SURVEY PROTOCOL

FOR THE

RED TREE VOLE

Arborimus longicaudus
(= *Phenacomys longicaudus* in the Record of Decision
of the Northwest Forest Plan)

Photo by Nick Hatch

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USDA Forest Service Region 6, Oregon and Washington
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Citation

Huff, R., K. Van Norman, C. Hughes, R. Davis and K. Mellen-Mclean. 2012. Survey Protocol for the Red Tree Vole, Version 3.0. Portland, OR. U.S. Department of the Interior, Bureau of Land Management, Oregon/Washington, and U.S. Department of Agriculture, Forest Service Regions 5 and 6. 52 p.

This protocol modifies and replaces the following documents:

Biswell, B., M. Blow, L. Finley, S. Madsen, and K. Schmidt. Undated. Survey Protocol for the Red Tree Vole, Version 2.0. Portland, OR. U.S. Department of the Interior, Bureau of Land Management, Oregon/Washington, and U.S. Department of Agriculture, Forest Service Regions 5 and 6. 32 p.

Biswell, B., M. Blow, R. Breckel, L. Finley, and J. Lint. 2002. Survey Protocol for the Red Tree Vole, Version 2.1. Portland, OR. U.S. Department of the Interior, Bureau of Land Management, Oregon/Washington, and U.S. Department of Agriculture, Forest Service Regions 5 and 6. 13 p.

USDA Forest Service, and USDI Bureau of Land Management. 2003. Red Tree Vole Protocol Revision, Version 2.2-Release of Pre-Disturbance Survey Requirements in Six Watersheds. BLM-Instruction Memorandum No. OR-2003-075. Portland, OR. U.S. Department of the Interior, Bureau of Land Management, Oregon/Washington, and U.S. Department of Agriculture, Forest Service Regions 5 and 6. 1 p. http://www.blm.gov/or/plans/surveyandmanage/files/12-red_tree_vole_v2-2.pdf

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SUMMARY OF MODIFICATIONS TO PREVIOUS PROTOCOL VERSIONS

This protocol combines Versions 2.0, 2.1, and 2.2 of the red tree vole survey protocol into one format and incorporates new direction regarding boundary lines and elevational limits for the Northern Mesic, Mesic, and Xeric Survey Zones (USDA and USDI 2000, 2001). The structure and organization of the document have been modified and new information added. The main changes in this updated protocol are a:

1. Modification of terminology, removing the term "Distribution Zone" and replacing it with "Survey Zone" to more accurately depict the intent of the delineated Northern Mesic, Mesic, and Xeric Zones,

2. Decrease in the upper elevation limit for surveys in portions of the Northern Mesic and Mesic Survey Zones,

3. Change in the eastern boundary and a decrease in the elevation limit for surveys in portions of the Xeric Survey Zone,

4. Modification of the time limitation before surveys must be repeated,

5. Focus on the need to conduct tree climbing to determine if a nest is a red tree vole nest and occupancy status of red tree vole nests,

6. Modification of the second set of conditions describing habitat under "General Habitat Descriptions," replacing pre-dominant with superdominant when considering stands with large tree components,

7. Recommendation to conduct tree climbing sampling in stands containing larger ($\geq$ 36″ dbh) trees, if visibility into the larger trees is poor and ground based surveys yield no vole nests,

8. Clarification of information about habitat and nests, and updates of pertinent literature,

9. Modification to data forms and data entry procedures, and

10. Refinement of the former system of categorizing red tree vole nests as "active" or "inactive" with finer categories that reflect nest occupancy based on observations of voles and nest materials.

CRITERIA FOR DETERMINING THE NEED FOR PRE-DISTURBANCE SURVEYS

Pre-disturbance surveys for red tree voles are required if all three of the following criteria are met: 1) the proposed project is within the Northern Mesic, Mesic, or Xeric Survey Zones (Figure 1), 2) there is suitable habitat within the planning area that may potentially contribute to a reasonable assurance of persistence of tree voles, and 3) the project disturbance is likely to have a significant negative impact on the species' habitat, its life cycle, microclimate, or life support requirements that affects persistence of red tree voles (USDA and USDI 2001: S&G 22). A detailed description of each criterion follows.

