# Site Management Plan
# for Oregon Spotted Frog, (Rana pretiosa),
# Buck Lake Complex, Klamath County, Oregon

Prepared by Lance Lerum , USFS Fremont-Winema National Forest

1/19/2012

Edited by
Rob Huff, Conservation Planning Coordinator, USFS Region 6 and BLM Oregon State Office
Amy Markus, Forest Wildlife Biologist, Fremont-Winema National Forests
Tia Adams, US Fish and Wildlife Service, Klamath Falls Fish and Wildlife Office
May2012

U.S.D.A. Forest Service Region 6 and U.S.D.I. Bureau of Land Management
Interagency Special Status and Sensitive Species Program

**Site Name:**
Buck Lake Complex
Klamath County, Oregon
Klamath Ranger District, Fremont-Winema National Forests
Bureau of Land Management-Klamath Falls Field Office
Private lands

**Common Name:** Oregon spotted frog
**Scientific Name:** *Rana pretiosa*

**Location and Legal Description:**
The site may be accessed by the Clover Creek Road approximately 19 miles northwest of Keno, Oregon and contains nearly 1,700 acres of National Wetlands Inventory (USFWS 2010). The nearest other Oregon spotted frog (OSF) populations occur approximately 18 air miles southwest at Parsnip Lakes and approximately 25 air miles north at Fourmile Creek (Map 1).

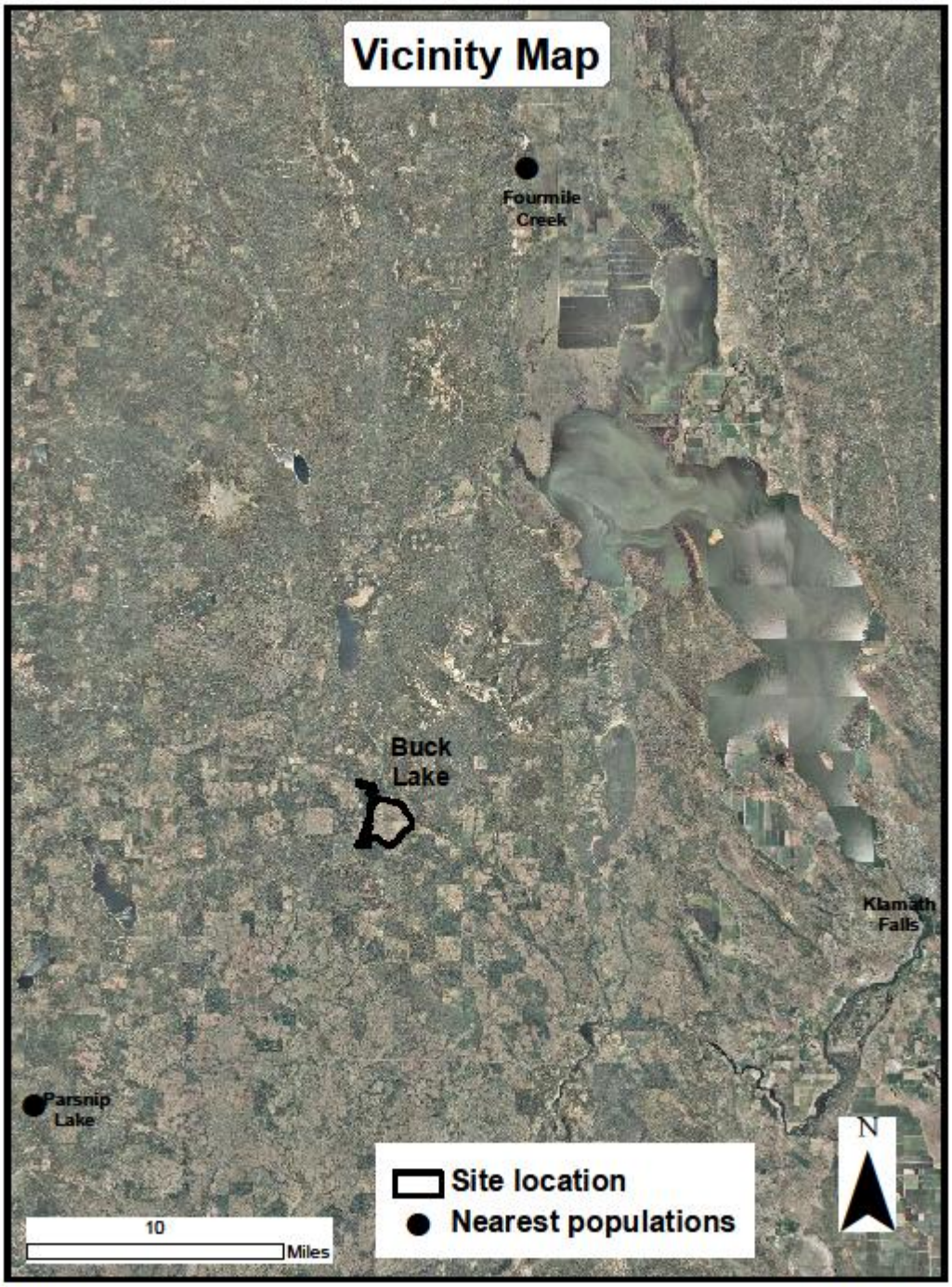
The Buck Lake Complex is comprised of several adjacent wetland habitat types that are locally known as Buck Lake, Buck Meadow, Buck Marsh, West Impoundment, and Tunnel Creek (Map 2). Land ownership is mixed federal and private and approximate acreage distributions are: 1500 acres at Buck Lake in private ownership, 70 acres at Tunnel Creek managed by Bureau of Land Management (BLM), and 80 acres at Buck Meadow and Buck Marsh managed by US Forest Service (USFS).

The complex is located in T. 38 S. R. 5 E. and portions of sections 11, 12, 13, 14, 23, and 24.

**Goals of the Management Plan:**
Primary direction and agency goals for management of Oregon spotted frog in the Klamath Basin have recently been developed in an interagency *Conservation Agreement for the Oregon Spotted Frog* (2010) where management goals were stated as:

