High-Priority Site Management Recommendations

for the

Red Tree Vole (*Arborimus longicaudus*)

Version 1.0
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Photo by Nick Hatch

Author

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Executive summary

Management status

The red tree vole (*Arborimus longicaudus*) is a small arboreal microtine that is endemic to the coniferous forests of western Oregon and northwestern California (Howell 1926, Maser 1966, Verts and Carraway 1998). Red tree voles are a category C survey and manage species under the Northwest Forest Plan (USDA and USDI 2001). As such, surveys are required for their nests prior to habitat-disturbing activities, but not all red tree vole sites require protection to provide for a reasonable assurance of species persistence. Sites needing protection to meet that persistence objective and sites not needing protection are called high-priority and non-high priority sites, respectively. Few attempts have been made to discriminate between high- and non-high priority sites; therefore most red tree vole sites are currently protected.

The US Fish and Wildlife Service determined that listing the red tree vole as a distinct population segment north of the Siuslaw River in the Oregon Coast Ranges under the Endangered Species Act was warranted but precluded (USDI FWS 2011). The population segment was added to the USFWS candidate species list which triggered the inclusion of red tree voles within this geographic area to the BLM special status and Forest Service sensitive species lists. Within that geographic area, the Fish and Wildlife Service stated that current Forest Service and BLM management provides adequate conservation for red tree voles on federal lands, whereas existing regulatory mechanisms on non-federal lands are inadequate (USDI FWS 2011).

Purpose of this document

These management recommendations are being developed pursuant to the 2001 record of decision governing survey and manage species (USDA and USDI 2001). These management recommendations outline the process for identifying red tree vole high-priority sites to provide a reasonable assurance of persistence on Forest Service and BLM lands within the range of the northern spotted owl (*Strix occidentalis caurina*), in accordance with survey and manage standards and guidelines. In addition, where red tree voles are listed as a Forest Service and BLM sensitive species in the north Oregon coast distinct population segment, these high-priority site management recommendations can be used as a tool to help prevent federal listing under the Endangered Species Act or a loss of species viability (FSM 2670, BLM 6840).

Management recommendations

Field unit personnel are not required to initiate the use of these management recommendations for any fifth-field watershed. However, if field unit personnel decide to identify high- and non-high priority sites within a fifth-field watershed, these management recommendations must be utilized to make those determinations. Red tree vole management within a fifth-field watershed will continue to follow current management direction until high-priority sites are identified for that watershed and a project decision document codifying those selections is issued.

At the fifth-field watershed scale field unit personnel will use these management recommendations to identify, 1) land-use allocations managed consistent with red tree vole conservation, 2) high-priority sites outside of those areas, and 3) connectivity areas linking sites

to provide a reasonable assurance of species persistence for red tree voles. Field unit personnel will also identify non-high priority sites within the fifth-field watershed, including areas where pre-disturbance surveys and site management are no longer needed, as well as key information gaps and what new information would trigger a revision to the selections made.

These management recommendations may be applied to any fifth-field watershed within the range of the species. The 1) land-use allocations managed consistent with red tree vole conservation, 2) high-priority sites, 3) connectivity areas, and 4) non-high priority sites, including areas no longer requiring site management or surveys, will be shared with the public through project-level National Environmental Policy Act analyses and decision documents.

Within the red tree vole range (Huff et al. 2012) five of the 225 fifth-field watersheds contain an incidental amount of Forest Service and BLM lands (<10 acres each watershed; McHugh 2014b). Because this amount of land neither appreciably contributes to nor diminishes red tree vole persistence, these five watersheds are released from the survey and manage standards and guidelines for red tree voles: Beaver Creek-Frontal Columbia River (hydrologic unit code 1708000302), Gales Creek (hydrologic unit code 1709001001), Johnson Creek (hydrologic unit code 1709001201), Point Saint George-Frontal Pacific Ocean (hydrologic unit code 1801010105), and Yamhill River (hydrologic unit code 1709000807).

Another watershed, Diamond Lake (hydrologic unit code 1710030101), that was previously identified as within the red tree vole range (USDA and USDI 2003b) is now considered to be outside the range (Huff et al. 2012). That watershed is also released from the survey and manage standards and guidelines for red tree vole.

Adaptive management

As field unit personnel apply these management recommendations, it is likely that issues or clarifications will arise that will necessitate a revision of this document. Creation or publication of new conservation planning tools or new red tree vole science may also trigger a need for an immediate review of these management recommendations. In addition, a review will be conducted at least every five years to address scientific findings, new species and habitat information and to assess field implementation of the rule set presented herein. Revision of this document may follow the reviews.

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I. Policy, status and management

A. Survey and manage

1. Background

The 1994 record of decision and standards and guidelines for amendments to Forest Service and Bureau of Land Management (BLM) planning documents within the range of the northern spotted owl (*Strix occidentalis caurina*) is referred to as the Northwest Forest Plan (NWFP; USDA and USDI 1994a). The NWFP divided the Forest Service and BLM land base within the range of the northern spotted owl (referred to as NWFP lands) into seven land-use allocations. These land-use allocations range from matrix, where timber production is focused, to late-successional reserves, where conservation of species associated with old forests is emphasized. Approximately 80 percent of NWFP lands fall within reserve land-use allocations, with 86 percent of existing late-successional and old-growth forest in the NWFP reserved (USDA and USDI 2000a).

At the time the NWFP was developed there were approximately 400 wildlife and botanical species considered by scientists to be late-successional and old-growth forest associated species that were rare or little known, leading to concern about their continued persistence. Species were included in this group of 400 based on evaluations of potential probability outcomes to species' distributions from the various NWFP management options considered. Specifically, species were assessed to determine the probability that "Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, well distributed across federal lands" based on implementation of the preferred management alternative for the NWFP (USDA and USDI 1994c; app. J2-2). Species with $\geq$80 percent probability of achieving that outcome were considered to have a reasonable assurance of persistence under the NWFP. Species with probability outcomes <80 percent were identified as having potential persistence issues, and comprise the group of 400 species. For these 400 species, potential mitigations were identified to help increase the probability outcome to $\geq$80 percent. The red tree vole scored a probability outcome of 73 percent.

The proposed mitigation for red tree voles consisted of 1) the adoption of riparian reserve land-use allocations to aid in dispersal and connectivity, and 2) pre-disturbance surveys and site management in all land-use allocations. The NWFP record of decision (USDA and USDI 1994a) included both of those mitigations: riparian reserve management and a set of standards and guidelines called survey and manage. The survey and manage standards and guidelines directed the agencies to conduct pre-disturbance surveys prior to habitat-disturbing activities and to manage (protect) sites discovered from those surveys.

An amendment in 2001 to the standards and guidelines (USDA and USDI 2001) established six survey and manage categories based upon relative rarity, practicality of conducting pre-disturbance surveys, and whether there were questions about the species' association with late-successional or old-growth forests (USDA and USDI 2001). The red tree vole was placed in category C, indicating the species was uncommon and pre-disturbance surveys and site management were only required for high-priority sites – those needing discovery and

management to provide a reasonable assurance of species persistence. Non-high priority sites did not require surveys or site management, as they were considered not necessary to provide a reasonable assurance of species persistence. Direction from the amended standards and guidelines (USDA and USDI 2001: 10) included:

> Until a Management Recommendation is written addressing high-priority sites, either assume all sites are high-priority, or local determination (and project NEPA [National Environmental Policy Act] documentation) of non-high priority sites may be made on a case-by-case basis.

Management recommendations for red tree voles (USDA and USDI 2000b) were completed prior to the 2001 amendment and did not address high-priority sites.

2. Current management

Since the red tree vole's placement into category C in 2001, few attempts have been made to distinguish high-priority or non-high priority sites. Exceptions are noted below.

a. Survey protocols

Of the four red tree vole survey protocols (Biswell et al. 2000, 2002; Huff et al. 2012; USDA and USDI 1996), none included all known habitat for red tree voles, as not all sites require protection to provide a reasonable assurance of species persistence. Survey protocol habitat descriptions dictating where required surveys must be conducted have focused on old forest and not included young forests, although many red tree vole nests have been found there (Clifton 1960, Maser 1966, Swingle 2005). The survey protocols also established that surveys were not required above certain elevations where few red tree vole nests have been found (Adams 2011). Although pre-disturbance surveys in stand conditions not meeting the survey protocol habitat definitions or above the upper elevation limits have not been required, sites discovered incidentally in those areas have not been released from site management requirements.

b. Site management, management recommendations

Red tree vole management recommendations described how sites were to be managed and protected (USDA and USDI 2000b). Both the management recommendations and survey protocol (Huff et al. 2012) indicated that active sites (sites with one or more tree vole nests with green cuttings, green resin ducts, or green fecal pellets), status undetermined sites (unknown if active or not), and unconfirmed species nests (unknown if red tree vole or not, and activity status unknown) required management and protection, while sites comprised solely of inactive tree vole nests (nests with desiccated or needleless cuttings, orange, tan or brown resin ducts, or dark brown to black fecal pellets) did not.

The management recommendations were amended in 2003 to address fuel reduction projects in stands with relatively short fire return intervals (<50 years) around communities-at-risk (USDA and USDI 2003a). The amendment allowed fuel reduction treatments to occur in red tree vole sites within 300 feet (approximately two site-potential tree heights) of structures or developments located within communities-at-risk, without protection of red tree vole sites. Red tree vole sites located within a one mile radius (Oregon) and a one-and-a-half mile radius (California) from

communities-at-risk still required protection, but with greater flexibility in treatment compared with sites outside those radii.

c. Case-by-case identification of non-high priority sites

Because the management recommendations (USDA and USDI 2000b) did not address high-priority sites, red tree vole sites have been managed in accordance with the management recommendations unless field unit personnel have made a local determination that the site is non-high priority. To make that determination, the field unit must follow a four-step process, outlined in Instruction Memorandum-OR-2012-036: http://www.blm.gov/or/plans/surveyandmanage/files/im-or-2012-036-nhp-site-memo.pdf.

d. Exemptions

In October 2006, a court case (Northwest Ecosystem Alliance et al. v. Mark E. Rey et al., No. 04-844P, W.D. Wash) resulted in a suite of project types being exempted from the survey and manage standards and guidelines, negating the requirement for pre-disturbance surveys and site management. As described in Pechman (2006), the exempted project types are:

1) Thinning projects in stands younger than 80 years old;

2) Replacing culverts on roads that are in use and part of the road system, and removing culverts if the road is temporary or to be decommissioned;

3) Riparian and stream improvement projects where the riparian work is riparian planting, obtaining material for placing in-stream, and road or trail decommissioning; and where the stream improvement work is the placement of large wood, channel and floodplain reconstruction, or removal of channel diversions, and

4) The portions of projects involving hazardous fuel treatments where prescribed fire is applied. Any portion of a hazardous fuel treatment project involving commercial logging will remain subject to the survey and management requirements except for thinning of stands younger than 80 years old.