1. **The proposed project is within the Northern Mesic, Mesic, or Xeric Survey Zones.** The 2000 FSEIS for the Amendment to the Survey and Manage Mitigation Measures (USDA and USDI 2000) subdivided the range of the red tree vole into three zones, referred to as the Northern Mesic, Mesic, and Xeric Zones. New information on the species range and elevation limits has been gathered since then and is now incorporated into the Survey Zone delineations. These Survey Zones (Figure 1) encompass a large area and biologists should use more site-specific and fine-scale maps at the project scale when determining elevation limits and boundaries specific to each Survey Zone. A general description of the survey area boundaries in each of the three Survey Zones is as follows:

    a. The **Northern Mesic Zone** is bounded to the north by the Columbia River, on the east by the 3,500 foot elevation contour along the west slope of the Cascade Mountains, on the west by the Pacific Ocean, and on the south by the Mesic Zone. Northeast of Mount Hood, the line delineating the eastern boundary of the Northern Mesic Zone extends east of the crest of the Cascades to include the headwaters of the Lake Branch watershed, where red tree voles are known to occur (Forsman et al. 2009a). Although the survey area goes up to the 3,500 foot elevation level in the Western Cascades portion of the zone, in the remainder of the zone there is no elevation limit.
    b. The **Mesic Zone** occurs south of the Northern Mesic Zone and is bounded on the south side by the Klamath River in California and on the southeastern side by the Xeric Zone. The northeastern limits follow the 4,500 foot elevation contour in the Western Cascades. The western boundary is the Pacific Ocean, except for the area in the extreme southern end of the zone, where the survey boundary moves inland along the Klamath River. In the Western Cascades portion of the zone, the survey area goes up to the 4,500 foot elevation level, while in the remainder of the zone there is no elevation limit.
    c. The **Xeric Zone** occurs east and southeast of the Mesic Zone. Based on recent surveys for tree voles and data from spotted owl (*Strix occidentalis caurina*) pellets (Forsman et al. 2004), the eastern edge of the Xeric Zone occurs from west of the Klamath County line north of the Middle Fork of the Rogue River and then north of the Rogue River to Grants Pass, then west of the Applegate River, to the Oregon/California border, then north of the border until Indian Creek (a tributary to the Klamath River), west of Indian Creek to its confluence with the Klamath River, then along the Klamath River, south of the China Peak HUC 5 watershed. In the Western Cascades portion of the zone, the survey area goes up to the 4,500 foot elevation level. In the Klamath Mountains portion of the zone the survey area goes up to the 5,000 foot elevation level.