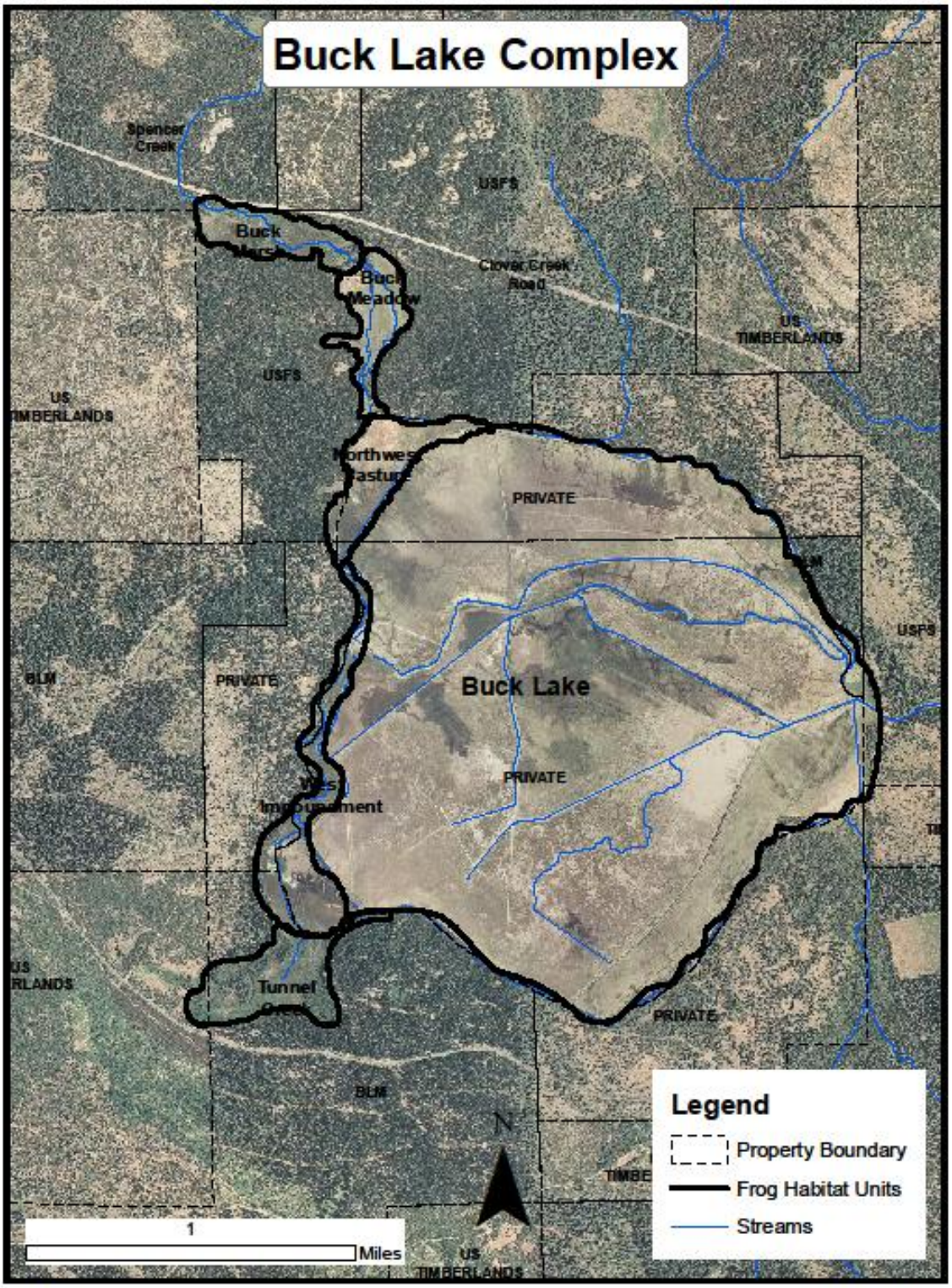
- "to manage occupied habitat in a manner that sustains and /or restores its ability to support OSF populations,
- to stabilize declining populations or increase populations within the Klamath Basin,
- to reduce threats,
- to increase distribution among available suitable habitats by restoring or creating habitat"

This Conservation Agreement also directs that Site Management Plans will be reviewed every five years to update new scientific findings or habitat information. This Site Management Plan (SMP) recommends management actions addressing these four goals and is discussed in the Management Needs section of this plan. Although this SMP may include site descriptions of the adjacent private lands, the recommendations for management actions included in this SMP apply to Federal lands only.




Map 1

May 2011




Map 2

May 2011

## Background

### *Species Range, Distribution, Abundance, and Trends*

Cushman and Pearl (2007) have prepared a Conservation Assessment for the Oregon Spotted Frog that may be referenced for detailed descriptions of this species' live history, range-wide distribution, abundance, and trends. Additionally, as a Candidate species for listing under the Endangered Species Act, US Fish and Wildlife Service annually update their *Species Assessment and Listing Priority Assignment Form* (USFWS 2010) with the latest science, trend, and distribution information available. The recently completed *Conservation Agreement for the Oregon Spotted Frog (Rana pretiosa) in the Klamath Basin of Oregon* (2010) summarizes descriptions of Oregon spotted frog, habitat, life history, distribution, and current status in a concise narrative repeated here:

*"Species Description*
*The Oregon spotted frog is the most aquatic ranid frog in western North America (Leonard et al. 1993). The back is covered with indistinct or scalloped black spots having light centers (Leonard et al. 1993, Corkran and Thoms 1996). The belly and groin region display a mottled wash of red to orange in adults, but coloration in juveniles is typically absent or restricted to the groin (Hayes 1998). The eyes are upturned and the fully webbed hind legs are relatively short compared to body length. Eggs are laid in fist sized spherical masses that typically contain 300 to 1500 embryos. Tadpoles are brown or gray with gold flecks, and the tail is about twice the body length (Leonard et al. 1993, Corkran and Thoms 1996).*

*Habitat Description*
*Breeding occurs in shallow pools at depths, 10-60 cm (4-24 in), and are often connected to larger or flowing water sources (McAllister and Leonard 1997, Pearl 1999). Eggs are generally laid above sedges, grasses, and rushes early in the year before plant growth has begun (McAllister and Leonard 1997). Post breeding habitats used by Oregon spotted frogs are typically aquatic, and often have areas of floating, emergent or submergent vegetation that is near refuge that can be used to escape predators. One study suggests that egg mass numbers were positively related to the presence of other Oregon spotted frog breeding sites nearby and the amount of emergent and subemergent vegetation coverage (Pearl and Adams, in press). Refuge microhabitats are aquatic and can include thick vegetation and deep water (≥0.5 m or 20 in deep; Licht 1986, Hayes 1998, Pearl et al. 2005). Habitats used during winter include flowing channels and springs (Hayes 1998).*

*Watson et al. found that the aquatic requirements necessary to complete the life cycle of Oregon spotted frogs include 1.) stable, shallow water for egg and tadpole survival in the breeding season, 2.) deep, moderately vegetated pools for adult and juvenile survival in the dry season, and 3.) shallow water levels over emergent vegetation for protecting all age classes during the cold weather in the wet season (2003).*

*Life History*

*Oregon spotted frogs emerge from wintering sites immediately after ice and snow begin melting. Timing varies among years and is strongly influenced by local site conditions (e.g., elevation and weather). Licht (1969) reported a minimum sustained air temperature of 5℃ (41° F) to initiate spotted frog (R. pretiosa pretiosa; currently R. luteiventris) emergence from overwintering sites.*

*Oregon spotted frogs typically oviposit communally and these aggregations can contain eggs from > 100 females in larger populations. Communal oviposition may be linked to the female's affinity for depositing egg masses on top of previously laid egg masses (Licht 1969). Egg deposition may occur when water temperatures reach 8-9℃ (46-48° F) (Hayes 1998). Time between laying and hatching is temperature dependent. In laboratory trials, the time to hatching for Oregon spotted frog eggs from 1 British Columbia site correlated strongly with water temperature, and ranged from 2-25 days in temperatures ranging from 7-28℃ (44-82° F).*