Red tree vole sites discovered incidentally or through other surveys in exempted projects do not require site management and are considered non-high priority sites.

e. Pilot area identification of non-high priority sites

In 2003, a team formed to identify red tree vole high-priority sites within a pilot area in Oregon identified some non-high priority sites instead (USDA and USDI 2003b). The pilot area included approximately 25 percent of the NWFP lands within the red tree vole range where extensive information was available on the distribution of red tree voles. The team grouped fifth-field watersheds into high, moderate, and low reserve categories and identified specific types of non-high priority sites wherein loss of the sites would still provide for a reasonable assurance of species persistence. Watershed categories were based on the percentage of future NWFP forest-

capable lands reserved. Future NWFP forest-capable lands were defined as forested stands currently providing or capable of becoming red tree vole habitat.

In high reserve watersheds, the team determined that all sites in matrix lands were non-high priority and further pre-disturbance surveys in matrix were unnecessary. In the moderate and low reserve watersheds, certain types of sites types in matrix were identified as non-high priority based on the number of nests per acre surveyed and the quality of the habitat in the sites. As these classifications were made from a broad-scale analysis, the team did not necessarily identify all non-high priority sites within the moderate and low watersheds.

The current red tree vole survey protocol (Huff et al. 2012) incorporated the team's pre-disturbance survey direction for high reserve watersheds and stated that the direction for these pilot watersheds (IM-OR-2003-062) was still valid.

B. Sensitive and special status species policies

In 2011, the US Fish and Wildlife Service (USFWS) identified red tree voles in the northern Oregon coast as a distinct population segment warranted for listing as threatened or endangered under the Endangered Species Act (ESA 1973) but precluded from listing because other species had higher priority listing decisions (USDI FWS 2011). The population segment was added to the USFWS candidate species list which triggered the inclusion of red tree voles within this geographic area to the BLM special status and Forest Service sensitive species lists. The distinct population segment occurs north of the Siuslaw River in the Oregon Coast Ranges (fig. 1).

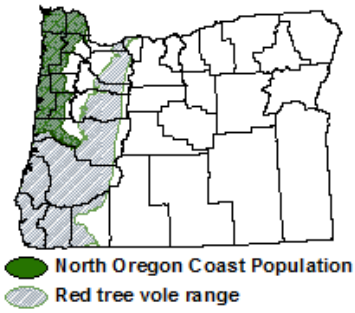

Figure 1 – The distinct population segment of the red tree vole (*Arborimus longicaudus*) and a coarse depiction of the vole's range in Oregon. Available at: http://www.fws.gov/oregonfwo/Species/Data/Images/FactSheetMaps/RedTreeVole.gif

Forest Service sensitive species policy requires the maintenance of viable populations on agency lands of all native and desired non-native wildlife, fish, and plant species. Forest Service management "must not result in loss of species viability or create significant trends toward federal listing" (USDA FS 2005: 5) for any identified sensitive species. On BLM lands, special status species policy (USDI BLM 2008) requires the BLM to conserve species and their habitats to reduce the likelihood and need for listing pursuant to the ESA.

Because the survey and manage standards and guidelines share general objectives with but are more directive (e.g., conduct surveys, manage sites) than the special status and sensitive species

policies, red tree vole management under survey and manage standards and guidelines meets agency obligations under BLM special status and Forest Service sensitive species policies.

The USFWS assessment of the current Forest Service and BLM regulatory mechanisms for red tree voles within the north Oregon coast distinct population segment concluded (USDI FWS 2011: 63747):

> Except for the limited amount and isolated nature of Federal lands north of Highway 20, federally managed lands are expected to provide for large, well-distributed populations of red tree voles throughout the rest of their range within the DPS [distinct population segment]. Based on the above assessment, we conclude that existing regulatory mechanisms on Federal land are adequate to provide for the conservation of the North Oregon Coast DPS of the red tree vole.

That is, Forest Service and BLM current management (section I.A.2.) is not likely to contribute towards listing or a loss of viability of the red tree vole.

II. Distribution and abundance of red tree voles

A. Pre-disturbance survey, strategic survey, and genetics data

Red tree voles are endemic to western Oregon and northwestern California. The red tree vole pre-disturbance survey protocols divided the range of the red tree vole into three areas: northern mesic, mesic, and xeric survey zones (Biswell et al. 2002, Huff et al. 2012). Approximately 4,000 known sites of red tree voles are documented in Forest Service and BLM databases (McHugh 2014a), patchily distributed throughout these zones. Survey data indicate that tree voles are absent in portions of the xeric zone (USDA and USDI 2007), east of the Applegate River and south of the Rogue and Middle Fork Rogue River (Forsman et al., in press), and rare or absent in much of the northern mesic zone (Forsman and Swingle 2005; Forsman et al. 2008, 2009, 2012; Price et al. 2015). In the northern mesic zone, tree vole populations in the northern Oregon Coast Ranges north of Highway 20 are especially rare and of concern (Forsman and Swingle 2005, Price et al. 2015, USDI FWS 2011). Information on red tree vole populations in the mesic and xeric zones in northern California is sparse as few surveys have been conducted (McHugh 2014a).

Miller et al. (2006) found a genetic discontinuity between tree voles in northern and southern Oregon, and a weaker genetic discontinuity between voles on the opposite sides of the Willamette Valley. The line separating the north-south discontinuity occurs near the southern end of the Willamette Valley.

Forsman et al. (2004) analyzed red tree vole remains in northern spotted owl pellets found in western Oregon, which showed red tree voles were most common in the central Cascades and the central and southern coastal regions, and least common in the north Oregon Coast Range, north Oregon Western Cascades, and the dry interior of southwest Oregon.

Using random plot survey data, Rosenberg et al. (n.d.) reported the highest density of red tree voles along the middle Oregon Western Cascades foothills and mountains, from the southern part

of the Willamette National Forest south through the Umpqua National Forest, including Roseburg BLM and portions of Eugene BLM, and along the central and southern part of the Oregon Coast Ranges. Roseburg BLM had the highest occurrence rate followed by Coos Bay BLM and the Siuslaw National Forest.

The survey and manage red tree vole taxa team indicated that there was a moderate-to-high number of sites within the mesic zone (Biswell et al. 2003), which, in Oregon, included many of the more populous areas described above by both Rosenberg et al. (n.d.) and Forsman et al. (2004).

B. Fifth-field watershed categorizations

The data on distribution, occurrence rates, and abundance demonstrate a variety of watershed conditions across the red tree vole range; thus approaches to or goals for species management and conservation throughout the species' range may vary based on these differences in watershed conditions (Groves 2003).

There are 225 fifth-field watersheds within the red tree vole range outlined in the pre-disturbance survey protocol (Huff et al. 2012). Fifteen of the watersheds have no NWFP acreage, and therefore are not subject to the survey and manage standards and guidelines. Five other watersheds each have <10 NWFP acres within the red tree vole range (McHugh 2014b), none of which are modeled as red tree vole habitat. At this scale (<10 NWFP acres per watershed), application of the survey and manage standards and guidelines neither improves nor hampers red tree vole conservation within these five watersheds or at the range-wide scale. As such, these five watersheds are removed from the survey and manage standards and guidelines for the red tree vole with the transmittal of this document:

- Beaver Creek-Frontal Columbia River (hydrologic unit code 1708000302),
- Gales Creek (hydrologic unit code 1709001001),
- Johnson Creek (hydrologic unit code 1709001201),
- Point Saint George-Frontal Pacific Ocean (hydrologic unit code 1801010105), and
- Yamhill River (hydrologic unit code 1709000807).

In addition, Diamond Lake (hydrologic unit code 1710030101), was previously identified within the mesic survey zone of the red tree vole (USDA and USDI 2003b). This watershed is well outside the boundary where pre-disturbance surveys are required (Huff et al. 2012) and is no longer considered to be within the range of the red tree vole. The Diamond Lake watershed is therefore removed from the survey and manage standards and guidelines for red tree vole.

Previous analyses (USDA and USDI 2007; USDI FWS 2011; Forsman and Swingle pers. comm. 2013) have identified three specific geographic areas of particular persistence concern due to few red tree vole nests and small amounts of red tree vole habitat. These three areas contain 70 fifth-field watersheds and are located in the:

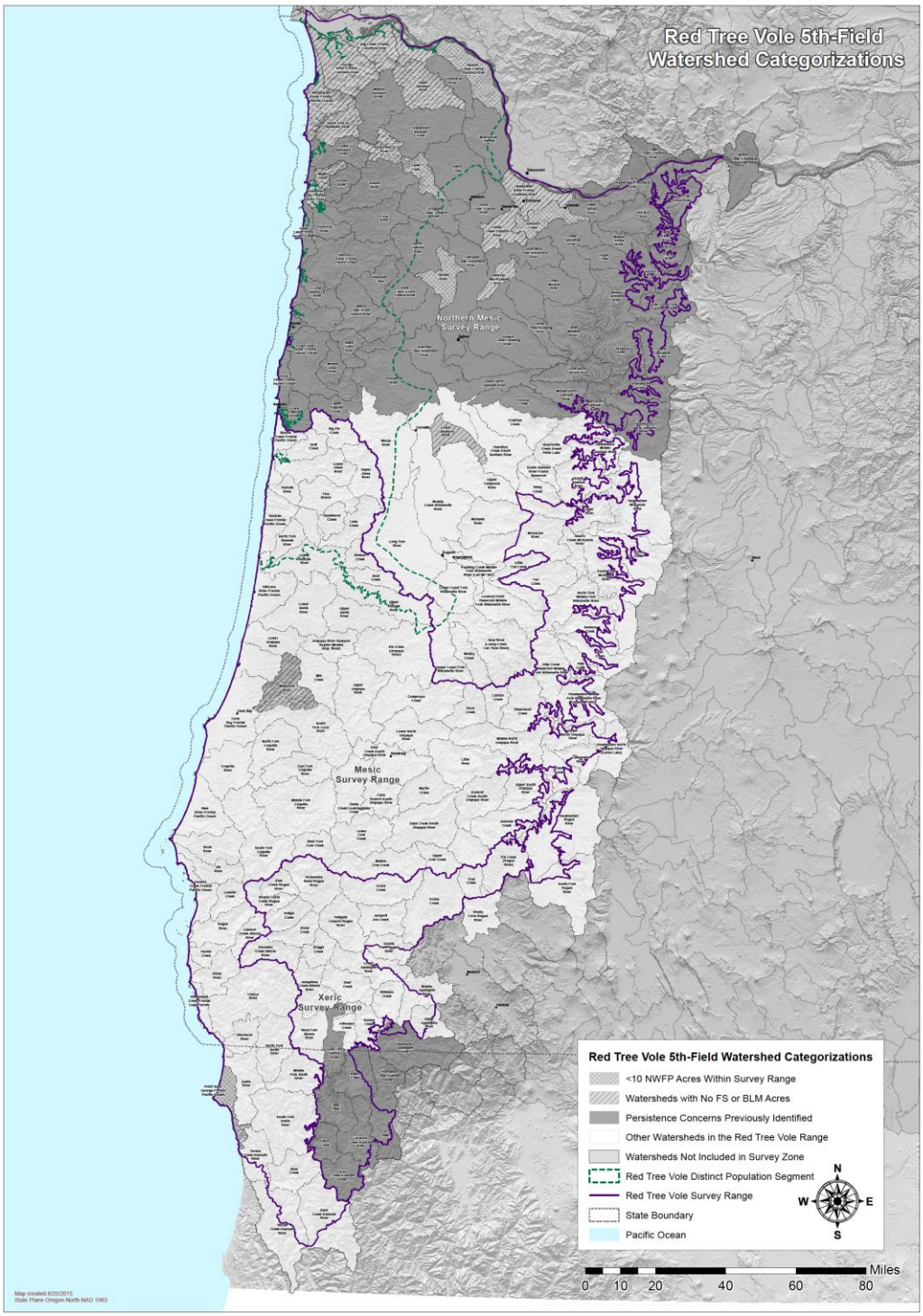

Figure 2 – **Red tree vole (*Arborimus longicaudus*) fifth-field watershed categorizations for the 2016 high-priority site management recommendations.** Available as a shape-file and accompanying spreadsheet with hydrologic unit codes and fifth-field watershed names at: http://www.blm.gov/or/plans/surveyandmanage/recommendations/mammals.php.

- northern mesic survey zone (Huff et al. 2012) at the fringes of the Willamette Valley and in the western Cascades, including the entire Detroit Ranger District on the Willamette National Forest, northward, including the Mount Hood National Forest and Columbia River Gorge National Scenic Area (30 watersheds);
- red tree vole north Oregon coast distinct population segment north of Highway 20 (31 watersheds); and
- the southern portions of the xeric survey zone (Huff et al. 2012) in California and southern Oregon (9 watersheds).

The remaining 135 fifth-field watersheds have not been previously identified as having specific persistence concerns (USDA and USDI 2007), although 20 of these watersheds, or portions thereof, lie within the southern portion of the red tree vole northern Oregon coast distinct population segment (USDI FWS 2011). Most of the 135 watersheds are within the mesic survey zone, and encompass the portion of the species' range with the majority of the known red tree vole nests (McHugh 2014a) and habitat (McHugh 2014b).

Figure 2 displays a visual representation of the watershed categorizations.

III. High-priority site management recommendations

The 2001 survey and manage standards and guidelines provided direction on delineating high-priority and non-high priority sites (USDA and USDI 2001: 20):

> Management Recommendations for uncommon species should also identify high-priority sites that must be managed to provide for a reasonable assurance of persistence of the taxon (or the procedures for designating such sites locally) as well as sites that no longer need to be managed for the benefit of those species. Management Recommendations may also identify areas where it is no longer necessary to continue surveys prior to habitat-disturbing activities or strategic surveys for the taxon.

These management recommendations outline the procedures for field unit personnel to utilize at the fifth-field watershed scale to identify high- and non-high priority sites as well as areas where surveys are no longer needed. These management recommendations do not direct field units to initiate the process of determining high-priority and non-high priority sites for any fifth-field watershed. Instead, if field unit personnel decide to identify high- and non-high priority sites within a fifth-field watershed, these management recommendations are to be utilized to make those determinations. Red tree vole management within a fifth-field watershed will continue to follow existing management direction (see section I.A.2.) until high-priority sites are identified for that watershed and a decision document codifying those selections is issued.

Fifth-field watersheds were chosen as an appropriate scale at which to make these determinations, having been used previously to assess red tree vole conservation concerns and to programmatically identify non-high priority sites in approximately one-quarter of the species' range (USDA and USDI 2003b). The fifth-field scale was utilized in that effort to "provide a

larger context with which to evaluate whether habitat is well distributed and being maintained to support reproductive, interacting individuals" (USDA and USDI 2003b; Attachment 1-12).

Providing a reasonable assurance of red tree vole persistence at the fifth-field watershed scale may be accomplished through a combination of protective land-use allocations and designation of a subset of known sites as high-priority sites. The number and location of high-priority sites and lands to manage for red tree vole persistence could vary greatly by watershed. Field unit personnel will apply a rule set at the fifth-field watershed scale to identify: 1) land-use allocations or designations managed consistent with red tree vole conservation; 2) high-priority sites outside those areas; 3) connectivity areas within and between watersheds; and 4) non-high priority sites, including areas where pre-disturbance surveys and site management are no longer needed. In addition, field unit personnel will identify key information gaps and what new information would trigger a need to update the identified approach.

High-priority site selection is to be conducted locally, through field unit level coordination, with the outcome available to the public in a project NEPA analysis and decision document (e.g., timber sale, vegetation or fuels management). Multiple fifth-field scale watersheds could be addressed simultaneously and disclosed to the public through one NEPA analysis and one decision document.

The designation of red tree vole as a category C survey and manage species is premised on not needing to maintain all red tree vole sites in order to provide a reasonable assurance of persistence. For watersheds with small amounts of habitat or where persistence issues have been previously identified, it may be difficult or impossible to select non-high priority sites or areas where pre-disturbance surveys and site management are no longer needed. In these situations, current management direction for red tree voles (section I.A.2.) should still be applied; however the high-priority site rule set could be utilized to determine areas to proactively manage for the development of red tree vole habitat. This approach would allow habitat to develop within key parts of the watershed and potentially provide for red tree vole management options in the future.

A. Development of base layers and background information

To initiate the identification of high-priority sites, field unit personnel should: 1) compile baseline information and data layers for the fifth-field watershed; 2) provide details on red tree vole surveys and known sites within the fifth-field watershed; and 3) display the information in tabular and map form. Information in support of the selection of high-priority sites can come from a variety of sources; some are listed below.

1. Red tree vole habitat

In 2002-2004, a random-plot survey was conducted using 365 one-hectare plots within the suspected range of the red tree vole. That study was designed to provide an estimate of vole nest abundance and to assess red tree voles' association with: 1) late-successional and old-growth forests versus young forests and 2) reserve land-use allocations versus matrix lands. Dunk and Hawley (2009) created a habitat suitability model from these data, which Rosenberg et al. (2014) extrapolated to the range of the species using 2012 Gradient Nearest Neighbor data. This extrapolation resulted in range-wide estimates of habitat suitability within 30 meter pixels based

on the suite of vegetative, topographic, and geographic variables in the Dunk and Hawley model. When plotting the modeled habitat, Rosenberg et al. (2014) used pixels with a habitat suitability score >0.25 as the optimal cut-point for discriminating between presence and absence, consistent with Dunk and Hawley.

An additional model of red tree vole habitat suitability has been developed using data from sites where tree voles were detected (Forsman et al., in press). The Forsman et al. model (in press), the extrapolated Dunk and Hawley model (Rosenberg et al. 2014), and a series of additional models based on these two models were evaluated for predictive utility using independent data (i.e., data not used to create the models) and the random-plot data (Rosenberg et al., n.d.). Rosenberg et al. (n.d.) determined that a model derived from the Dunk and Hawley extrapolated model, the Forsman et al. (in press) model, and Rosenberg et al.'s BEST9 model performed best. This "ensemble model" (Rosenberg et al., n.d.) only included pixels with consistent predicted outcomes among the three separate models as either tree vole present or tree vole absent. Results that were consistent among the 3 models covered 61 percent of the red tree vole range. Rosenberg et al. (n.d.) suggest the use of BEST9 to cover the remaining 39 percent of the range because it performed best of the three models, albeit the performance was similar to the extrapolated Dunk and Hawley model.

The ensemble model (Rosenberg et al., n.d.) and the BEST9 model (Rosenberg et al., n.d.) are available for BLM and Forest Service personnel from the following locations:

For BLM: P:\oso\Flora_Fauna\Fauna\RedTreeVole\SpatialProducts\RTV_Habitat_Models

For Forest Service:
T:\FS\NFS\R06\Program\ISSSSP\GIS\SurveyAndManage\AnalysisProduct\HabitatModels

Also available at these locations are the Rosenberg et al. (2014) extrapolation of the Dunk and Hawley model and the Forsman et al. (in press) model.

Field review and professional expertise should always be used in conjunction with models, and could fine tune model outcomes for use in identifying 1) land-use allocations managed consistent with red tree vole conservation, 2) high priority sites outside those areas, 3) connectivity areas within and between watersheds, and 4) non-high priority sites, including areas where pre-disturbance surveys and site management are no longer needed. If field review suggests predictions of tree vole presence or absence inconsistent with those from the model(s), examining the Gradient Nearest Neighbor data used in the models with field measurements is advised, because the Gradient Nearest Neighbor data may not be consistent with ground measurements. If outcomes from the model(s) are modified, field unit personnel must document their assessment results, what changes were made to what pixels, and why, so as to justify and track any implemented changes.

Field unit personnel may also develop their own habitat layer. For instance, in expert discussions (Van Norman 2014) four stand types were considered non-habitat for red tree voles based on professional judgment:

- non-forest areas (clear-cuts, permanent openings);
- stands with no Douglas-fir (or in the Oregon Coast Ranges, no Douglas-fir [*Pseudotsuga menziesii*], western hemlock [*Tsuga heterophylla*] or Sitka spruce [*Picea sitchensis*]);
- stands of any age that are less than 60 percent canopy closure; and
- stands <20 years old.

Stands meeting these criteria could be mapped out as non-habitat. Stands not meeting these descriptions can be considered red tree vole habitat and mapped as the habitat layer for a watershed. It is important to note that the habitat description derived in the expert discussions (Van Norman 2014) differs from the current survey protocol (Huff et al. 2012). The current survey protocol focuses survey efforts to discover nests before habitat is disturbed in mature and old forests, as protection of only a subset of red tree vole sites is considered necessary to provide a reasonable assurance of red tree vole persistence. The expert-derived habitat description (Van Norman 2014) is more inclusive than the protocol (Huff et al. 2012), recognizing that red tree voles do utilize and reproduce in young forests. Furthermore, young forests may play a role in the selection of land-use allocations managed consistent with red tree vole conservation, high-priority sites outside those areas, connectivity areas, and non-high priority sites, including areas where surveys and site management are no longer needed.