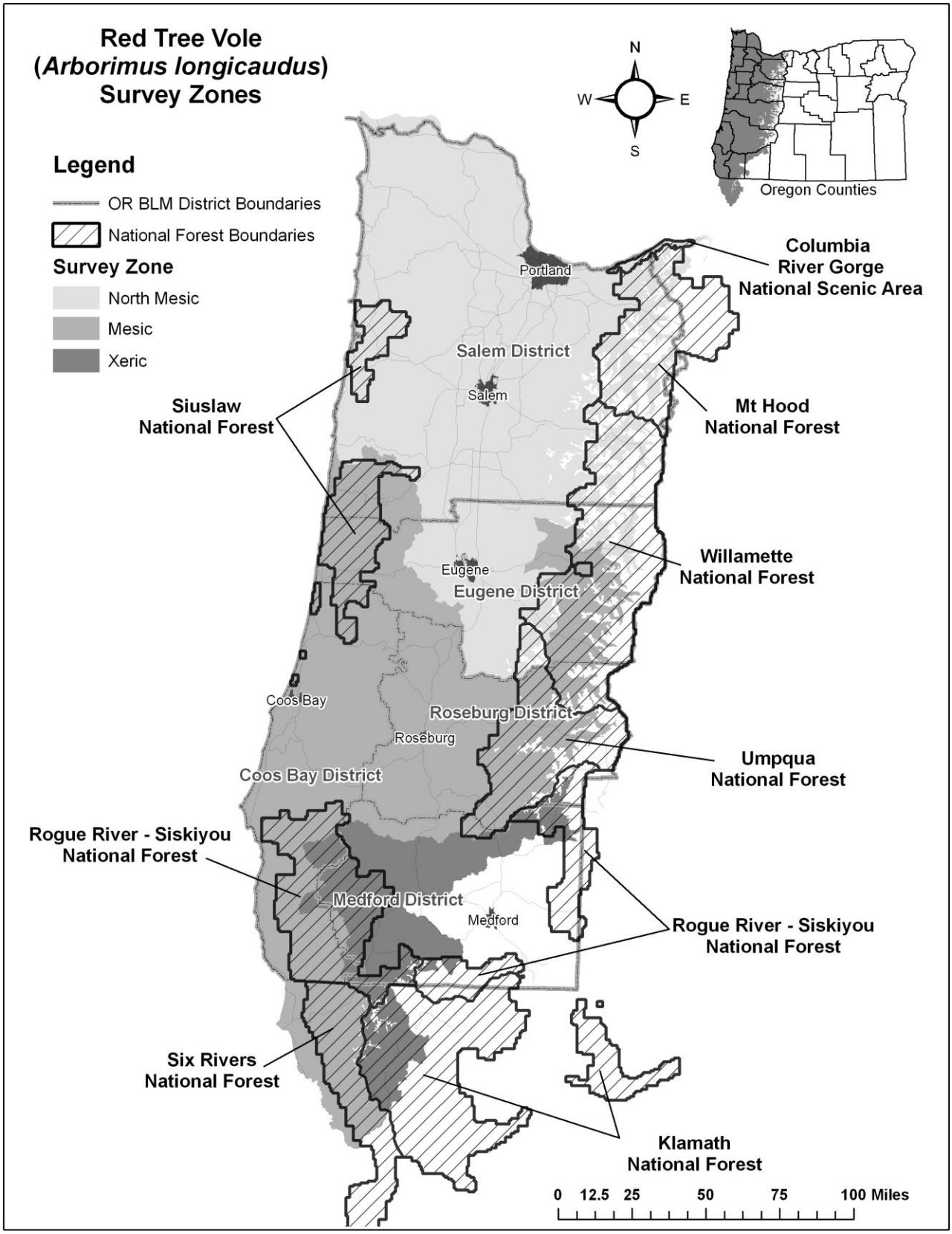

Figure 1—Northern Mesic, Mesic, and Xeric Survey Zones for the red tree vole (*Arborimus longicaudus*).

It is important to note that these Survey Zones do not entirely capture the range of the red tree vole in the Cascades and Siskiyou Mountains where there may be a few red tree voles that occur at elevations above the upper limits of the Survey Zones. The elevation cutoffs for the Survey Zones are a compromise designed to keep surveyors from spending large amounts of time conducting surveys in places where the likelihood of finding red tree voles is low. Elevation limits and survey zone boundaries were determined through recommendations from Forsman and Swingle (pers. comm.) and were supported by analysis of Forest Service (FS) and Bureau of Land Management (BLM) database queries. For the elevation decrease, a disproportionate number of nests were found above the recommended elevation limits as compared to survey effort (FS/BLM unpublished data). The eastern survey zone boundaries incorporate all red tree vole nests (and spotted owl pellets with red tree vole remains) found to date. If red tree vole nests are found at elevations above the limits identified in any of the Survey Zones or in habitats not targeted by this survey protocol, then those areas would be managed as known sites in accordance with the current direction for this species.

Watersheds Exempted from Surveys in Matrix and Adaptive Management Areas (AMA)
There are certain watersheds that are exempt from pre-disturbance surveys in Matrix and AMA or a combination of Matrix/AMA and Riparian Reserve allocations. On 22 April 2003, the "Supplemental Direction for Identification of Non-High Priority Sites for Red Tree Voles Within the Pilot Area" was transmitted to the field (Forest Service File Code 2630; Bureau of Land Management Instruction Memorandum No. OR-2003-062, http://www.blm.gov/or/efoia/fy2003/ib/im-or-2003-062.pdf). The supplemental direction established a programmatic process that allows field units to identify non-high priority sites. Application of the programmatic process allows for sites within Matrix and AMA or a combination of Matrix/AMA and Riparian Reserve land allocations in 5th field watersheds with high amounts of future red tree vole habitat in reserved land allocations, to be identified as non-high priority and thus released for other management priorities. This direction is still valid.