*High breeding site fidelity is suspected because oviposition often occurs within 0.5 m (20 in) of previous years locations (Licht 1969). Use of traditional oviposition sites that may have limited availability because of unique characteristics, and the possibility that adults may have limited flexibility to switch sites, makes the Oregon spotted frog particularly vulnerable to habitat changes at oviposition sites (Hayes 1994).*

*Egg masses are vulnerable to freezing and desiccation because they are deposited in shallow water (Licht 1974 and 1975, Hayes 1998). During early development, embryos have water temperature tolerance limits between 6-28℃ (43-82° F) (Licht 1971). The duration of the larval stage varies with elevation and temperature.*

*Several aspects of the Oregon spotted frog's life history make it particularly vulnerable to habitat alterations: 1) communal egg laying at sites used year after year restricts the number of reproductive sites, 2) the species' warm water requirement results in habitat overlap with introduced warm water fish, 3) the active season warm water requirement may limit suitable habitat in the cool climates of the Pacific Northwest, and 4) the species may be vulnerable to the potential loss or alteration of springs used for overwintering (Hayes et al. 1997).*

*Distribution*

*The species is currently known from <50 sites in southwestern British Columbia, western and south-central Washington, and western, central, and south-central Oregon; no populations are known to persist in California (Cushman and Pearl 2007). Revisits of historic localities suggest the species is lost from 70-90% of its historic range (Cushman and Pearl 2007).*

*Status*

*The Oregon spotted frog is considered a Candidate species by the USDI - Fish and Wildlife Service (USFWS). Candidate species are plants or animals for which the USFWS has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act but for which development of a proposed listing regulation is precluded by other higher priority listing activities.*

*The Oregon spotted frog is ranked as Sensitive-Critical by Oregon Department of Fish and Wildlife; a Special Status Species by Oregon BLM; and Sensitive by the Region 6 Regional Forester's Special Status Species List. The Oregon Natural Heritage Information Center gives the Oregon spotted frog a Global rank of G2 (globally imperiled because of rarity); a National rank as N2 (taxa that are threatened with extirpation or presumed to be extirpated in the United States); and a State rank of S2 (taxa that are threatened with extirpation or presumed to be extirpated from the state of Oregon). Oregon spotted frog is also considered a List 1 classification which means the species is threatened with extinction or presumed to be extinct throughout their entire range; these are the taxa most at risk, and should be the highest priority for conservation action."*

***Site Description and Ecological Processes***

The *Spencer Creek Pilot Watershed Analysis* (BLM 1995) described and analyzed watershed conditions and provides detailed descriptions of physical characteristics of the area. A brief description of the features and processes may be taken from excerpts from this document: "The watershed originates at the crest of the southern Oregon Cascades, flows southeast and empties into the Klamath River just above Topsy Reservoir. Elevations range from approximately 8,200 feet at the top of Aspen Butte to 4,000 feet at the mouth of Spencer Creek." "Unique features within the watershed include Buck Lake...Buck Lake lies in the upper end of the watershed and is a significant contributor to the ecological systems within the watershed." This watershed is unique in that it is the only drainage in the Klamath Basin flowing off the east flank of the Cascades that has a south-facing aspect.

Soils are variable within the 54,160 acre Spencer Creek watershed and at the higher elevations are derived from mudflow, pyroclastics, and glacial material while lower elevation soils originate from andesite, tuff, and volcanic ash. Floodplain and basin soils are formed in lacustrine sediments or alluvium derived from volcanic ash.

The area climate is characterized by warm, dry summers and cold, snowy winters with most precipitation occurring as snow and infrequent summer thunderstorms. Mean annual precipitation widely ranges between 15 and 40 inches with significant yearly and elevation differences. High elevation deep snowpack can accumulate with peak runoff determined by the timing and duration of spring rains and snow depths.

Spencer Creek originates in Mountain Lakes Wilderness at about 8,000 feet and flows into the Klamath River at about 4,000 feet. Spencer Creek, Tunnel Creek, and several seeps and springs flow into and through Buck Lake which was historically a marsh. Circa 1943 a natural dam was removed and a series of canals and irrigation structures were developed at Buck Lake which served to drain the marsh and convert land for agricultural purposes primarily related to livestock production. Buck Lake and Spencer Creek are the primary perennial hydrologic features in the watershed.

Franklin and Dryness (1973) described five different potential forested vegetation zones that occur in the watershed area. Forests surrounding the Buck Lake wetland complex are in the Lodgepole Pine Zone which is characterized as valley bottoms with poor cool air drainage from

4800 to 6600 feet in elevation. Plant associations include lodgepole pine/huckleberry/forb and lodgepole pine/grouse huckleberry/long-stolon sedge. White fir is a significant understory component in some of the lodgepole pine stands and may be the climax species dependent upon frost, soil moistures and fire cycles.

The Buck Lake Complex has been delineated into several units of differing habitat types with varying importance to OSF (Map 2, also see Appendix 1 Photos). Buck Marsh and Buck Meadow are USFS lands and currently do not support OSF presence. The marsh is fed by several springs and Spencer Creek flows through these two units. Some winters Spencer Creek freezes and flows cease. There is evidence of beaver presence in the marsh and it appears that spring flooding could provide breeding habitat. It is unknown if the site could provide overwintering habitat.

Buck Meadow currently does not provide OSF habitat although a spring fed ephemeral pond does provide breeding for western toad (*Bufo boreas*) and Pacific chorus frog (*Pseudacris regilla*). The pasture generally floods in the spring but does not stay flooded long enough to provide OSF breeding habitat. Soils are dense, compacted till, possibly further compacted by past heavy livestock use, and provide little water infiltration. Riparian vegetation is sparse and likely would not support beaver occupancy.

The USFS conducted a Level II stream survey of the Spencer Creek reach flowing through Buck Marsh and Buck Meadow on June 28, 2010 (USFS 2011a). This reach was described as: "Reach 5 was determined to be a Rosgen E6 stream channel type due to its gradient and silt dominated substrate. A large portion (3500') of reach 5 was determined to be a marsh. The average wetted width (Rosgen E channel only) is 6.4 feet. The reach averages 19 pools per mile with residual pool depth of 1.2 feet. Stream banks are 98% stable and 2% unstable with sections of unstable bank along both sides of the stream. The reach had 6 pieces of LWD per mile (0 large/medium and 6 small pieces per size class).

The stream side vegetation was dominated by grass forbs with an overstory of grass forbs. There are some isolated pockets of lodgepole pine. The stream runs through a very large valley dominated by marshland. A channel begins to take shape at the end of the valley up to the road crossing. There are active beaver dams in the marsh. Unidentified fish were observed throughout the reach."

The Northwest Pasture is mostly privately owned. Approximately three to four acres of USFS lands along the western edge are included in this occupied polygon. This unit is primarily vegetated with meadow grasses and only seasonally floods in the spring.

The West Impoundment is also privately owned and borders the western edge of Buck Lake.

The Tunnel Creek unit is on Bureau of Land Management lands and provides OSF habitat associated with older beaver dams along the stream reach. Beaver are still present but not very active and dams are becoming decadent and in need of repair. Oregon spotted frog breeding has been documented in this unit in the past but not in recent years. This unit likely still provides some suitable habitat for OSF.