2. Other data layers

Several other data layers are available and should be utilized. These include:

- fifth-field watersheds;
- Forest Service and BLM land ownerships;
- range where red tree vole pre-disturbance surveys are required (Huff et al. 2012);
- known red tree vole sites and areas surveyed, housed in BLM Geographic Biotic Observations and Forest Service Natural Resource Information System databases; and
- data layers pertaining to landscape-level disturbances, vegetation changes, or impediments to red tree vole movement, including:
    - wildland urban interface and communities-at-risk;
    - fire risk and condition class;
    - climate change models;
    - landslide, debris flow and ice/wind damage models; and
    - larger roads, rivers, recreation areas, human development, and surface mines.

B. Rule set description and application

At the fifth-field watershed scale, field unit personnel will identify:

- land-use allocations managed consistent with red tree vole conservation, which form the backbone of red tree vole persistence in the watershed;
- high-priority sites outside of those areas (note that red tree vole high-priority sites do not necessarily need to contain known red tree vole nests, but there should be sufficient information indicating that the potential habitat is likely occupied or capable of being occupied);

- connectivity areas providing linkage between sites, between land-use allocations managed consistent with red tree vole conservation, between sites and land-use allocations managed consistent with red tree vole conservation, and to adjacent watersheds;
- non-high priority sites, including areas no longer requiring site management or pre-disturbance surveys;
- information gaps that limit identification of these types of sites and areas; and
- what new information would trigger a need to revisit and perhaps revise the selected sites and areas.

The fifth-field watershed scale approach must address all sites and suitable habitats, including those above elevation limits identified in the red tree vole survey protocol (Huff et al. 2012). It is important to note, however, that habitat above the elevational line is far less likely to harbor red trees voles than areas below the line (Adams 2011; Rosenberg et al., n.d.) and as such should not be solely relied upon to provide for red tree vole persistence in the fifth-field watershed.

A reasonable assurance of red tree vole persistence may be provided through the application of the following rules at the fifth-field watershed scale. Where possible, the rule set is based on red tree vole life history gathered from formal studies. Many of the other rules were developed from five of the six principles laid out by Diamond (1975) and utilized in the Pacific Northwest by Thomas et al. (1990) in forming a conservation strategy for the northern spotted owl. For purposes of these high-priority site management recommendations, the following list applies to high-priority sites as well as land-use allocations managed consistent with red tree vole conservation:

- larger reserves are better than small ones;
- reserves closer together are better than reserves farther apart;
- clustered reserves are better than reserves in a line;
- reserves connected by corridors are better than unconnected ones; and
- round reserves are better than long, thin reserves.

The rule set also incorporates criteria described by Shaffer and Stein (2000), that conservation areas (or, for purposes of these management recommendations, high-priority sites and land-use allocations managed consistent with red tree vole conservation) should be:

- representative of the various biological features and range of environmental conditions within the landscape;
- resilient to natural and human-caused disturbances, and
- redundant, to avoid extirpation from human-caused and stochastic events and human-related threats.

1. Identification of land-use allocations managed consistent with red tree vole conservation, high-priority sites outside those land-use allocations, and connectivity areas

a. Land-use allocations managed for red tree vole conservation

Field unit personnel should develop a base map of land-use allocations that will be managed consistent with red tree vole conservation. Management objectives for land-use allocations in the watershed should be evaluated in relation to red tree vole needs. Land-use allocations, or portions thereof, should not be included in this base layer if management of the land-use allocation would include activities that would trigger pre-disturbance surveys (Huff et al. 2012). For instance, in some land-use allocations, management may be desired to provide greater stand resiliency from fire, insects, or drought or to return to an historic ecological condition, and those goals may not necessarily provide short- or long-term conservation for red tree voles. Field unit personnel should assess the following for inclusion in this layer:

- NWFP reserve land-use allocations: late-successional reserves, riparian reserves, northern spotted owl 100 acre cores, congressionally reserved areas, and occupied marbled murrelet sites;
- Forest Service land and resource management plan and BLM resource management plan reserve land-use allocations (e.g., BLM areas of critical environmental concern, Forest Service research natural areas);
- other protective land-use allocations (e.g., administratively withdrawn, old-growth areas);
- other set-asides (e.g., areas currently managed for other survey and manage species, including lands that may be precluded from timber harvest); and
- land management overlays (e.g., northern spotted owl critical habitat).

Field unit personnel should document assumptions and existing direction for land-use allocations included in this layer, describing how management is consistent with red tree vole persistence.

b. High-priority sites

High-priority sites are known or presumed red tree vole locations. They may be comprised of unoccupied or unknown occupancy habitat, but there should be sufficient information indicating that the potential habitat is capable of being occupied.

High-priority site numbers, location and size are directly tied to connectivity within the watershed and to adjoining watersheds. Little is known about red tree vole dispersal other than studies on young leaving their natal area; adult dispersal has largely been unstudied. Experts surmise that red tree voles do not disperse long distances (Forsman and Swingle 2013). Based on this, in general, high-priority sites should be no further than 3280 feet (one kilometer) from other high-priority sites or land-use allocations managed consistent with red tree vole conservation. High-priority sites should be interconnected to other high-priority sites or land-use allocations managed consistent with red tree vole conservation, through the management of red tree vole habitat between those locations. Shorter connectivity distances are preferred (Olson and Burnett 2013), but further distances may be acceptable if the connectivity areas are larger and contain high amounts of red tree vole habitat. Each high-priority site should be connected to at least three

other high-priority sites or land-use allocations managed consistent with red tree vole conservation to provide resiliency in face of stochastic events.

1. Composition of high-priority sites

a. Choose stands containing Douglas-fir, or, along the coast, Douglas-fir, western hemlock or Sitka spruce. Throughout their range, red tree voles primarily eat Douglas-fir needles except along the coastal forests where red tree voles also eat western hemlock and Sitka spruce needles (Forsman et al. 2008, in press; Price et al. 2015).

b. Choose stands with large trees present. Large Douglas-fir (Aubry et al. 2003) and western hemlock or Sitka spruce (Forsman et al. 2008, Price et al. 2015) are important to red tree vole habitat. Some have speculated that a single large old-growth tree could sustain many generations of red tree voles (Franklin et al. 1981; Maser 1998), providing for long-term persistence at that specific site.

c. Choose old-growth forest conditions when available. Franklin et al. (1981), Carey (1991), and Dunk and Hawley (2009) postulated that old-growth forests are ideal habitat for red tree voles as they have more broken crowns and cavities (Bingham and Sawyer Jr. 1992) that provide opportunities for nesting. Pitfall trapping studies have indicated the species is most abundant in old-growth (Corn and Bury 1986, 1991; Corn et al. 1988).

d. Select high-priority sites that are relatively unfragmented with little edge habitat. Based on a pitfall trapping study red tree voles were most abundant in contiguous mature conifer forest (Martin and McComb 2002).

e. Select stands that have higher canopy closure. In his study of 65 occupied nests, Swingle (2005) reported that canopy closure ranged from 66 to 93 percent (mean = 86 percent) in young forests and 53 to 91 percent (mean = 78 percent) in old forests. Aubry et al. (2003) also noted that interconnected canopies of large trees are important.

f. The larger the high-priority site, the more flexibility in the composition of the site. In larger areas ($\geq$25 acres) young stands can be included and still meet conservation needs. Red tree voles may be more abundant in old forests, but young forests are not necessarily unsuitable and sometimes have high densities of voles (Clifton 1960, Maser 1966, Swingle 2005, Thompson and Diller 2002).

g. In some areas it may be appropriate to select young unthinned forest as high-priority sites. This may be necessary based on spacing rules and connectivity needs as described elsewhere in the rule set.

    i. Young forests may be important habitat for red tree voles especially in landscapes where old forests have been eliminated or significantly reduced (Swingle and Forsman 2009).

    ii. Red tree voles may begin to move into young stands when the trees become big enough to support arboreal nests. In an examination of 173 nests found in young forest, Swingle

(2005) found that approximately two-thirds of the nests were in branch whorls or forked trunks, while the other third were in broken tops, single limbs or palmate branch clusters.

h. Habitat quality of young forests may increase with large old legacy trees (Mazurek and Zielinski 2004) and higher canopy closure.

i. Small patches of forest can sometimes act as refugia for tree voles and should not be discounted, especially in a landscape deficient in habitat (Price et al. 2015). Small patches that interrupt expanses of unsuitable habitat may act as stepping stones for some species (Dramstad et al. 1996), helping facilitate movement across an inhospitable landscape.

j. Choose sites that are within more resilient stand types or are less prone to disturbance. Where possible, choose sites with stand conditions that may render the sites more resilient to ecological pressures, tree disease, insects, fire, and windstorm events, to encourage longer term persistence of those sites (Groves 2003).

2. Size of high-priority sites

a. High-priority sites should be $\geq$10 acres, with the size of the site increasing relative to the number of nests within the site as per the red tree vole management recommendations (USDA and USDI 2002b).

b. Each high-priority site should be sized to provide acreage for a number of non-overlapping home ranges to ensure interactions among voles. The following studies suggest a variety of home range sizes for red tree voles.

   i. Maser (1966) conducted a population density study on approximately 30 acres in 29-50 year old Douglas-fir and Oregon white oak (*Quercus garryana*) forest. He located 12 adults (along with three sub-adults and 25 juveniles) for a density of approximately one adult per 2.5 acres (10,117 meters^2) surveyed.

   ii. Swingle and Forsman (2009) estimated a mean home range of approximately 0.43 acres (1,732 meters^2) and median range of 0.19 acres (760 meters^2) based on the movement of 45 adults (15 males, 30 females).

c. Consider designating larger sites ($\geq$25 acres) to build in site resiliency, which is particularly important in parts of the species' range where fire plays a significant role. Larger high-priority sites are more resilient than smaller ones and can withstand small losses of habitat while still providing functionality for the species.

d. Consider varying high-priority site size based on proximity to larger land-use allocations managed for red tree vole conservation. One approach could be to have smaller sites (10 acres) when closer to those areas and larger high-priority sites ($\geq$25 acres) when sites are further away.

e. The lesser the amount of larger land-use allocations managed consistent with red tree vole conservation within the watershed, the greater the need for larger (≥25 acres) high-priority sites.