Sixteen watersheds within the pilot area were noted as having high amounts (83–100%) of red tree vole habitat in reserved land allocations. Within these 16 watersheds, any site in Matrix or AMA, or a combination of Matrix/AMA and Riparian Reserve land allocations can be identified as non-high priority, and hence pre-disturbance surveys within those allocations within these watersheds are not required. The 16 watersheds are: Lower Smith River, Lower Umpqua River, Wolf Creek, Fall Creek, Upper Umpqua River, Mill Creek (Lower Umpqua River), Canton Creek, Lower Siuslaw River, Upper Siuslaw River, Steamboat Creek, Boulder Creek (North Fork Umpqua River), Middle Fork Willamette River/Lookout Point, Deadwood Creek, North Fork Siuslaw River, Little Fall Creek, and Indian Creek/Lake Creek (Figure 2). Within these 16 watersheds, projects in land allocations other than Matrix, AMA, or a combination of Matrix/AMA and Riparian Reserves are not exempted from surveys by this direction.

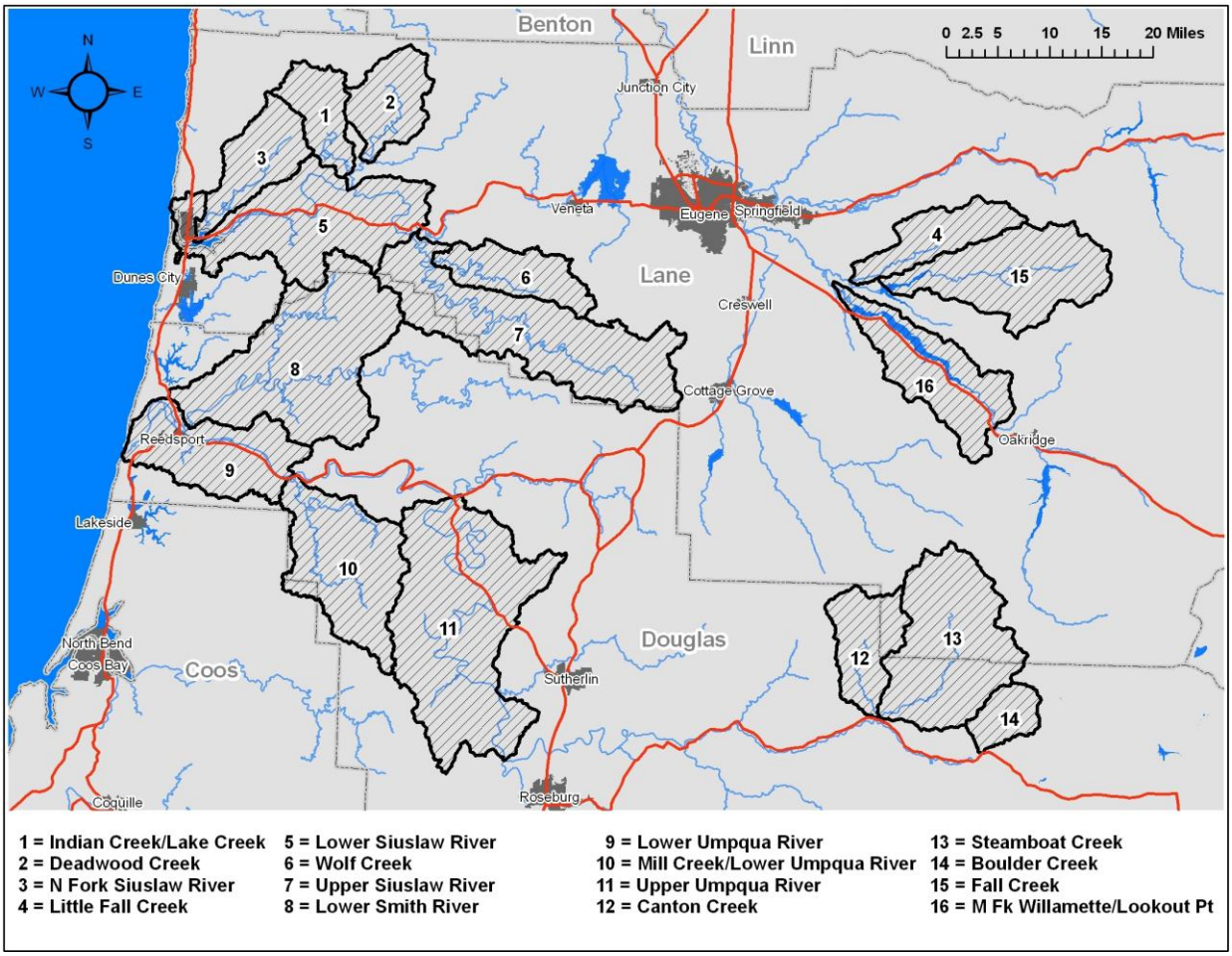

Figure 2—Watersheds exempted from red tree vole (*Arborimus longicaudus*) surveys within Matrix and Adaptive Management Area (AMA) or a combination of Matrix/AMA and Riparian Reserve land allocations.

2. **Suitable habitat that may potentially contribute to a reasonable assurance of persistence occurs within the proposed project area (USDA and USDI 2001: S&G 23).**
Habitat descriptions listed below do not include all stand conditions where red tree vole nests occur. The differences in survey recommendations for stand conditions between Survey Zones are based on the following factors: number of known extant sites, detection rate of vole nests per survey effort, site quality, tree species, amount of late-successional forest, and land ownership patterns. The variation in these factors across their range takes into consideration the need to locate and identify a sufficient number of sites that may provide for a reasonable assurance of persistence of red tree voles.

   For this criterion, either the Quadratic Mean Diameter (QMD) or Arithmetic Mean Diameter (AMD) size description and one of the two vole general habitat descriptions have to be met. Stands that meet both: 1) the QMD or AMD and 2) one of the two general habitat descriptions, are considered suitable habitat that may potentially contribute to a reasonable assurance of persistence, and would require surveys if Criteria 3 is met.