The large Buck Lake Unit is also privately owned.

***Site Management History and Current Land Allocations***

Of the nearly 1,700 acres of wetland habitats at Buck Lake, 1550 acres are in private ownership, 70 acres at Tunnel Creek are managed by BLM, and 80 acres at Buck Meadow and Buck Marsh are managed by USFS. The Land and Resource Management Plan (LRMP) for the Winema National Forest (1990) has designated USFS lands in this area as Management Area 3-Scenic Management and lands are managed to provide visually appealing scenery for the forest user. Timber harvest, grazing, and recreation activities are allowed within this management designation. The Buck Lake Complex units are also within riparian corridors and are protected as such with further management activity restrictions.

The federal lands in the watershed surrounding the site are actively managed for timber production with many acres having received some treatment in the past. Buck Meadow and Buck Marsh are included in the Forest Service grazing allotment and Tunnel Creek is within the BLM grazing allotment. These units have received varying levels of past and ongoing use.

In 2009 the Forest Service constructed a perimeter fence around Buck Meadow to better manage grazing use. Cattle are excluded from the pasture until late fall when the fence is let down and cattle gathered for a short period of time prior to removing from the allotment for the season. Little cattle use has occurred in the last several years. Buck Marsh receives little grazing use because of the wet nature and numerous down lodgepole pines limiting cattle movement. Grazing on allotment lands within a mile of Buck Lake has been light to moderate . Similar to Buck Marsh, the majority of the Tunnel Creek meadow/marsh area gets little use because of the wet nature of the site (BLM 2005).

Some falling of trees has occurred in Buck Marsh and may have been associated with efforts to reduce forest encroachment into the wetlands although no records of these activities could be located. It appears that this occurred in the early 1990's based upon comparing current and older aerial photos of the site. Little commercial timber occurs within the Buck Lake Complex units and such activities are not likely to be pursued on federal lands.

The majority of the occupied habitat for the OSF occurs on private lands adjacent to federal lands, however the USFS, BLM, and USFWS are working to maintain and increase coordination with the private landowners for the continued conservation of the OSF and its habitat.

***Site Specific Abundance and Trends***

The presence of Oregon spotted frogs at the Buck Lake complex was documented in 1994 by Hayes (Hayes 1995) while surveying the Spencer Creek watershed for amphibians. Hayes returned to Buck Lake in 1995-1997 and continued investigating the OSF and other amphibian and reptile populations. Using implanted passive inductance transponders (PIT) tags Hayes attempted a mark-recapture study to estimate the adult population demographics of OSF at Buck Lake. This study estimated the adult OSF population size at 519 however, the low numbers of

recaptures resulted in low confidence for the value. "Standard of error of this estimate is enormous (SE=500) such that 95% confidence intervals (±980) had an upper limit of 1499 and a lower limit that surpassed zero" (Hayes 1998). Since the Hayes studies, various USFS, BLM, USFWS, and USGS personnel have continued to sporadically resurvey this population documenting continued presence (see Table 2). Egg mass surveys conducted in 2006 through 2011 (no surveys in 2007) located 24, 25, 16, 38, and 6 egg masses respectively. Search effort and locations were not consistent each year so no abundance trend should be inferred from these data. The 2011 breeding surveys followed a winter with higher snowpack than seen in recent years and a cold late spring thaw creating difficult survey conditions. Frogs may have altered breeding locations and timing partially accounting for the low egg mass detection that year. No active management or habitat manipulations specific to restoring or enhancing OSF populations have occurred to date. No egg masses were detected in the Tunnel Creek locations during 2008-2011 surveys.

It is not known exactly where Oregon spotted frog individuals are currently overwintering. A Service First funded project installed underwater video cameras during the winter of 2010 and 2011 with the intent of determining these locations and observing presence of potential predators and other inter and intra species interactions. In conjunction with this video work, a cooperative study by a student at the Oregon Institute of Technology is looking at environmental factors, like dissolved oxygen (DO) and temperature at suspected overwintering locations and likely travel corridors to breeding sites. No frogs were detected at suspected overwintering sites until March when they became actively moving to breeding sites. Either the selected camera locations were not at overwintering sites or these animals were positioned under the pond detritus and vegetation and remained largely sedentary throughout the winter months. Measured dissolved oxygen levels did not fall below 4.3 ppm under the ice and often recorded near saturation at spring sources (Lerum pers. obsv.). Dissolved oxygen levels may not be a significant limiting factor at this location given the many spring sources with high DO levels, although minimum tolerance levels for overwintering OSF are not known.

### *Site Threats*

Threats identified in the U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form last updated April 2010 listed: 'non-native predaceous fish, exotic vegetation encroachment, grazing, vegetation succession, water diversion, and habitat alteration.'

Threats specific to the area addressed in this SMP include:

- Habitat alteration
- Vegetative changes
- Non-native fish and bullfrogs
- Livestock grazing
- Isolation
- Disease
- Climate change

*Habitat Alteration:*
Several aspects of the Oregon spotted frog's life history make it particularly vulnerable to habitat alterations: 1) communal egg laying at sites used year after year restricts the number of reproductive sites, 2) the species' warm water requirement results in habitat overlap with introduced warm water fish, 3) the active season warm water requirement may limit suitable habitat in the cool climates of the Pacific Northwest, and 4) the species may be vulnerable to the potential loss or alteration of springs used for overwintering (Hayes et al. 1997).

It has been suggested that beavers produce the necessary habitat components for Columbia spotted frogs (Demmer and David 2008) and evidence suggests that some OSF populations are also dependent upon habitat created by beavers. Tunnel Creek breeding sites are associated with beaver dams and these dams are becoming old and decadent with little repair or new construction taking place. Beaver are still present but population numbers appear to currently be low. Although abundant willow and other shrubs are available in Tunnel Creek, low hardwood shrub density along Buck Meadow and Spencer Creek suggest limited suitable beaver habitat. Riparian shrub and tree planting at some locations on federal land could improve current habitat conditions for beaver.

*Vegetative Changes:*
Succession by native and non-native vegetation has potential to modify conditions at wetlands associated with Oregon spotted frog habitat (Cushman and Pearl 2007). Threats exist from exotic plant invasions, such as reed canarygrass (*Phalaris arundinacea*). Aggressive exotics can completely alter the structure of wetland environments and can create dense areas of vegetation that may be unsuitable as Oregon spotted frog habitat (McAllister and Leonard 1997). USFS stream survey of Spencer Creek through Buck Marsh and Buck Meadow in 2010 did not locate any aquatic invasive species.

Succession (changes in plant communities) may be a factor threatening many Oregon spotted frog sites by changing open water conditions and solar exposure altering water temperatures. Fire, beaver, and active floodplain meanders were natural disturbances that were historically more common within Oregon spotted frog habitat, and acted to periodically create open water habitat (Cushman and Pearl 2007). These natural disturbances have now been largely eliminated from this locality.