3. Location of high-priority sites

a. Locate sites to provide well-distributed populations and habitat within the watershed. Examining placement of high-priority sites within sixth-field watersheds can aid achievement of well-distributed sites across the fifth-field watershed.

b. Designate sites at or near the edge of the watershed or the outer boundary of the range of the species. Populations at the edge of their range may be of increased importance in maintaining opportunities for speciation and biodiversity (Fraser 1999), which increases adaptability to future environmental changes (Lesica and Allendorf 1995). Furthermore, peripheral populations may represent refugia for species as their range is reduced, as described by Lomolino and Channell (1995), who found range collapses in mammal species were directed towards the periphery. In addition, high-priority sites retained at the edge of the watershed improve connectivity to adjacent watersheds.

c. High-priority sites do not need to be located within those land-use allocations managed consistent with red tree vole conservation, as management of these areas should not conflict with red tree vole site persistence.

d. Ensure high-priority sites are in a diversity of conditions to safeguard the persistence of multiple sites within the watershed. If sites are selected in more disturbance-prone or climate change predicted areas, select more sites to provide redundancy in the face of potential site loss.

   i. Utilize fire hazard and climate change models to help identify high-priority sites. Site location may differ in high fire risk areas versus lower risk areas and areas potentially more resilient to climate change effects (north facing) versus areas more susceptible (south facing).

   ii. Utilize wildland-urban interface maps to identify where vegetation management to reduce fuel loadings is more likely. Consider where management actions would impede red tree vole persistence in those areas.

   iii. Assess hazard, debris flow, and ice and wind damage layers for potential threats to habitat, and select high-priority sites accordingly.

e. Consider whether other rare species may be present at the site and would benefit from the site being protected (Dramstad et al. 1996).

f. Location of high-priority sites is strongly dictated by connectivity needs. Determine where larger roads, rivers, recreation areas or other landscape features may limit red tree vole movement.

4. Number of high-priority sites

a. The number of high-priority sites needed in a watershed is variable and dependent on factors such as watershed size, amounts of land-use allocations managed consistent with red tree vole conservation, amounts of red tree vole habitat, and desired connectivity. The number of high-priority sites needed will likely decrease with an increase in the acreage of land-use allocations managed consistent with red tree vole conservation. There is not an absolute number or formula to determine the number of sites needed.

b. In portions of the watershed with low amounts of land-use allocations managed consistent with red tree vole conservation, consider multiple linked and sometimes closely grouped high-priority sites to ensure resiliency from stochastic and human caused events (Groves 2003).

c. The number of high-priority sites in a watershed may vary based on the size of the high-priority sites designated. For instance, a larger number of smaller-sized high-priority sites may be needed compared to a smaller number of larger-sized high-priority sites within the same area.

d. In certain situations, existing land-use allocations and standards and guidelines alone may be adequate in providing a reasonable assurance of red tree vole persistence within the watershed, so that no high-priority sites are needed.

c. Connectivity

Connectivity to promote demographic and genetic interchange shall be accomplished by the management of landscape patterns or corridors. A corridor is a "linear landscape element that provides for movement among habitat patches" (Rosenberg et al. 1997: 678). Generally the entire area delineated as a corridor is managed to provide for connectivity. Landscape patterns, on the other hand, focus on the management of patches within the larger landscape to maintain a certain spatial array and amount of habitat available at any given time. These patterns may change through time, as long as the general spatial array and amount of habitat continues to provide for connectivity.

Connectivity areas serve to provide linked patches or continuous habitat between sites, between land-use allocations managed consistent with red tree vole conservation, between sites and land-use allocations managed consistent with red tree vole conservation, and to adjacent watersheds. For purposes of these high-priority site management recommendations, either the corridor or landscape pattern approach may be utilized to provide connectivity for red tree voles, or a combination of both.

Because of red tree voles' presumed low-mobility, stands included in connectivity areas must be comprised of suitable habitat for red tree voles. Each high-priority site should be connected to at least three other high-priority sites or land-use allocations managed consistent with red tree vole conservation. Such connections provide some resiliency should stochastic events disrupt a connection. Low mobility species may need redundancy of connectivity corridors (Raphael and Molina 2007), as many generations may be necessary to move between high quality habitat patches.

Diaz and Apostol (1993: 2.5) noted that the effectiveness of a connectivity area "…often depends on how wide it is…and how frequently breaks, or discontinuities are encountered." Pinto and Kiett (2008) also identified habitat condition, corridor size and corridor redundancy as key elements to consider when delineating effective connectivity areas. The following rule set addresses these considerations.

1. Composition of corridors or patches managed as connectivity areas

a. Although continuous canopy is preferred in connectivity areas, canopy gaps or non-forest openings within corridors or patches can be included, but should be <100 feet. Smaller forest canopy gaps (<100 feet wide, e.g., logging roads and first-order streams) do not impair tree vole movement (Biswell and Meslow 1996, Swingle and Forsman 2009), but large non-forest openings are suspected to be a barrier to dispersal (Swingle and Forsman 2009).

b. Young forests can provide connectivity. Swingle (2005) noted that young forests may provide connectivity between remnant patches of old forest.

c. Where there is little old forest available as connectivity areas, select forested links that can provide a sheltered environment for red tree vole (e.g., unthinned stands ≥20 years old; Forsman and Swingle pers. comm. 2013).

2. Width of corridors and size of landscape patches

a. Connectivity corridors should be ≥300 feet in width. This distance is based on the approximate minimum distance used when delineating habitat areas for active red tree vole sites (USDA and USDI 2000b), where the edge of the habitat area must be at least one site-potential tree from a nest. Using a radius of one site-potential tree (here, 150 feet for range-wide application) results in a 300 foot wide protected area around the nest, which is used to inform the corridor/landscape patch width.

b. Landscape patches managed for connectivity should be ≥300 feet wide and long and ≥ five acres in size. This minimum patch size is intended to encompass known red tree vole dispersal distances. Swingle (2005) radio-tracked six sub-adults and two juveniles and found an average dispersal distance of 184 feet (56 meters) with a range of 10-246 feet (3-75 meters). A circle with a radius of 246 feet (75 meters) is approximately 4.4 acres.

c. Riparian reserves can be widened to accommodate red tree vole dispersal (USDA and USDI 1994a: B-13):

> …any analysis of Riparian Reserve widths must also consider the contribution of these reserves to other, including terrestrial, species. Watershed analysis should take into account all species that were intended to be benefited by the prescribed Riparian Reserve widths. Those species include fish, mollusks, amphibians, lichens, fungi, bryophytes, vascular plants, American marten, red tree voles, bats, marbled murrelets, and northern spotted owls.

Management of riparian reserves as connectivity areas should emphasize red tree vole conservation objectives outlined in the rule set, in addition to aquatic and other riparian species.

d. The wider the area or larger the patch managed for connectivity, the greater the flexibility in the management of the stands in the connectivity areas. Including young forest in corridors or patches that are larger than the rule set dictates could allow for the thinning of those stands to promote red tree vole habitat. Although thinning may have negative effects on red tree voles (Wilson and Forsman 2013), having a connectivity area larger than required by the rule set can help to minimize that effect.

3. Location of connectivity areas on the landscape

a. Connectivity may be adequately provided by existing vegetation patterns and land-use allocations within the watershed. Review the location of the land-use allocations managed consistent with red tree vole conservation and high-priority sites in relation to existing habitat. Utilize the rule set to determine locations within the landscape where adequate interconnections exist between high-priority sites and land-use allocations managed consistent with red tree vole conservation. Assess where adequate connectivity exists to adjacent fifth-field watersheds based on current land-use allocations. For example, watersheds with extensive and larger ($\geq$300 feet wide) riparian reserves may not need additional areas identified for connectivity, if those riparian reserves are managed consistent with red tree vole conservation as identified in the rule set.

b. Ensure connectivity occurs within the survey zone of the species (Huff et al. 2012); connectivity areas in habitat above the survey protocol elevation line may be identified, but not as the sole source for linkage within and to adjacent watersheds.

c. Select corridors or patches that are potentially more resilient to disturbances and climate change and less likely to be managed for fuel reduction around communities.

   i. As with the selection of high-priority sites, utilize fire risk, climate change models, and wildland urban interface maps in both the selection of stands comprising the connectivity areas and the placement of the connectivity areas on the landscape. As possible, in landscapes with fast fire return intervals (i.e., <50 years) choose connectivity areas with longer fire return intervals, or where fire has not skipped the natural disturbance rate (i.e., fire condition class 1).

   ii. Utilize hazard models, including those for smaller scale disturbances like landslides, debris flows, and ice/wind damage. In more disturbance prone areas, select multiple connectivity areas to provide redundancy and guard against potential breaks in connections.

   iii. Consider using riparian reserves or north facing east-west connectivity routes, to provide hill shading from topographic relief to mitigate the potential of warming landscape conditions due to climate change (Olson and Burnett 2013). Employ a variety of linkages to connect north-south, east-west, and altitudinal linkages within and between watersheds

to allow multiple potential pathways in response to changing climate conditions (Olson and Burnett 2013). North-south connections, over watershed boundaries where ridges extend in an east-west direction, could aid species resilience to effects from climate change (Olson and Burnett 2013).

d. Utilize maps showing larger roads, rivers, recreation areas, human development, surface mines, or other factors that may affect red tree vole distribution and dispersal in the watershed. There may be pre-defined linkages or areas avoided by red tree voles within the watershed and to adjacent watersheds. For instance, road placement or land ownership patterns may restrict linkage, funneling connectivity into certain areas.

e. In checkerboard ownership, use diagonal linkage (Olson and Burnett 2013) to link to adjacent blocks, focusing on connecting corners of ownership. Maximize effectiveness of corner linkages either by managing these areas as high-priority sites, patches in a connectivity landscape pattern, or connectivity corridors. Consider providing maximum habitat protection at the corners.

f. Connectivity to adjacent watersheds must link to areas within the watersheds that provide for red tree vole persistence. This can include land-use allocations managed consistent with red tree vole conservation, red tree vole sites, riparian reserves, or other areas that currently provide red tree vole habitat.

g. Connectivity to adjacent watersheds can be provided by linking red tree vole habitat to the watershed ridgelines. This can be achieved by delineating connectivity areas (landscape patterns or corridors), utilizing existing land-use allocations managed consistent with red tree vole conservation, identifying high-priority sites at or near ridges, or extending headwater riparian reserves up to the ridgeline (Olson and Burnett 2013).

    i. Extending headwater riparian reserves up to the ridgeline provides the shortest link to the adjacent watershed (Olson and Kluber 2014), reducing travel distances and lands devoted to red tree vole conservation. As possible, connect these headwater riparian reserves to headwater riparian reserves in the adjacent watersheds.

    ii. A priority for connectivity to adjacent watersheds should be where headwater locations link three adjoining watersheds (Olson and Burnett 2013). These represent ecologically efficient areas, linking three watersheds all in one location.