   For more isolated stands that meet the minimum diameters (QMD or AMD) and one of the two general habitat descriptions, professional judgment should be used to evaluate the likelihood that

the stand currently provides habitat for the red tree vole. For instance, a 2 acre stand meeting the habitat criteria but surrounded by clear-cuts may not provide habitat.

a. **QMD or AMD Size Description by Survey Zone**
For purposes of deciding whether a stand is suitable habitat that may potentially contribute to a reasonable assurance of red tree vole persistence, determine the estimated QMD or AMD of the stand. Administrative units may use whichever method is more commonly used in their local forest management applications. If the estimated QMD or AMD is greater than or equal to the diameters for the survey zones listed below, the stand may be suitable habitat:

1. Northern Mesic Zone: QMD ≥ 16″ or AMD ≥ 15″.
2. Mesic Zone: QMD ≥ 18″ or AMD ≥ 16″.
3. Xeric Zone: QMD ≥ 16″ or AMD ≥ 14″.

If the stand does not meet the minimum mean diameters, then the stand is considered to not be composed of "suitable habitat that may potentially contribute to a reasonable assurance of persistence" and surveys are not required.

b. **Red Tree Vole General Habitat Descriptions**
If the minimum QMD or AMD criterion for the stand has been met, then determine if one of the general habitat classes below applies:

1. Mature and old-growth conifer forests and older mixed-age conifer forests containing Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), Sitka spruce (*Picea sitchensis*), or western hemlock (*Tsuga heterophylla*) with multi-layered canopies and branches capable of supporting nests. Mature forests are characterized by the onset of slowed height growth, crown expansion, heavier limbs, gaps, some mortality in larger trees, and appearance of more shade-tolerant species or additional crown layers (USDA and USDI 2001). 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 (USDA and USDI 2001). Typically, in Douglas-fir forests west of the Cascades, mature forests begin between 80–130 years, and old-growth forests at 180–220 years old.

