includes noise disturbance, chemical contamination, and increased sedimentation. Even though there is lack of documentation, motorized use has likely contributed to negative impacts on	Bridger-Teton National Forest: species distributions and status. Unpublished report, prepared for the Bridger-Teton National forest. Herpetology Laboratory, Idaho State University, Pocatello. 44pp. Patla, D. A. 2000b. Amphibians of the National Elk Refuge, Jackson Hole, Wyoming. Part 2. Report to USDI National Elk Refuge. Idaho State U, Pocatello, ID. Patla, D. A. 2001. Conservation assessment for the boreal toad (*bufo boreas boreas*) on the Bridger-Teton National Forest, Wyoming. Patla, D. A. and D. Keinath. 2005. Columbia spotted frog (*Rana luteiventris* formerly *R. pretiosa*): a technical conservation assessment. Prepared for the USDA Forest Service, Rocky Mountain Region, Species Conservation Project. 87pp. Reaser, J. K. and A. Blaustein. 2005. Chapter 11: repercussions of global change. Pages 60-63 *in* Lannoo, M. Amphibian declines: the conservation status of United States species. University of California Press, Berkely, California. Reaser, J. K. and D. S. Pilliod. 2005. *Rana luteiventris* Thompson, 1913: Columbia spotted frog. Pages 87-88 in Lannoo, M. (ed.). Amphibian declines: the conservation status of United States species. University of California Press, Berkely, California.

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	Columbia spotted frog metapopulations on the BTNF. *Livestock Grazing* Livestock grazing can adversely affect important aquatic and terrestrial Columbia spotted frog habitat through a large variety of impacts including reduced survival due to trampling and lowered water quality, negative impacts on herbaceous habitat (humid microsites, hiding/escape cover, insect habitat), lowered water tables, altered plant species composition, accelerated water-level declines, and reductions in the prevalence of burrows removal or reduction of herbaceous and shrub cover, stream bank collapse, soil compaction, and reduction of beaver and burrowing rodent populations (DeLong 2015). Furthermore, Columbia spotted frog mortality due to trampling can be considerable. Bartelt (1998 and 2000) observed the death of many hundreds of amphibian metamorphs at a breeding site on the Targhee National Forest when a band of sheep was driven through the area, resulting in major implications to the species reproduction. While livestock grazing use can create openings beneficial to tadpoles, metamorphs, and adults, particularity where basking may have positive implications to Chytrid fungus eradication, this one potential benefit is outweighed by the much larger number of negative effects. Livestock effects on water quality through urination, defecation and trampling, can reduce dissolved oxygen levels, increase eutrophication of water, increase turbidity, and increase nitrates, ammonia, and fecal coliforms (Maxell 2000, Keinath and McGeee 2005, Patla and Keinath 2005, Burton et al. 2009). Although conservative levels of livestock grazing do not necessarily have biologically meaningful effects on amphibians (Adams et al. 2009, Roche et al. 2012); long-term effects, similar to those on the BTNF, may decrease riparian vegetation − which filters water and increases stream bank stability– and overtime results in degraded riparian and wetland areas that may become unsuitable for Columbia spotted frogs. Livestock grazing may also remove important vegetative cover that provides microhabitats for amphibians, which are important for thermoregulation (Bartelt 2000). In riparian areas, over-use	Roche, L. M., Roche, B., Allen-Diaz, D. J., Eastburn, and K. W. Tate. 2012. Cattle grazing and Yosemite toad (Bufo canorus Camp) breeding habitat in Sierra Nevada meadows. Rangeland Ecology and Management 65:56-65. Russell, K. R., Moorman, C. E., Edwards, J. K., Metts, B. S., and D. C. Guynn. 1999. Amphibian and reptile communities associated with beaver (*Castor canadensis*) ponds and unimpounded streams in the piedmont of South Carolina. Journal of Freshwater Ecology 14:149-158. Skaar, D. R., Arnold, J. L., Koel, T. M., Ruhl, M. E., Skorupski, J. A., and H. B. Treanor. 2017. Effects of Rotenone on Amphibians and Macroinvertebrates in Yellowstone. Yellowstone Science 25(1). https://www.nps.gov/yell/learn/ys-25-1-effects-of-rotenone-on-amphibians-and-macroinvertebrates-in-yellowstone.htm. Swanson, D. L., Graves, B. M., and K. L. Koster. 1996. Freezing tolerance/intolerance and cryoprotectant synthesis in terrestrially overwintering anurans in the Great Plains, USA. Journal of Comparative Physiology B 166:110–119. U.S. Forest Service (USFS). 2004. Greys River Landscape Scale Assessment. Bridger-Teton National Forest, Greys River Ranger District, Afton, Wyoming. Wyoming Game and Fish Department. 2017. State Wildlife Action Plan. Columbia