*Non-Native Fish and Bullfrogs:*
The warm water habitat requirement of the Oregon spotted frog makes it unique among native ranids of the Pacific Northwest, but also exposes this species to a number of introduced fish, contributing to losses of populations (Hayes and Jennings 1986, Hayes 1997, McAllister and Leonard 1997; Pearl et al. 2009a). Oregon spotted frogs, which are palatable to fish, did not evolve with these introduced species and may not have the mechanisms to avoid predatory fish that prey on the tadpoles of native amphibians. The negative effects of introduced fish on the Oregon spotted frog have been suggested by demographic data showing that sites with a disproportionate ratio of older frogs to juvenile frogs (i.e., poor recruitment) also have significant numbers of brook trout (e.g., Penn Lake and Fourmile Creek, Oregon) and/or fathead minnow (Wood River Ranch, Oregon) (Hayes 1997, Pearl 1997). Brook trout, occurring at 18 sites, are the most frequently recorded introduced predator and apparently occurs with the Oregon spotted

frog at coldwater springs where this species probably overwinters (Hayes et al. 1997). Brook trout and bullhead catfish are present though large fish with a gape large enough to swallow a juvenile spotted frog have not been observed in the last several years of field work at the site (Lerum, pers. obs.). Stream surveys of Spencer Creek (USFS 2010) noted numerous unidentified fish in Buck Marsh with no mention of size. The significance of tadpole predation at these sites is not known.

Bullfrogs have been introduced into the Pacific Northwest from eastern North America and are thought to possess a competitive advantage over Northwestern ranid frogs because: 1) bullfrogs have evolved with many of the introduced fish species and developed defenses against these predators, 2) bullfrog tadpoles are not palatable to all fish or birds (Kruse and Francis 1977, McAllister and Leonard 1997), 3) bullfrog tadpoles may displace tadpoles of other frog species from warmer water where conditions are optimal for development (Hayes 1994, Kiesecker and Blaustein 1998, Pearl et al. 2004), to cooler water which slows development, and 4) bullfrog tadpoles are more resistant to the effects of pesticides and heavy metals than other ranid frogs (Hayes and Jennings 1986). Bullfrogs also may act as direct predators on OSF tadpoles and juvenile frogs. Currently bullfrogs are not known to occur on federal land.

*Livestock Grazing:*
Livestock grazing effects on OSF are not well documented and may be beneficial or detrimental to OSF habitats and viability. The limited data and evidence of impacts of grazing are mixed, and may vary between sites. Livestock grazing may, in some instances, benefit Oregon spotted frogs by maintaining openings in the vegetation in highly disturbed wetland communities, but it may negatively affect this species if the habitat has been previously degraded (Hayes 1997, Hayes et al. 1997, McAllister and Leonard 1997, Shovlain 2005), particularly at springs used as overwintering sites for frogs. Although this should not imply that livestock grazing is required for the maintenance of Oregon spotted frog habitat (Hayes 1997), using livestock grazing as a tool to create more open water conditions warrants further research.

It is suspected, based on the habitat needs of the Oregon spotted frog, that there could be negative impacts from grazing and the magnitude is likely dependent on the timing and intensity of grazing. These negative impacts may include reduced water quality, reduction of water quantity in low water years, damage or reduction of vegetative cover, channel instability, and direct trampling.

Direct effects to OSF from grazing at this site are not understood and have not been investigated. Certainly habitat modifications creating grazing opportunities significantly affect OSF habitat availability. Current management objectives on USFS lands at Buck Marsh and Buck Meadow are not to eliminate grazing but to manage when and where livestock are allowed to graze so as to minimize potential impacts on the frogs. To facilitate this, a fence was built around Forest Service lands at Buck Meadow to manage livestock use timing and duration.

*Isolation:*
For a highly aquatic species such as Oregon spotted frog, which breeds in specific wetland types and exists in a landscape often substantially altered from historic conditions, factors relating to isolation include: distance, permeability of habitat between source site and nearest breeding site,

frequency of dispersal movements, and risks to/vulnerability of animals moving between potential breeding sites (*e.g*., exotic predators, culverts, etc.) (Cushman and Pearl 2007). With the exception of the upper Deschutes Basin sites, distances separating most of the known Oregon spotted frog populations are generally at least 2 km (1.2 mi) from one another (Cushman and Pearl 2007). Long distance movements by Oregon spotted frog appear to be infrequent and strongly linked to aquatic corridors (Cushman and Pearl 2007). Funk et al. suggests that genetic analysis reveals low levels of within population genetic variation in Oregon spotted frogs (2008). Low genetic variation may be attributed to small effective population sizes, historic or current genetic bottlenecks, and/or low among population gene flow (Funk el al. 2008, Blouin 2000).

Blouin et al (2010) hypothesizes low connectivity among widely spaced OSF populations, rather than small population size, is the main reason for low genetic variation. They suggest that highly aquatic and patchy habitat is the obvious cause of this low connectivity. This study recommends that management actions should maintain connectivity between potentially connected populations and either expand or find additional populations to maintain diversity. This is probably best accomplished by improving, or expanding the available wetland habitats at each site (Blouin et al. 2010).

This OSF population is separated from the nearest other OSF populations at Parsnip Lake and Fourmile Creek by distances of 18 and 25 air miles respectively. Connectivity to these other populations through wetted, likely migration corridors, would be much greater distances, and not likely, given changes in riparian habitats and lack of suitable OSF habitats in between these populations. This population is effectively isolated from other OSF populations. An analysis of genetic samples collected from these populations to assess connectivity, isolation, and genetic bottlenecks is currently being conducted by USGS and Colorado State University.

A connectivity analysis conducted in 2010 (USFS 2011b) of this site did not attempt to assess reconnecting this population to these nearest distant populations. An analysis of nearby potential habitat did suggest that Buck Marsh likely could provide suitable OSF habitat but the connectivity through Buck Meadow provided a barrier of unsuitable habitat due to lack of breeding and overwintering habitat. To partially address isolation issues and potentially expand available OSF habitat, two breeding ponds placed 100-200 meters apart, were proposed to be built in Buck Meadow to assist frog movement from the private land, through Buck Meadow to potentially suitable habitat in Buck Marsh. However, during the winter of 2009-2010 Spencer Creek froze and did not flow for a period of time and it is unknown if the area could support over wintering. Flows were continuous through Buck Marsh during the 2010-2011 winter. Until this overwintering habitat suitability can be assessed this pond creation proposal is being postponed. It was felt that since there is beaver activity in the marsh, the area may also support over wintering sites for the frogs.

*Disease:*
Amphibians are susceptible to several diseases that may result in population losses either directly or as secondary stressors that reduce fitness and vigor in the population (Gray et al. 2009, Pearl et al. 2009b, Petrisko et al. 2009). Chytridiomycosis is a disease of amphibians that is caused by the fungal pathogen *Batrachochytrium dendrobatidis* (Bd) and testing has shown that the pathogen is present in this population (Pearl et al. 2009). Recent research by Padgett-Flohr and

Hayes (2011) found that OSF infected with chytrid in a laboratory setting were able to clear the infections with no mortality suggesting some resistance to Bd. Test animals came from a population that had previously been declining and it was suggested that these animals may have previously developed some resistance to the disease and further testing from a population that had not previously been declining was recommended. OSF also possess diverse antimicrobial peptides that may help mitigate effects of dermal pathogens like Bd (Rollins-Smith, et al. 2005). The combination of field data and lab data imply that Bd is not currently a primary driver of declines, although factors that mediate its effects are not completely fully understood.