2. Identification of non-high priority sites, including areas where pre-disturbance surveys and site management are no longer needed

Identify red tree vole sites and areas where management and pre-disturbance surveys are no longer needed to provide a reasonable assurance of species persistence. In most cases, after the identification of land-use allocations managed consistent with red tree vole conservation, high-priority sites, and connectivity areas, it is expected that pre-disturbance surveys and site management within the remainder of the watershed would no longer be needed.

However, in some watersheds (or portions thereof) it may be difficult to identify non-high priority sites or areas no longer needing pre-disturbance surveys based on low amounts of red tree vole habitat or questions about potential red tree vole occupancy. In those cases, site management and pre-disturbance surveys may need to continue until sufficient habitat develops within the watershed or occupancy status of red tree voles is better known.

Field unit personnel should clearly indicate where site management is no longer required (non-high priority sites) and where pre-disturbance surveys are not needed to provide a reasonable assurance of species persistence.

3. Identification of information gaps

Information gaps may have been realized during the identification of land-use allocations managed consistent with red tree vole conservation, high-priority sites outside those areas, connectivity areas, and non-high priority sites, including areas where pre-disturbance surveys and site management are no longer needed. Field unit personnel should 1) describe these gaps, 2) identify actions needed to address the gaps, and 3) determine if the high-priority site selection can proceed without the information. If this information is required to complete the process, field unit biologists should obtain assistance from regional and state office personnel.

4. Identification of adaptive management triggers

The red tree vole persistence approach developed and enacted for the fifth-field watershed provides the management direction for red tree voles in that watershed until updated, replaced, or removed through a new project NEPA decision. The expected longevity of the identified approach should be disclosed, as well as what new information would necessitate a revision. For instance, should wildfire occur within the watershed, the field unit is expected to conduct a review to determine whether a modification of tree vole management is warranted. If so, then the field unit would revise the land-use allocations managed consistent with red tree vole conservation, high-priority sites, connectivity areas, and non-high priority sites, including areas where surveys and site management are no longer needed, and document the modifications through a project-specific NEPA analysis and decision.

As the high-priority site selection process is utilized, field unit personnel should share the outcomes with regional and state office personnel for the benefit of others interested in undertaking a similar effort.

5. Documentation of rule set application

Maps should be utilized to display 1) land-use allocations managed consistent with red tree vole conservation, high-priority sites outside those areas, and connectivity areas; 2) non-high priority sites, including areas where pre-disturbance surveys and site management are no longer required; 3) information gaps; and 4) adaptive management triggers. Tables and text should be used to document the number, size, composition, and distance between high-priority sites, connectivity areas and land-use allocations managed consistent with red tree vole conservation. Where information gaps and adaptive management triggers can't be spatially displayed, describe within the text or tables. Document assumptions and conclusions for how the rule set was applied. In addition, identify management direction within the watershed consistent with the following:

a. Land-use allocations managed consistent with red tree vole persistence

Management within these land-use allocations will continue to follow the standards and guidelines within the specific land management plan for the National Forest or BLM District. No activities that would trigger surveys as identified in the survey protocol (Huff et al. 2012) should occur within these land-use allocations. Young stand management is acceptable; however, the age or structure of the stands proposed for treatment should not trigger the need for pre-disturbance surveys.

b. High-priority sites

The following excerpts from the red tree vole management recommendations (USDA and USDI 2002b) are applicable when managing high-priority sites; here, the term habitat area is synonymous with high-priority site:

> Any management that occurs within a Habitat Area should not remove or modify nest trees, the canopy structure of the stand, or remove any of the dominant, co-dominant, or intermediate (Daniel et al. 1979) crowns. This includes activities that may isolate nest trees or alter the microclimate within the stand. Some activities may be appropriate if they maintain or improve, and do not degrade (short- or long-term), the habitat condition in the Habitat Area. Examples of these activities include planting, road decommissioning, trail and road maintenance, culvert replacement, manual vegetation maintenance, special forest product removal, and hand piling and jackpot burning to reduce fire hazard. Because red tree voles are potentially affected by heat and smoke that penetrates the crown, burning should not occur beneath nest trees or where heat and smoke would penetrate the crown (USDA and USDI 2000b:15).

The management recommendations discuss fuels management within red tree vole habitat areas (USDA and USDI 2000b:17):

> Fuels management has become an important part of ecosystem management and community protection on NF [National Forest] and BLM lands within these areas. Pile or jackpot burning can be used to reduce excessive accumulations of fuels. Understory burning can be used to reduce fuel loading and vertical fuel continuity. Wildfires in stands that are managed using underburning are generally less severe, and fire suppression is more effective. Fuels treatment should be considered adjacent to Habitat Areas to provide further protection where natural fire frequencies have been altered or where fire hazard is high. Burning should be conducted during a time of year when the likelihood of fire escaping into the tree canopy is lowest, but may occur during any time of year under appropriate weather conditions. However, because red tree voles are potentially affected by heat and smoke that penetrates the crown, burning prescriptions should direct heat and smoke away from Habitat Areas.

In some cases, high-priority sites within a one mile (Oregon) or one-and-a half mile (California) radius of communities-at-risk may have been identified. If those sites occur within stands in fire

regimes 1, 2, or 3A (i.e., less than 50 year fire return intervals) and those stands have missed two or more natural fuel-reducing fire events (i.e., condition class 2 or 3), then the following low risk treatments may be applied in those high-priority sites (USDA and USDI 2003a: 29-31):

> Pile and Broadcast Burning: Broadcast and pile burning may occur within the Habitat Area. Within the Habitat Area hand pile & burn, or pull, pile & burn (in jackpot burns) down material away from the bole of any red tree vole nest (confirmed active, assumed active and status underdetermined) trees. Piles should be created and burned to meet the objective of minimizing direct heat and smoke from entering nest tree crowns, including nests that are confirmed active, assumed active or status undetermined. The number of piles per acre should not place the delineated Habitat Area at a greater risk of loss from naturally or human caused fire ignition. Pile burning should be conducted during a time of year and under conditions when the likelihood of fire escaping into the tree canopy is low.
>
> Burning should not remove or modify nest trees that contain confirmed active, assumed active and status underdetermined nests; the canopy structure of the stand; or remove any of the dominant, co-dominant, or intermediate (Daniel et al. 1979) crowns within the Habitat Area. Prior to broadcast burning ensure that fuels within the Habitat Area will be at a level that allows for broadcast burning to be accomplished with an average scorch height of < 15 feet. A fire behavior program, such as Behave Plus may be used to determine the appropriate weather conditions for meeting these desired fire effects. If needed within the Habitat Area, first hand pile and burn, or pull, pile and burn (in jackpot burns) down material a sufficient distance to minimize heat and smoke from entering the crown of the nest tree. Piles will then be burned prior to broadcast burning (underburning) to minimize smoke and heat entering the canopy during the broadcast burn.
>
> Both pile burning and broadcast burning should be conducted during a time of year and under conditions when the likelihood of fire escaping into the tree canopy is lowest. Burning prescriptions and flame lengths should meet the objective of minimizing direct heat and smoke from entering nest tree crowns. Because red tree voles are potentially affected by heat and smoke that penetrates the crown, burning should not occur beneath confirmed active, assumed active and status undetermined nest trees.
>
> Fire Lines: Fire lines may be constructed through Habitat Areas but should not remove sound green trees that are providing structure to the intermediate, co-dominant or dominant tree canopy within the delineated Habitat Area. In some cases, trees that are providing intermediate, co-dominant or dominant tree canopy and have the potential to burn through and fall or crown out may be felled and if they do not contain and are not adjacent to (confirmed active, assumed active or status undetermined) nests. Modification of canopy structure around active nest trees due to removal of adjacent trees should not occur. Removal of shrubs, ground cover, or low-hanging limbs is acceptable throughout the Habitat Area.

Foam: Fire fighting foam may be applied to understory vegetation within Habitat Areas as long as it is not directly applied to confirmed active, assumed active or status undetermined tree vole nests or the foliage of the nest tree or adjacent trees.

Thinning: Refer to "Management Recommendations for the Oregon Red Tree Vole", Version 2.0 which states that: "Thinning should not remove or modify nest trees, the canopy structure of the stand, or remove any of the dominant, co-dominant, or intermediate (Daniel et al. 1979) crowns within the Habitat Area." This includes activities that may isolate nest trees or reduce the interconnectivity of branches within the canopy.

Pruning: Pruning of lower branches is acceptable. Pruning >15 feet from ground level should not occur. If mechanical equipment is used, mechanical damage should not be inflicted on confirmed active, assumed active or status undetermined red tree vole nest trees, nest tree roots or trees within a 50-foot radius of the active red tree vole nest tree.

Grinding: Grinding of understory shrubs and ground fuels is acceptable, but there should be no removal of Dominant, Co-Dominant or Intermediate trees. Grinding of material >15 feet from ground level should not occur. Mechanical damage to confirmed active, assumed active or status undetermined red tree vole nest trees, nest tree roots or trees within a 50-foot radius of the active red tree vole nest tree should be avoided.

Crushing, Chopping/Mowing, Chipping, Raking: To the extent practicable, mechanical damage should not be inflicted on confirmed active, assumed active or status undetermined red tree vole nest trees, nest tree roots or trees within a 50-foot radius of the active red tree vole nest tree.

In general, habitat-disturbing activities are not expected to occur within areas managed as high-priority sites, thus pre-disturbance surveys for red tree voles would not be needed in these areas.

c. Connectivity areas

Clearly describe management guidelines, including assumptions, restrictions and flexibilities for all connectivity areas.

Management within land-use allocations identified for connectivity will continue to follow the standards and guidelines within the specific land management plan for the National Forest or BLM District. However, within connectivity areas, the need for pre-disturbance surveys is not expected, as land management should be consistent with red tree vole persistence needs, which precludes habitat-disturbing activities as identified in Huff et al. (2012). As defined in the rule set, young stand management may occur within some of these areas; however, the age or structure of the stands proposed for treatment should not trigger the need for pre-disturbance surveys.

d. Land-use allocations neither identified as being managed consistent with red tree vole conservation nor identified as high-priority sites or connectivity areas

Typically, these land-use allocations should no longer require site management or pre-disturbance surveys since these areas are not relied upon to contribute to red tree vole persistence. Exceptions are likely in watersheds with few nests, small amounts of red tree vole habitat or NWFP lands. Clearly describe if pre-disturbance surveys and site management are needed, and if so, where.