OR

2. Conifer or conifer-dominated mixed conifer-hardwood forests with canopy closure of intermediate, co-dominant and dominant trees ≥ 60%, and with two or more superdominant conifer trees per acre that have the following characteristics that provide foundations for vole nests: large limbs, palmate branch clusters, well developed crowns, cavities, broken tops, forked trunks, multiple leaders, or dwarf mistletoe (*Arceuthobium* spp.) brooms. Superdominant trees typically have crowns that extend above the general stand canopy and have large branches in the upper canopy of the dominant trees in the stand (Curtis et al. 1998). Superdominant trees may be remnant trees from an earlier cohort, or they may be trees from the dominant cohort that were more open grown and have become much larger than the rest of the trees in the stand.

If the stand meets the minimum mean diameters described in a. above, but does not meet either one of these general habitat descriptions in b. then the stand is considered to not be composed of "suitable habitat that may potentially contribute to a reasonable assurance of persistence" and surveys are not required.

3. **The proposed project is a habitat-disturbing activity that has the potential to cause a "significant negative effect on the species habitat or the persistence of the species at the site" (USDA and USDI 2001:S&G 22)**.
"Habitat-disturbing activities are defined as those disturbances likely to have a significant negative impact on the habitat, life cycle, microclimate, or life support requirements of the species. The evaluation of the scale, scope, and intensity of the anticipated negative impact of the project on habitat or life requirements should include an assessment of the type, timing, and intensity of the disturbing activity. The line officer should seek the specialists' recommendations to help determine the need for a survey based on site-specific information. In making such determinations, the line officer should consider the probability of the species being present on the project site, as well as the probability that the project would cause a significant negative effect on the species habitat or the persistence of the species at the site" (USDA and USDI 2001:22). "Site" is defined in the glossary section of the Survey and Manage Standards and Guidelines (USDA and USDI 2001:83). If the proposed activity is determined to not pose a potential significant negative effect at the site, then surveys are not required.

   Activities that would remove or modify the intermediate, co-dominant, dominant, or pre-dominant/superdominant canopy within the stand may be considered habitat-disturbing to red tree voles. This includes activities that may cause a significant negative effect on red tree voles or habitat in the project area by isolating or damaging nests or nest trees.

   Routine maintenance of improvements and existing structures is not considered a habitat-disturbing activity. Examples of routine maintenance include road maintenance, clearing encroaching vegetation, managing existing seed orchards, and falling hazard trees (USDA and USDI 2001:S&G 22).

   Some other examples of projects that might not be considered habitat-disturbing and, therefore, not require pre-disturbance surveys include: brush and understory clearing, hand and machine piling of smaller diameter material, stream restoration, snag creation, tailholds, guylines, and lift trees.

   In addition, there are survey exemptions that have been identified through settlement agreements associated with Survey and Manage litigation. A full listing of those exemptions may be found on the Survey and Manage General Guidance webpage http://www.blm.gov/or/plans/surveyandmanage/guidance.php.

NATURAL HISTORY

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 primarily arboreal but will come to the ground to move between trees if there are no branch pathways between trees (Swingle and Forsman 2009). Needles and twig bark of Douglas-fir, grand fir, western hemlock, and Sitka spruce are the only known foods eaten by red tree voles (Walker 1930, Maser 1966). Red tree voles are prey to many species of mammals and birds, including weasels (*Mustela* spp.) and the northern spotted owl (Forsman et al. 1984, 2004; Graham and Mires 2005; Swingle et al. 2010). In areas where they are particularly abundant they may provide 30–50% of the items consumed by spotted owls (Forsman et al. 1984).