Viral pathogens of the genus *Ranavirus* have been responsible for recent widespread amphibian population die-offs and may be an interaction of suppressed and naïve host immunity, anthropogenic stressors, and novel strain introduction (Gray et al. 2009). Water-molds of the genus *Saprolegnia* can be found on decaying animal and plant debris in freshwater habitats worldwide, have been implicated in the mortality of amphibian eggs and have been identified in OSF populations in the Klamath Basin (Petrisko 2009). Presence or significance has not been studied at the Buck Lake Complex.

*Climate Change:*
Climate change is expected to significantly affect water resources in the western United States by the mid 21st century (Barnett et al., 2008). Climate change is generally predicted to result in increased air and water temperatures, decreased water quality, increased evaporation rates, increased proportion of precipitation as rain instead of snow, earlier and shorter runoff seasons, and increased variability in precipitation patterns (Adams and Peck 2002). Similar to other sites, the federal lands are vulnerable to changes in precipitation and temperature affecting water quantity and timing.

Climate change or localized drought can negatively impact Oregon spotted frogs in all life cycles, particularly in isolated populations occupying fragmented habitat. Seasonal drought affects populations by increasing the likelihood of egg mass desiccation and exposure to freezing, concentrating post-metamorphs thus elevating predation risk, and increasing the impacts of localized events (Licht 1974 and 1975, Hayes 1997*b*, Kiesecker and Blaustein 1997). Multiple year droughts carry impacts similar to seasonal droughts, but may expose populations to negative long term impacts including decreased population numbers, potential losses in population heterozygosity, exacerbation of impacts from catastrophic events, and potential extirpation (which is more serious in isolated populations and metapopulations with remote chances of being recolonized).

Changes in water levels due to climate change or localized drought can cause seasonal loss of habitat and degradation of essential shoreline vegetation. Hayes (1997) assessed 38 percent Oregon spotted frog sites as having a moderate to high risk from drought (i.e. the potential for a drop in water level that could reduce or eliminate the species' habitat). Sites with the greatest risk included sites depending on surface flow rather than flows from springs and having low precipitation levels. Sites with the greatest risk from drought are in Oregon in the Klamath and Deschutes Basins (Hayes 1997). Higher temperatures may also lead to earlier and more rapid surface water runoff flooding in the spring. Both drought and flooding can negatively impact Oregon spotted frogs in all life cycles, particularly in isolated populations occupying fragmented

habitat. Other sites at risk from fluctuations in water levels include those that are beaver dependent, those that depend upon overbank flow from rivers and streams, sites related to irrigation systems, and sites dependent upon immigrations from nearby habitat.

## Management Needs

### *Desired Site Conditions:*

The desired site conditions for the Forest Service and BLM lands are an increase in suitable habitat allowing greater distribution and abundance of animals. This may be achieved by restoration and enhancement activities. Threats to OSF would be minimized and resiliency built into the habitat and population so that temporary adverse conditions do not place the viability of the population at risk.

The first priority for this population should be to maintain the existing conditions and protect habitat conditions that are providing for a population of OSF to persist. This may best be achieved by initially maintaining adequate and stable water flows which would encourage continued beaver occupancy and dam maintenance on federal lands. Once this is secured, or concurrently if means are available, efforts may then be extended to restore and enhance conditions that allow for population growth and distribution expansion. Other threats to OSF may then be addressed to build resiliency into the habitat and population so that temporary adverse conditions do not place the population at risk.

Suggested Management Actions on FS and BLM lands are summarized in Table 1 below:

**Table 1. Suggested Management Actions**

| Action Needed | Timeline | Threat | Activity Location | Desired Site Condition |
|---|---|---|---|---|
| Remove water control features and restore Buck Lake outlet elevation and function. | ongoing | Habitat Alterations | Throughout SMP area | Restored historic water storage and hydrologic function. Restored OSF habitat. |
| Remove encroaching conifers. Restore riparian species along Spencer Creek. Enhance beaver abundance and viability by improving riparian habitat conditions. | 2013 | Vegetative Changes | Buck Meadow and Buck Marsh | Restore and increase suitable frog habitat |
| Monitor and assess nonnative predator impacts. Initiate control measures as needed. | 2013 | Non-native Predators | Throughout SMP area | Non-native predators do not impact OSF viability |
| Monitor and assess impacts. Implement management control when determined necessary. | ongoing | Livestock Grazing | Throughout SMP area | Minimize habitat or population negative impacts attributed to grazing. |
| Create breeding sites and wintering sites to connect habitats. | 2013 | Isolation | Throughout SMP area | Increase available suitable habitat |
| Support research to assess population impacts related to amphibian diseases. Sterilize field equipment between sites | 2011 | Disease | Throughout SMP area | Eliminate or minimize human related transmission vectors. |
| All actions above to restore and enhance habitats and reduce viability stressors | ongoing | Climate Change | Throughout SMP and potential range expansion areas | Increase population resiliency to reduce effects of climate change related stressors. |
| Monitor habitat and population changes by continuing egg mass surveys and monitoring water levels and beaver dam condition. | Annually. | All Threats | Primarily in the SMP area and connectivity reach to Crane Creek. | Changes are detected and adaptive management actions taken as needed. |
| Update Site Management Plan as directed in Interagency Conservation Agreement | 2016 or sooner if warranted | All Threats | Throughout SMP area | Incorporate new science findings and habitat information every five years |

***Actions Needed:***

**Habitat Alterations:**
Buck Meadow has been highly impacted by hydrologic alterations related to agriculture and cattle grazing. The USFS has considered restoration and OSF habitat enhancement on their parcel to connect the Buck Marsh to Northwest Pasture, via Buck Meadow, creating both breeding and wintering habitat on their parcels improving connectivity and habitat availability.

These actions are dependent on funding and a hydrological and biological evaluation of the area to determine the project's feasibility and success. The completion of this project would require NEPA analysis.

There should be consideration of enhancement of beaver habitat to encourage expansion of the current beaver population. Since recent beaver activity is evident stocking the site with additional beaver does not fit within the Oregon Department of Fish and Wildlife beaver introduction guidelines (http://www.dfw.state.or.us/wildlife/living_with/docs/Guidelines_for_Relocation_of_Beaver_in_Oregon.pdf). Habitat at Buck Meadow may need to be modified with riparian plantings in order to increase suitability for beaver. The proposed actions are similar to Demmer and David 2008; adding large woody debris for ease of lodge and dam building and planting hardwoods in adjacent areas as future food sources and dam material. NEPA analysis would need to be completed prior to project implementation. Suitable beaver habitat appears to exist at Tunnel Creek.

**Vegetative changes:**
A gas pipeline has been proposed to be constructed paralleling the Clover Creek Road. This project is currently undergoing permitting and NEPA analysis. The USFS has been successful in moving the proposed route to north of the Clover Creek Road to avoid impacting Buck Marsh. Proposed mitigation measures include riparian vegetation plantings along Spencer Creek in Buck Meadow which will enhance habitat suitability for beaver.