In managed forests where pre-disturbance surveys and site management are unnecessary to provide a reasonable assurance of red tree vole persistence, consider retention of larger old Douglas-fir trees (and western hemlock and Sitka spruce in the Oregon Coast Ranges) which help provide habitat for tree voles in young forests (Hunter and Bond 2001). Also consider retaining trees with broken tops, densely spaced branch clusters, deformed limbs, bushy crowns, and forked trunks as these serve as important habitat components for tree voles (Swingle 2005). Moreover, such retention could enable shifts in red tree vole conservation emphasis in response to stochastic events and climate change, while improving resilience within the watershed.

C. NEPA documentation in project level analyses

When applying these high-priority site management recommendations, documentation in a project-specific National Environmental Policy Act (NEPA) document and decision document must be made.

1. Suggested language to include in the project-specific NEPA document

The project-specific NEPA document should include language similar to the following:

> The red tree vole (*Arborimus longicaudus*) is a category C survey and manage species. The objective for category C species is to identify and manage high-priority sites to provide for a reasonable assurance of species persistence. Until high-priority sites can be determined, manage all known sites (USDA and USDI 2001: 10). Effective in [May 2016], the high-priority site management recommendations for the red tree vole were completed (Huff 2016). The high-priority site management recommendations outline a management approach under the survey and manage standards and guidelines to provide for a reasonable assurance of species persistence across the range of the species on Forest Service and Bureau of Land Management (BLM) lands.
>
> The 2001 record of decision and standards and guidelines (USDA and USDI 2001) allow for the identification of high-priority sites that must be managed to provide for a reasonable assurance of persistence of the taxon or the procedures for designating such sites locally, as well as non-high priority sites that no longer need to be managed for the benefit of those species. Management recommendations may also identify areas where it is no longer necessary to continue surveys prior to habitat-disturbing activities or strategic surveys for the taxon (USDA and USDI 2001: 19-20).

> The following summary of the analysis for the [*insert name of project*] incorporates by reference the high-priority site management recommendations (Huff 2016). This particular fifth-field watershed, [*insert name*], contains …[*insert information about the fifth-field watershed, providing details about the amount of Forest Service and BLM lands within the survey zone of the red tree vole, the amount of land-use allocations managed consistent with red tree vole conservation, the amount of potential habitat, and how much and the proportion of that habitat included in land-use allocations managed consistent with red tree vole conservation.*] A reasonable assurance of species persistence will be provided within this fifth-field watershed by [*describe the combination of land-use allocations managed consistent with red tree vole conservation, the number and array of high-priority sites/areas outside those areas, and connectivity areas*].

2. Information to include in the project-specific NEPA document

Summarize the analysis utilized to determine 1) land-use allocations managed consistent with red tree vole conservation, 2) high-priority sites outside those areas, 3) connectivity areas, and 4) areas where surveys and site management are no longer needed. The analysis must show the sites, habitat, or areas to be managed consistent with red tree vole persistence and what sites or areas do not require surveys or management. In addition to information specific to red tree vole persistence, effects on other resources must also be analyzed.

The NEPA document should discuss that the approach is intended to be a longer-term strategy and should clearly express that the field unit will follow this approach for future project planning until another NEPA decision modifies the approach for that fifth-field watershed. Subsequent projects in the fifth-field watershed can tier to the original project NEPA analyses.

3. Suggested language to include in the NEPA decision document:

Forest Service language:

> I find that this decision complies with the [*insert name of Forest*] Land and Resource Management Plan as amended by the *2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* and complies with the "High-Priority Site Management Recommendations for the Red Tree Vole (Huff 2016)."

BLM language:

> The [*insert name of project*] conforms with the [*insert name of District*] District 1995 Resource Management Plan as amended by the *2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* and complies with the "High-Priority Site Management Recommendations for the Red Tree Vole (Huff 2016)."

Checklist of key information to include in the NEPA decision document:

- ☐ Reference use of and compliance with the red tree vole high-priority site management recommendations (Huff 2016).
- ☐ State the management direction that will provide for a reasonable assurance of species persistence.
    - ☐ Describe and summarize how the high-priority site analysis was completed.
    - ☐ Describe where high-priority sites will be managed within the watershed.
    - ☐ Describe where pre-disturbance surveys are no longer required, and where still required.
    - ☐ Identify non-high priority sites, including areas where newly discovered red tree vole sites will not require site management.
    - ☐ Identify how long the approach is expected to be effective.
    - ☐ Identify what new information would likely trigger a potential change in management and subsequently a need to revisit the approach.

IV. Adaptive management

These high-priority site management recommendations strive to be adaptive, and as such, are subject to revisions based on a variety of factors. First, as field units apply the process and rule set outlined herein, issues or clarifications may arise that will necessitate a revision of this document. In addition, an immediate review and potential revision of this document may be conducted following the creation or publication of new conservation-oriented planning tools such as habitat models. As red tree vole science is further explored, information from those efforts may warrant a review of the rule set. The concern for persistence for red tree voles may change over time, requiring different approaches to meeting species persistence objectives other than those outlined in this document. Additionally, should the red tree vole be listed as threatened or endangered by the USFWS within the north Oregon coast distinct population segment, a review of this document may be triggered.

These high-priority site management recommendations will be reviewed at least every five years to address new species knowledge, scientific findings, habitat information, and results of implementation. Revision may follow the five-year reviews to refine the approach outlined in this document or to address emerging issues.

Finally, new information and new tools will be shared with field units as soon as available and incorporated or addressed in this document as needed.

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Glossary

Active site (as in active red tree vole site) – Location with one or more confirmed active red tree vole nests. An active tree vole nest was defined by Huff et al. (2012: 15) as containing green conifer cuttings, green resin ducts, or green fecal pellets, and does not indicate if the nest is actually occupied by a tree vole or not. These sites include any other type of red tree vole or "unconfirmed species" nests or resin duct location, as long as at least one tree in the site is active, thereby defining the site as an "active" Site. All red tree vole nests and "unconfirmed species" nest types and resin duct locations should be considered as part of the site as long as they are within 100 m of at least one other red tree vole nest or resin duct location or "unconfirmed species" nest that is considered to be part of the site (Huff et al. 2012).

Adaptive management areas (AMAs) – Land-use allocation under the Northwest Forest Plan; areas designated for development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives (USDA and USDI 1994b).

Administratively withdrawn areas (AWAs) – Areas removed from the suitable timber base through agency direction and land and resource management plans (USDA and USDI 1994b).

Area of critical environmental concern (ACEC) –ACECs are designated areas where special management attention is needed to protect important historic, cultural and scenic values, fish or wildlife resources, or other natural systems or processes; or to protect human life and safety from natural hazards. The ACECs are proposed in BLM resource management plans. Approval by the BLM state director, of the plan or plan amendment, officially designates ACECs (USDI BLM 2013).

Bureau of Land Management (BLM) administered lands – Oregon and California Railroad Act lands, public domain, Coos Bay wagon road, acquired lands, and split estate (federal minerals; USDA and USDI 2001).

Candidate species – For the U.S. Fish and Wildlife Service (FWS), candidate species are plants and animals for which FWS 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 (USDI FWS 2014).

Congressionally reserved areas – Areas that require congressional enactment for their establishment, such as national parks, wild and scenic rivers, national recreation areas, national monuments, and wilderness. Also referred to as congressional reserves, includes similar areas established by executive order such as national monuments (USDA and USDI 1994b).

Connectivity – A measure of the extent to which conditions among late-successional and old-growth forest areas provide habitat for breeding, feeding, dispersal, and movement of late-successional old-growth associated wildlife and fish species (USDA and USDI 1994b).

Distinct population segment (DPS) – A vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The Endangered Species Act provides for listing species, subspecies, or distinct population segments of vertebrate species (USDOC NOAA 2014b).

Endangered Species Act (ESA) – A law passed in 1973 to conserve species of wildlife and plants determined by the Director of the U.S. Fish and Wildlife Service or the National Marine Fisheries Service to be endangered or threatened with extinction in all or a significant portion of its range. Among other measures, ESA requires all federal agencies to conserve these species and consult with the U.S. Fish and Wildlife Service or National Marine Fisheries Service on federal actions that may affect these species or their designated critical habitat (USDA and USDI 2001).

Environmental impact statement (EIS) – A statement of the environmental effects of a proposed action and alternatives to it. It is required for major federal actions under Section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review. It is a formal document that must follow the requirements of NEPA, the Council of Environmental Quality guidelines, and directives of the agency responsible for the project proposal (USDA and USDI 2001).

Fragmentation – Process of reducing size and connectivity of stands that compose a forest (USDA and USDI 1994b).

Habitat – Environment where a plant or animal naturally or normally lives. For surveys: habitat specific to the species being surveyed, generally described in survey protocols or management recommendations (USDA and USDI 2001).

Habitat-disturbing activity – Activities with disturbances having a likely substantial negative impact on the species habitat, its life cycle, microclimate, or life support requirements (USDA and USDI 2001).

Hazardous fuel treatments – A management activity designed to reduce fuel levels and reduce burn intensity. Treatments include, but are not limited to, thinning tree stands, creating fuel breaks, controlling bark beetle infestations, and implementing prescribed fire (USDA and USDI 1994b).

High-priority sites – A site or group of sites deemed necessary for species persistence. The high-priority sites may be identified as specific locations, sites meeting specific criteria, or as a distribution of populations or sites over a geographic area that may change over time. High-priority sites are designated through the management recommendations for the species. High-priority sites are generally a subset of known sites; however, in some cases, all known sites may be determined to be high-priority sites. Management of high-priority sites is necessary to ensure species persistence (USDA and USDI 2001). Red tree vole high-priority sites do not necessarily need to contain known red tree vole nests, but there should be sufficient information indicating that the potential habitat is likely occupied or capable of being occupied.

Land-use allocation – Commitment of a given area of land or a resource to one or more specific uses (such as campgrounds or wilderness). In the Northwest Forest Plan, one of the seven allocations of congressionally withdrawn areas, late-successional reserves, adaptive management areas, managed late-successional areas, administratively withdrawn areas, riparian reserves, or matrix (USDA and USDI 2001).

Late-successional forests – Forest stands consisting of trees, structural attributes, supporting biological communities, and processes associated with old-growth and/or mature forests. Forest seral stages that include mature and old-growth age classes. Age is not necessarily a defining characteristic but has been used as a proxy or indicator in some usages. Minimum ages are typically 80 to 130 years, more or less, depending on the site quality, species, rate of stand development, and other factors (USDA and USDI 1994b).