Tree voles collect cuttings from tips of live conifer branches that they harvest by chewing through the stem, leaving a distinctive angled chisel-cut. Voles typically harvest 14–30 cuttings per night and store these on top of or inside their nests (Forsman et al. 2009b). Length of cuttings average 14 cm (range = 1–35 cm; Forsman et al. 2009b). Resin ducts are small tubules inside the needles of conifers that contain unpalatable chemicals that are the plant's chemical defense against browsers (Kelsey et. al. 2009). When feeding on conifer needles, tree voles often (but not always) remove the portion of the needle containing the resin ducts before eating the palatable part of the needle (Howell 1926, Benson and Borell 1931). They use the discarded portion of the needle to line the tunnels and sleeping chamber inside their nests, which is why occupied or recently occupied nests often have a pleasant "Christmas Tree" odor. In Douglas-fir, the paired resin ducts are located along the edges of the needle, and tree voles remove the resin ducts by chewing along the edges of the needle before eating the rest of the needle. In western hemlock, the single resin duct is located in the center of the needle and tree voles eat the edges of the needle before discarding the midrib (Walker 1930, Clifton 1960). Voles that feed on Douglas-fir typically accumulate large amounts of resin ducts in their nests, whereas voles that feed on western hemlock accumulate smaller amounts of resin ducts. Because the resin ducts in Sitka spruce are discontinuous and located in the basal portion of the needle (Kelsey et al. 2009), voles feeding on these needles may have few or no resin ducts in their nests (Forsman and Swingle unpubl. data). No other species removes the resin ducts from conifer needles and uses them to build their nests, so it is usually easy to identify tree vole nests based on the presence of resin ducts.

After eating the needles, tree voles strip and eat the bark from many of the twigs that they harvest. These debarked twigs are often found in their nests and are typically 1–6 cm in length with a chisel-cut at each end. Fibrous tree vole fecal pellets that are slightly larger than mouse droppings are also found in their nests, often in copious amounts. Fresh tree vole fecal pellets are bright green and then gradually fade with age until they become dark brown or black. In nests that are occupied for long periods of time the old fecal pellets, resin ducts, debarked twigs, and uneaten cuttings gradually decompose, forming a brownish soil-like material inside the nest.

Red tree voles are solitary and build their nests in trees near their food. Although it is common to find multiple nests in the same tree, there have been only a few cases in which climbers visually observed more than one occupied vole nest in the same tree (Benson and Borell 1931, Maser 1966, Forsman and Swingle unpubl. data). Nests typically consist of a compact mass of conifer branch tips (cuttings), resin ducts, fecal pellets, dead twigs, debarked twigs, and lichens (Howell 1926, Benson and Borell 1931, Clifton 1960, Maser 1966, Gillesberg and Carey 1991, Forsman et al. 2009b).

Stable platforms for tree vole nests in large trees are typically found on large branches, dwarf mistletoe brooms, epicormic branches (palmate branch clusters), and in cavities or hollow limbs. In young trees, nests are most commonly located in branch whorls, forked trunks, or broken tops with multiple leaders. Nests have been documented from 2–75 m above ground (Swingle 2005, Price et al. 2010). Old tree vole nests are sometimes found below the live crown of the nest tree, but most occupied nests are located in the live crown, where voles can easily reach their food (Swingle 2005). A small number of males have been found in nests on the ground (Howell 1926, Maser 1998, Thompson and Diller 2002), leading to speculation that many males nest on the ground, but this has never been proven and is highly unlikely in forests where the live canopy is high above ground.

Red tree voles were rated as highly vulnerable to local extirpation due to habitat fragmentation or loss (Huff et al. 1992). Several studies indicated tree voles are associated with old forests (Corn and Bury 1986, Dunk and Hawley 2009), but they also occur in younger forests (Jewett 1920, Howell 1926, Clifton 1960, Maser 1966, Thompson and Diller 2002, Swingle and Forsman 2009). Tree vole populations have probably declined in many parts of their range as a result of logging, fire, and forest conversion to agriculture and rural development. In Oregon, they are uncommon or absent in most of the northern Coast Ranges and northern Cascades, where large areas of old forest have been repeatedly logged or burned during the last century (Wimberly and Ohmann 2004). Although significant steps have been taken to protect tree vole habitat on federal lands, Huff et al. (1992) predicted that the tree vole population will continue to decline in the future as old forests are harvested or burned, and rural areas are converted to housing developments or agricultural crops.

Many biologists who have studied tree voles have noted that their nests tend to occur in clumps on the landscape (e.g., Howell 1926, Maser 1998). Signs of their presence range from areas with many nests in a single stand to stands in which only a few nests can be found (Forsman et al. 2009a).