**Non-native Predators:**
Large non-native fish were not observed in significant numbers during recent spring egg mass surveys or winter video monitoring. Brook trout and bullheads are present, however, and effects are unknown at this site. Bullfrogs have not been documented to occur at this site. Continued monitoring for the presence of these predators should be conducted so that early detection and rapid response control measures might be implemented if needed. Prevention measures such as education of private landowners and public to prevent introductions of non-native species might be pursued. Native predators on site (otters, cranes, herons, mink, raccoon, garter snakes, etc.) may also contribute to population declines and impacts might best be minimized by improving and restoring natural habitat thereby improving the health and abundance of the OSF population so that it may absorb these losses.

**Livestock Grazing:**
Agencies are currently actively managing grazing on public lands to minimize potential negative impacts to OSF populations.

**Isolation:**
An Oregon spotted frog working group connectivity exercise conducted in 2011 did not find it likely or feasible that this population could become connected to other populations. In order to reduce isolation effects efforts should be made to enhance habitats to ensure connectivity between subpopulations within the site management plan area. Genetic samples have been collected and are currently being analyzed by USGS which should help determine genetic interchange between these populations. Efforts should be made to assess adjacent unoccupied

habitat which might be enhanced to provide OSF habitat to increase population distribution and abundance. Once genetic studies and a genetic management plan are completed an introduction of animals from neighboring populations might be considered to reduce the impacts from isolation and genetic bottlenecks.

**Disease:**
Until further research is conducted to clarify the relationship between amphibian diseases and the localized importance in amphibian mortality and potential links to population decline, current management efforts should focus on reducing the vectors that might introduce or transfer these pathogens between populations. Ongoing efforts to sterilize waders and equipment used by surveyors and researchers should continue.

**Climate Change:**
Any and all actions to improve habitat suitability and population viability will build resiliency in to the population so that stressors related to climate change may be minimized.

## Adaptive Management

**Monitoring/Site Revisits:**
Buck Lake has been visited and some level of survey or study conducted most years since the population was first discovered in 1994 (Table 2). Initial surveys monitored adults and juveniles and later surveys focused on egg mass searches with increasing levels of effort. Survey results suggest that the population of Oregon spotted frogs may have declined from 1994 to 2010. Fencing was installed in 2009 at Buck Meadow to manage grazing. US Geological Survey researchers are currently conducting a genetic analysis to assess isolation and connectivity amongst the Buck Lake population of frogs. Buck Lake is also one of the sites monitored in the ongoing USGS occupancy study. A Service First project is currently assessing overwintering habitat use. The interagency *Conservation Agreement for the Oregon Spotted Frog* (2010) also directs that Site Management Plans will be reviewed every five years to update new scientific findings or habitat information.

Table 2. Actions and Monitoring

| DATE | PERSONNEL | MANAGEMENT ACTION | RESULTS OR OBSERVATION | ADDITIONAL COMMENTS |
|---|---|---|---|---|
| 2006-07 | Pearl USGS | Chytrid sampling | Bd present | Published Pearl et al. 2009 |
| 2008 | FWS, BLM, USFS | Lidar survey and map | 2' contour map generated | Intent was to use for FWS/private restoration design |
| 2009 | Lerum, USFS | Fence construction around Buck Meadow | Improved management of cattle grazing | Letdown fence excludes cattle until early fall. |

| | | | | |
|---|---|---|---|---|
| 2010 | Pearl, USFS<br>Lerum, USFS | Collect genetic samples for USGS | Analysis ongoing | Scheduled to complete analysis in 2011 |
| 2010- | Pearl, USGS | Occupancy Monitoring | Ongoing rangewide | Multi-year project |
| 2010-2011 | Lerum, USFS<br>Mattecheck OIT | Underwater cameras and datasondes | Improved OSF overwintering knowledge | Ongoing work. |
| 2011 | Lerum USFS | Draft Site Management Plan | Complete 2011 then ongoing | Update every 5 years or sooner as conditions warrant |

## Literature Cited


Adams, R.E. and D.E. Peck. 2002. Climate change and drought: Implications for the West. Western Economic Forum. 1:14-19.

Barnett, T.P. D.W. Pierce, H.G. Hidalgo, C. Bonfils, B.D. Santer, T. Das, B. Bala, A.W. Wood, T. Nozawa, A.A. Mirin, D.R. Cayan, and M.D. Dettiger. Human-Induced Changes in the Hydrology of the Western United States . Science: 319 (5866), 1080-1083.

Blouin, M. 2000. Final report for Challenge Cost Share Agreement No. 06-20-99-021, Analysis of population genetic structure in the Oregon spotted frog, *Rana pretiosa.* Oregon State University, Corvallis, Oregon.

Blouin, M.S., I.C. Phillipsen and K.J. Monsen. 2010. Population structure and conservation genetics of the Oregon spotted frog, *Rana pretiosa.* Conservation Genetics, 11:2179-2194.

Corkran, C.C. and C. Thoms. 1996. Amphibians of Oregon, Washington and British Columbia: A field identification guide. Lone Pine Publishing Co, Inc. Redmond, Washington. 176 pp.

Cushman, K.A. and C.A. Pearl. 2007. A Conservation Assessment for the Oregon Spotted Frog (*Rana pretiosa*). USDA Forest Service Region 6 and USDI Bureau of Land Management, Oregon and Washington.

Demmer, R. and David, J. 2008. Improving and creating Columbia spotted frog habitat. Working draft paper. USDA Forest Service region 6 and USDI Bureau of Land Management. Interagency Special Status and Sensitive Species Program. 12 pages.

Franklin, J.F. and C.T. Dryness. 1973. Natural Vegetation of Oregon and Washington. Pacific Northwest and Range Experiment Station Forest Service, U.S. Department of Agriculture Portland, Oregon. USDA Forest Service General Technical Report PNW-8. U.S. Government Printing Office Washington D.C.

Funk, W.C., C.A. Pearl, H.M. Draheim, M.J. Adams, T.D. Mullins, and S.H Haig. 2008. Range-wide phylogeographic analysis of the spotted frog complex (*Rana luteiventris* and *Rana pretiosa*) in Northwestern North America. Molecular Phylogenetics and Evolution 49:198-210.

Gray, M.J., D.L. Miller, and J.T. Hoverman. 2009. Ecology and pathology of amphibian ranaviruses. Diseases of Aquatic Organisms. Vol. 87: 243–266.

Hayes, M. P. 1994. The spotted frog (*Rana pretiosa*) in western Oregon. Final report to the Oregon Department of Fish and Wildlife. 31 pp. + appendices.

Hayes, M. P. 1995. The amphibian fauna of the Spencer Creek system. Final report to the Nature Conservancy, sponsored by the Bureau of Land management, the Oregon department of fish and Wildlife, Pacificorp the Weyerhaeuser Company, and the Winema National Forest.

Hayes, M.P. 1996. Amphibian and reptiles surveys of the Spencer Creek system (Klamath County, Oregon). Final report of a study sponsored by the Bureau of Land Management, the Oregon Department of Fish and Wildlife, the Nature conservancy, Pacificorp, the Weyerhaeuser Company, and the Winema National forest. 25 pp. + appendices.