Late-successional reserves (LSR) – Land allocation under the Northwest Forest Plan with the objective to protect and enhance conditions of late-successional and old-growth forest ecosystems that serve as habitat for late-successional and old-growth forest related species, including the northern spotted owl. Limited stand management is permitted, subject to review by the Regional Ecosystem Office (USDA and USDI 1994b).

LiDAR (Light Detection and Ranging) – A remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the earth (USDOC NOAA 2014a).

Manage (as in manage known sites) – To maintain the habitat elements needed to provide for persistence of the species at the site. Manage may range from maintaining one or more habitat components such as down logs or canopy cover, up to complete exclusion from disturbance for many acres, and may permit loss of some individuals, area, or elements not affecting continued site occupancy (USDA and USDI 2001).

Management recommendations – An interagency document that addresses how to manage known sites and that provides guidance to agency efforts in conserving survey and manage species. They describe the habitat parameters that will provide for maintaining the taxon at that site. They may also identify high-priority sites for uncommon species or provide other information to support management direction (USDA and USDI 2001).

Matrix – Federal lands outside of reserves, withdrawn areas, managed late-successional areas, and adaptive management areas (USDA and USDI 1994b).

Mature forest – A subset of late-successional forests. Mature forests are characterized by the onset of slowed growth, crown expansion, heavier limbs, gaps, mortality in some larger trees, and appearance of more shade-tolerant species or additional crown layers. In Douglas-fir in the western Cascade Range, this stage typically begins between 80 and 130 years, depending on site conditions and stand history (USDA and USDI 2001).

Mesic – Of, characterized by, or adapted to a moderately moist habitat (USDA and USDI 2007).

National Environmental Policy Act (NEPA) – A congressional act passed in 1969 to declare a national policy that encourages productive and enjoyable harmony between humankind and the

environment, promotes efforts that prevent or eliminate damage to the environment and biosphere, stimulates the health and welfare of humanity, enriches the understanding of the ecological systems and natural resources important to the nation, and established a Council on Environmental Quality (USDA and USDI 1994b).

Northwest Forest Plan (NWFP) –A record of decision was signed on April 13, 1994, by the Secretaries of the Department of Agriculture and the Department of Interior to adopt amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl (USDA and USDI 1994a). The record of decision, including the standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl is referred to as the "Northwest Forest Plan." The Northwest Forest Plan is not a "plan" in the agency planning regulations sense; the term instead refers collectively to the 1994 amendment to existing agency unit plans or to the specific standards and guidelines for late-successional species incorporated into subsequent administrative unit plans (USDA and USDI 2001).

Old forest – For purposes of these high-priority site management recommendations, old forest is the equivalent of late-successional forests, and encompasses both mature and old-growth forest seral stages. For this document, the minimum age of forested stands meeting this definition is 80 years old.

Old-growth forest – An ecosystem distinguished by old trees and related structural attributes. Old-growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include tree size, accumulations of large dead woody material, number of canopy layers, species, composition, and ecosystem function. More specific parameters applicable to various species are available in the USFS, Region 6, 1993 interim old-growth definitions (USDA FS 1993). The Northwest Forest Plan supplemental environmental impact statement and FEMAT describe old-growth forest as a forest stand usually at least 180 to 220 years old with moderate-to-high canopy closure; a multi-layered, multi-species canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood (decadence); numerous large snags; and heavy accumulations of wood, including large logs on the ground (USDA and USDI 2001).

Persistence (as in persistence objective for a species) – An abbreviated expression of the species management objectives for these standards and guidelines. Generally the persistence objective for vertebrates is based on the Forest Service viability provision in the regulations implementing National Forest Management Act. For non-vertebrates, it is a similar standard to the extent practicable. Use in standards and guidelines such as "…sites not needed for persistence" includes an understood "reasonable assurance of" or "to the extent practicable" (USDA and USDI 2001).

Persistence (as in persistence at a site) – Continued occupancy by a species at a known site (USDA and USDI 2001).

Practical surveys (relative to surveys prior to habitat-disturbing activities) – Surveys are practical if characteristics of the species (such as size, regular fruiting) and identifying features

result in being able to reliably locate the species, if the species is present, within one or two field seasons and with a reasonable level of effort. Characteristics determining practicality of surveys include: individual species must be of sufficient size to be detectable; the species must be readily distinguishable in the field or with no more than simple laboratory or office examination for verification of identification; the species is recognizable, annually or predictably producing identifying structures; and the surveys must not pose a health or safety risk (USDA and USDI 2001).

Pre-disturbance surveys – See "Surveys prior to habitat-disturbing activities."

Record of decision – A document separate from, but associated with, an environmental impact statement that: states the management decision, states the reason for that decision, identifies all alternatives including the environmentally preferable and selected alternatives, and also states whether all practicable measures to avoid environmental harm from the selected alternative have been adopted, and if not, why not (USDA and USDI 1994a).

Research natural areas (RNAs) – Any tract of land or water which supports high quality examples of terrestrial or aquatic ecosystems, habitats, and populations of rare or endangered plant or animal species, or unique geological study of the features, and is managed in a way that allows natural processes to predominate, with minimal human intervention (USDA FS, n.d).

Reserves – Congressionally reserved areas (such as wilderness) and land-use allocations that were designated under the Northwest Forest Plan, including late-successional reserves, riparian reserves, and managed late-successional areas. Reserves help to protect and enhance conditions of late-successional and old-growth forest ecosystems. Stand management actions are either prohibited or limited within these allocations. The likelihood of maintaining a connected viable late-successional ecosystem was found to be directly related to the amount of late-successional forest in reserve status (USDI and USDA 2001).

Riparian reserves – Areas along live and intermittent streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian reserves are important to the terrestrial ecosystem as well, serving, for example, as dispersal habitat for certain terrestrial species (USDA and USDI 1994a).

Site (as in occupied site) – The location where a specimen or population of the target species (taxonomic entity) was located, observed, or presumed to exist (occasionally used as a local option to pre-disturbance surveys for certain vertebrates) based on indicators described in the survey protocol or management recommendation. Also, the polygon described by connecting nearby or functionally contiguous detections at the same location (USDA and USDI 2001).

Site (as used in manage known sites) – The occupied site plus any buffer needed to maintain the habitat parameters described in the management recommendation (USDA and USDI 2001).

Standards and guidelines – The rules and limits governing actions, as well as the principles specifying the environmental conditions or levels to be achieved and maintained (USDA and USDI 1994b).

Stochastic Event – Random event, such as fire, landslide, and hurricanes (USDA and USDI 2007).

Strategic Surveys – Survey and manage surveys at the landscape, population, or site-specific scale to address questions that relate to identified objectives for each category. May range from random plot surveys with broad statistical inference, to habitat-focused proposive surveys designed to locate species sites and confirm suspected habitats (v. pre-disturbance or clearance surveys; USDA and USDI 2007).

Survey and manage – Mitigation measure adopted as a standard and guideline within the Northwest Forest Plan record of decision and amended in 2001 that is intended to mitigate impacts of land management efforts on those species that are closely associated with late-successional or old-growth forests whose long-term persistence is a concern. These measures apply to all land allocations and require land managers to take certain actions relative to species of plants and animals, particularly some amphibians, bryophytes, lichens, mollusks, vascular plants, fungi, and arthropods, which are rare or about which little is known. These actions include: (1) manage known sites; (2) survey prior to ground-disturbing activities; (3) conduct extensive and general regional (strategic) surveys (USDA and USDI 2001).

Survey and manage category – Groupings of species by relative rarity, practicality of pre-disturbance surveys, and information status. Management direction is generally the same for all species within a category and differs between categories (USDA and USDI 2001).

Survey protocol – Unless otherwise specified, survey protocols are for surveys prior to habitat-disturbing activities. These are interagency documents describing the survey techniques needed to have a reasonable chance of locating the species when it is present on the site, or needed to make an "equivalent-effort" of locating the species when it is present on the site. Survey protocols also identify habitats needing surveys and may identify habitats or circumstances not needing surveys. Instructions for conducting strategic surveys may be prepared along with the strategic survey implementation guide and may be referred to as strategic survey protocols (USDA and USDI 2001).

Surveys prior to habitat-disturbing activities – Surveys conducted to determine if the species is present at a site proposed for habitat-disturbing activities. Includes "practical surveys" and "equivalent-effort surveys." See additional detail in the standards and guidelines (USDA and USDI 2001).

Threatened species – Plant or animal species likely to become endangered throughout all or a significant portion of its range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register (USDA and USDI 1994b).

Uncommon (species) – A term used under the survey and manage standards and guidelines to categorize the relative rarity of a survey and manage species. A determination that a species is "uncommon" is based on information that indicates a species may have: (1) more widespread

distribution; (2) higher number of sites; (3) low-to-high number of individuals per site; (4) more stable populations or habitats; (5) less restricted distribution pattern relative to range or potential habitat; and (6) moderate-to-broad ecological amplitude (USDA and USDI 2001).

Unconfirmed species nests (in reference to arboreal nests and red tree vole) – Sites where the species using the nest has not been determined are assumed to be active for management purposes. Tree climbing did not occur and therefore the site is assumed to be active; tree climbing would identify these sites as either "active" or "inactive" sites, or not red tree vole. These sites may include "inactive" nests, as long as at least one tree in the site is an "unconfirmed species nest", thereby defining the site as "managed as active". All "unconfirmed species" nests and "inactive" red tree vole nests should be considered as part of the site as long as they are within 100 m of at least one other nest that is considered to be part of the site (Huff et al. 2012).

Undetermined status site (as in status of red tree vole site) – The activity status of confirmed tree vole nests has not been determined for the nests in the site. The site is assumed to be currently active by the species for management purposes. Additional survey effort would identify these sites as either active or inactive sites. All "undetermined status", "inactive", and "unconfirmed species" nest types and resin duct locations should be considered as part of the site as long as they are within 100 m of at least one other nest/resin duct location that is considered to be part of the site (Huff et al. 2012).

Viability – Ability of a wildlife or plant population to maintain sufficient size to persist over time in spite of normal fluctuations in numbers, usually expressed as a probability of maintaining a specific population for a specified period (USDA and USDI 1994b).

Viability provision – A provision contained in the National Forest System Land and Resource Management Planning Regulation of 1982, pursuant to the National Forest Management Act. This provision is found in 36 CFR 219.19 and reads as follows: "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area" (USDA and USDI 2001).

Well distributed – Distribution sufficient to permit normal biological function and species interactions, considering life history characteristics of the species and the habitats for which it is specifically adapted (USDA and USDI 2001).

Young forest – For purposes of the high-priority site management recommendations, young forests are forested stands <80 years old.

Xeric – Of, characterized by, or adapted to an extremely dry habitat (USDA and USDI 2007).