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	and trampling by livestock, in combination with lowered water tables, can lead to major reductions in sedge canopy cover over time (Youngblood et al 1985, Padgett et al. 1989), which in turn adversely affects Columbia spotted frogs. Loss of bankside willows may result in reduced beaver activity or dispersal of beavers; a species whose activities are responsible for the establishment of amphibian breeding habitats (Donker and Fryxell 1999, Russell et al. 1999). Grazing may also reduce the number of insect prey that amphibians depend on (Fleischner 1994) and cause soil compaction in riparian areas, eliminating the ability for amphibians to burrow underground in order to prevent desiccation or freezing (Duellman and Trueb 1986, Swanson et al. 1996). Grazing and trampling results in changes in plant species composition, which includes the spacing of individual plants, and can affect amphibian use in these areas. In particular, broad-level changes in plant species composition (i.e., shifts from one community to another) and changes in the abundance of particular plant species on a site, both of which influence plant height and spacing and ultimately cover, are important to amphibians such as Columbia spotted frogs (Patla and Keinath 2005). Examples on the BTNF include conversion of a moist meadow or wet sedge meadow community to a plant community dominated by Kentucky bluegrass (as described by Youngblood et al. 1985 for the Greys River area) or conversion of native moist meadow and silver sagebrush communities to those dominated by nonnative bluegrasses (Youngblood et al. 1985, USFS 2004). Such changes in plant species composition contributes to the decrease in Columbia spotted frog habitat across the BTNF. <u>*Atmospheric Nitrogen*</u> Nitrate and ammonia concentrations are increasing in lakes, ponds, and wetlands in at least parts of the BTNF due in part to increases in atmospheric nitrogen (DeLong 2015). An increase in nitrate and ammonia concentrations results in the increased probability of less-than-suitable water quality being produced by livestock grazing use. These elevated concentrations of nitrogen	spotted frog (*Rana luteiventris*). Youngblood, A. P., W. G. Padgett, and A. H. Winward. 1985. Riparian community type classification of eastern Idaho – western Wyoming. U.S. Department of Agriculture, Forest Service, Intermountain Region, R4-Ecol-85-01.

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	and ammonia levels in areas throughout the BTN may result in negative implications to Columbia spotted frog tadpoles. <u>*Fire and Fuels Management*</u> Current drought patterns, natural wildfires, and enhanced emphasis on fuels management projects on National Forest System lands has likely elevated the significance of this risk factor on amphibian populations and habitats . As pointed out by Maxell (2000), little or no direct information is available about the impacts of fire and fire management on amphibians, particularly in the intermountain west. The fire-adapted nature of forests (conifer and aspen) on the BTNF suggest that natural fire regimes pose little threat to the persistence of native amphibians. However, fire or management activities that reduce the amount of coarse woody debris may be detrimental to toads, as discussed in more detail under the "*Timber Harvest*" sub-section. Furthermore, wild and prescribed fires, particularly near breeding sites, may result in amphibian mortality. Large, high-intensity fires– like those on the BTNF on occasion– may result in sediment delivery to downstream breeding sites, in turn, decreasing Spotted frog reproduction. Both positive and negative impacts on Columbia spotted frog habitat is likely. While fire and fuels management can result in negative threats to Columbia spotted frog, a reduction in the occurrence and spread of fires can negatively impact toads by reducing non-forested habitat (e.g., moist meadows, willow communities), reducing spring flows (which can affect duration of water in breeding wetlands), excessive shading of breeding pools, and reductions in the distribution and abundance of aspen. Reductions in the distribution and abundance of aspen is a likely contributor to reductions in the distribution of beaver pond complexes suitable habitat for Columbia spotted frogs. <u>*Introduced Species*</u> An introduced population of bullfrogs exists at Kelly Warm Springs in Grand Teton National Park, but bullfrogs are not known elsewhere in the Greater	