Hayes, M.P. 1997. Status of the Oregon spotted frog (*Rana pretiosa sensu stricto*) in the Deschutes Basin and selected other systems in Oregon and northeastern California with a rangewide synopsis of the species' status. Final report prepared for The Nature Conservancy under contract to US Fish and Wildlife Service, Portland, Oregon. 57 pp + Appendices.

Hayes, M.P. 1997b. The Buck Lake Oregon spotted frog (*Rana pretiosa*) population (Spencer Creek system, Klamath County, Oregon). Final report of a study prepared for the Nature Conservancy that was sponsored by Winema National Forest. 20 pp. + appendices.

Hayes, M.P. 1998. The Jack Creek population of the Oregon spotted frog (*Rana pretiosa*) Chemult Ranger District, Winema National Forest (Klamath County, Oregon). Final report prepared for The Nature Conservancy under contract to the Winema National Forest. Unpublished Report 14 pp.

Hayes, M.P. 1998b. The Buck Lake Oregon spotted frog (*Rana pretiosa*) population (Spencer Creek system, Klamath County, Oregon). Final report of a study prepared for the Bureau of Land Management and the Nature Conservancy, the latter sponsored by Winema National Forest. 22 pp. + appendices.

Hayes, M.P. and M.R. Jennings. 1986. Decline of ranid frog species in Western North America: are bullfrogs (*Rana catesbeiana*) responsible? Journal of Herpetology 20:490-509.

Kiesecker, J. M. and A.R. Blaustein. 1998. Effects of introduced bullfrogs and smallmouth bass on microhabitat use, growth, and survival of native red-legged frogs (*Rana aurora*). Conservation Biology 12:776-787.

Kruse, K.C. and M.G. Francis. 1977. A predation deterrent in the larvae of the bullfrog, *Rana catesbeiana*. Transactions of the American Fisheries Society. 106:248-252.

Leonard, W.P., H.A. Brown, L.L.C. Jones, K.R. McAllister, and R.M. Storm. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, The Trailside Series. Seattle, Washington.

Licht, L.E. 1969. Comparative breeding behavior of the red-legged frog (*Rana aurora aurora*) and the western spotted frog (*Rana pretiosa pretiosa*) in southwestern British Columbia. Canadian Journal of Zoology 47:1287-1299.

Licht, L.E. 1971. Breeding habits and embryonic thermal requirements of the frogs, *Rana aurora aurora* and *Rana pretiosa pretiosa*, in the Pacific Northwest. Ecology 52:116–124.

Licht, L.E. 1974. Survival of embryos, tadpoles, and adults of the frogs *Rana aurora aurora* and *Rana pretiosa pretiosa* sympatric in southwestern British Columbia. Canadian Journal of Zoology 52:613-627.

Licht, L.E. 1975. Comparative life history features of the western spotted frog, *Rana pretiosa*, from low-and high-elevation populations. Canadian Journal of Zoology 53:1254-1257.

McAllister, K.R. and W.P. Leonard. 1997. Washington State status report for the Oregon Spotted Frog. Washington Department of Fish and Wildlife, Olympia, 38 pp.

Mote, P. W., E. Parson, A. F. Hamlet, W. S. Keeton, D. Lettenmaier, N. Mantua, E. L. Miles, D. Peterson, D. L. Peterson, R. Slaughter, and A. K. Snover. 2003. Preparing for climatic change: The water, salmon, and forests of the Pacific Northwest. Climatic Change 61(1–2):45–88. http://www.springerlink.com/content/t20189917l34th3/fulltext.pdf

Padgett-Flohr, G.E. and Hayes, M.P. 2011. Assessment of the vulnerability of the Oregon spotted frog (*Rana pretiosa*) to the amphibian Chytrid fungus (*Batrachochytrium dendrobatidis*). Herpetological Conservation and Biology 6(2):99-106.

Pearl, C.A., M.J. Adams, R.B. Bury, and B. McCreary. 2004. Asymmetrical effects of introduced bullfrogs (*Rana catesbeiana*) on native ranid frogs in Oregon. Copeia 2004:11-20.

Pearl, C.A, and M.P. Hayes. 2004. Habitat associations of the Oregon spotted frog (*Rana pretiosa*): A literature review. Final Report. Washington Department of Fish and Wildlife, Olympia, Washington, USA.

Pearl, C.A., Adams, M.J., Leuthold, N., 2009a, Breeding habitat and local population size of the Oregon spotted frog (Rana pretiosa) in Oregon, USA: Northwest Naturalist, v. 90, p. 136-147.

Pearl, C.A., J. Bowerman, M.J. Adams, and N.D. Chelgren. 2009b. Widespread Occurrence of the Chytrid Fungus *Batrachochytrium dendrobatidis* on Oregon spotted frogs (*Rana pretiosa*). EcoHealth. DOI: 10.1007/s10393-009-0237-x.

Petrisko, J.E., C.A. Pearl, D.S. Pilliod, P.P. Sheridan, C.F. Williams, C.R. Peterson, and R.B. Bury. 2008. Saprolegniaceae identified on amphibian eggs throughout the Pacific Northwest, USA, by internal transcribed spacer sequences and phylogenetic analysis. Mycologia 100:171-180.

Rollins-Smith, L.A., and J.M. Conlon. 2005. Antimicrobial peptide defenses against chytridiomycosis, an emerging infectious disease of amphibian populations. Developmental and Comparative Immunology 29:589–598.

Shovlain, A. 2005. Oregon Spotted Frog habitat use and Herbage (or Biomass) Removal from Grazing at Jack Creek, Klamath County, Oregon. Master's Thesis, Oregon State University, Corvallis, Oregon.

USDA Forest Service. 1990. *Land and Resource Management Plan. Winema National Forest.* Dept. of Agriculture. U.S. Forest Service. Klamath Falls, Oregon. http://www.fs.fed.us/r6/frewin/projects/forestplan/index.shtml

USDA Forest Service. 2008. Ecological Unit Inventory of the Winema Portion. Fremont-Winema National Forests, Oregon. Interim Report #10.

USDA Forest Service. 2010. Conservation Agreement for the Oregon Spotted Frog (*Rana pretiosa*) in the Klamath Basin of Oregon. 21 pages.

USDA Forest Service. 2011a. Level II Stream Survey Summary Report Spencer Creek, 2010. Fremont-Winema National Forests, Lakeview Ranger District. Steve Ruda and J.D. Jones. Unpublished and on file. 8 pages.

USDA Forest Service. 2011b. Klamath Basin Oregon Spotted Frog Connectivity Analysis. Unpublished working draft document. U.S. Forest Service. Klamath Falls, Oregon.

USDI Bureau of Land Management. 1995. Spencer Creek Pilot Watershed Analysis. On the web at: http://www.fs.fed.us/r6/frewin/projects/watershed/spencer/wa.pdf

USDI Fish and Wildlife Service. 2010. Species Assessment and Listing Priority Assignment Form for Oregon spotted frog (Rana pretiosa). Updated annually. 82 pages.

# Appendix 1. Buck Lake Units on Federal Lands --Typical Habitat Photos