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	Yellowstone Ecosystem including the BTNF. Bullfrogs would likely be restricted to thermal waters if they exist on the BTNF. However, if introduced to areas on the Forest, bullfrogs could adversely affect native amphibians through predation, competition, or disease transmission. Introduction of non-native fish or introducing fish into historically fishless habitats may have negative effects on palatable amphibian species, such as the spotted frog. Low abundance and reduction in the distribution of amphibian species in otherwise suitable habitat on the BTNF has been linked to the introduction of non-native fish into formerly fishless lakes that supported amphibian breeding (DeLong 2015). The potential for the spread of diseases harmful to amphibians from introduced fish or from the water they reside, or on the boots and gear of fishermen, is an important concern. Control of unwanted fish through the use of chemical pesticides such as rotenone and antimycin poses strong risks to larval amphibians (Skaar et al. 2017). *Herbicides, Pesticides, and Other Chemicals* The biphasic (aquatic and terrestrial) characteristic of the Columbia spotted frog and the permeability of their skin renders them potentially vulnerable to levels and types of chemicals that have been judged safe for other organisms. As noted by Maxell (2000), there are no requirements for testing the toxicity of pesticides and herbicides on amphibians. Effects resulting from pesticides and herbicides include direct mortality, sub-lethal effects including behavioral changes and reduced disease resistance, and risks from non-active components of supposedly safe pesticides and herbicides. Rotenone has the potential to have severe negative impacts on tadpoles. To the extent rotenone has been used in waters of the BTNF near breeding Columbia spotted frogs is currently unknown. *Oil, Gas and Mineral Development* Oil and gas development has the potential to impact water quality in wetlands used by Columbia spotted frogs if occupied wetland habitat were to exist near	

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	developed sites (Loeffler 2001, Patla and Keinath 2005). Patla and Keinath (2005) reported that threats from oil and gas development and mineral extraction "…include environmental contaminants produced by tailings, released groundwater, mining/transport accidents, acid drainage, and leaching of additional metals from stream and soil substrates." Contaminated settling ponds can be used by spotted frogs, exposing them to accumulated heavy metals, some of which (e.g., copper) are acutely toxic to tadpoles (Loeffler 2001). Lefcort et al. (1998) describe the dramatic impact of heavy metals on the terrestrial and aquatic environment in northern Idaho, where soils, rivers, and lakes have high levels of metals. They report that "only remnant, nonrecruiting populations of anurans" occur in the upper reaches of the contaminated Silver Valley. Lefcort et al. (1998) tested the effects of heavy metals (i.e., lead, zinc, cadmium, and combinations) on spotted frog tadpoles and found that they reduced the survival, growth, and fright response of tadpoles." In addition to water quality impacts from normal operations (above), spills can occur, which could result in adverse impacts to Spotted frogs. While oil and gas development is occurring on the BTNF, the extent to which such activities are having negative impacts to Columbia spotted frogs is unknown. *Loss of Wetland Habitat* Amphibian breeding sites can be lost or adversely affected by climate change, timber harvest activities, recreation/development, livestock grazing, mining, water source development and impoundment. Concerns for amphibians, including the risk factors as described above, include wetland habitat loss and disturbance, hydrological changes, sedimentation, and water contamination. Reductions in the distribution of beaver pond complexes can also contribute to lower distribution and abundance of Columbia spotted frogs.	
Summary and recommendations: The Bridger-Teton National Forest overlaps with the majority of the Columbia spotted frog distribution and habitat range in Wyoming. The species is found throughout the northern portion of the BTNF, and		Date: February 7, 2018

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while there are gaps across the Forest where occupancy is unknown, suitable habitat for the Columbia spotted frog is present forest-wide, excluding the Wind River Mountain range. There is current uncertainty of the Columbia spotted frog population trend and abundance on the BTNF. However, rigorous survey efforts within the past few years are contributing to the data necessary to assess Columbia spotted frog populations on the BTNF. While population trend data is absent on the BTNF, scientific literature suggests that Columbia spotted frog populations are in decline. This species is highly vulnerable to environmental elements and the risk factors, as described in greater detail above, are a significant component to the viability of this species and the Columbia spotted frogs' persistence on the BTNF over the long-term. Multiple stressors; including disease, climate change, timber harvest, livestock grazing, motorized use, recreation, and invasive species introduction all result in potential substantial impacts to Columbia spotted frogs, either directly or indirectly through habitat loss or degradation, on the BTNF. These risk factors are likely contributing to reduced distribution and abundance of Columbia spotted frogs on the BTNF. Amphibians face multiple potential stressors including disease, climate change, habitat alteration, and invasive species. Environmental stressors can also be interactive. Given these risk factors, coupled with relatively low occupancy and reduced distributions, the viability of these species and their persistence on the Bridger-Teton over the long-term are of substantial concern. TFor these reasons, it is recommended that the Columbia spotted frog is a Species of Conservation Concern for the Bridger-Teton National Forest. Evaluator(s): Ashley Egan, Randall Griebel		