Geographic Range of Tree Voles

There are two species of tree voles, the red tree vole that occurs in western Oregon and extreme northwestern California and the Sonoma tree vole (*Arborimus pomo*) that occurs in the coastal forests of California from the Klamath River south to Freestone in southern Sonoma County (Hayes 1996, Forsman and Swingle, unpubl. data). The only known ecological difference between the congeners is that the Sonoma tree vole will also feed on Bishop pine (*Pinus muricata*; Wooster and Town 2002) and Monterrey pine (*P. radiata*; Diller and Forsman unpubl. data). The most significant change regarding the range of the red tree vole since the implementation of the Northwest Forest Plan (NWFP) is clarification regarding the taxonomic relationship of populations in northern California. In the Final Supplemental Environmental Impact Statement (FSEIS) for the NWFP (USDA and USDI 1994a), the Oregon and California border was used as the dividing line between the red tree vole and Sonoma tree vole, as proposed by Johnson and George (1991). Subsequent DNA analyses suggested that a more appropriate dividing line between the congeners was the Klamath River in northwestern California (Murray 1995, Blois and Arbogast 2006). This protocol was developed for surveys within the range of the red tree vole and does not apply to the Sonoma tree vole, which mostly occurs on private lands (USDA and USDI 1994b, Forsman et al. in prep).

NEST CATEGORIZATION

Arboreal nests found using this protocol must be classified into one of the following three categories: **Confirmed red tree vole nest**, **Confirmed non-tree vole nest**, or **Unconfirmed species nest**. Nests categorized as Confirmed red tree vole will be further categorized based on how recent the red tree vole activity was. From the ground, red tree vole nests generally appear as a compact mass. Close inspection by tree climbers will reveal diagnostic characteristics that differentiate tree vole nests from the nests of other arboreal rodents or birds. Finding or observing resin ducts, vole cuttings, debarked twigs, vole fecal pellets, or seeing a vole are the definitive indicators a nest has been or is occupied by a red tree vole.

Over time, individual nests may be used by squirrels, woodrats, or voles, but rarely at the same time (Maser 1966, Swingle 2005). There are six other mammals in the range of the red tree vole that build or use arboreal nests: white-footed voles (*Arborimus albipes*), Douglas' squirrels (*Tamiasciurus douglasii*), northern flying squirrels (*Glaucomys sabrinus*), western gray squirrels (*Sciurus griseus*), and woodrats (*Neotoma fuscipes* and *N. cinerea*). Red tree voles may build their nests on top of or inside unoccupied nests of these species or other arboreal nests built by birds. Since tree voles will take over unoccupied nests of other species, tree climbing is the best method to determine if red tree voles have used the nest structure or not.

Many structures detected will be old and dilapidated rodent nests or natural accumulations of litter and broken branches, especially on dwarf mistletoe brooms. From the ground, these generally appear as dark haphazard accumulations of twigs, needles, moss, and/or lichens on the topside of a branch or in a crotch in a tree. Many of these structures are very compacted and do not contain any fresh material. Many will also have large holes through the nest, or the nest material will be falling off the structure. Samples of this fallen material can sometimes be seen on the ground under the nest.

The following describes general criteria to use to help make the appropriate determinations on nest classification. See also Table 1 for a summary of the key diagnostic characteristics.

1. **Confirmed red tree vole nest**
   This includes nests that are "active", "inactive", or the nest activity status is undetermined; data codes for confirmed red tree vole nests are included below under, "Categorizing Confirmed Red Tree Vole Nests", as the activity or occupancy status of confirmed red tree vole nests must be further classified.

   Below are typical signs that indicate a nest structure may be occupied or was used by a red tree vole. Some of these features may be present on the ground below the nest or they may be visible in the tree from the ground using binoculars:

   a. Cuttings of Douglas-fir, grand fir, western hemlock, or Sitka spruce are piled on top of or pulled inside the nest entrances. Unlike the longer cuttings typically harvested by squirrels and woodrats, vole cuttings are shorter, typically only 5–20 cm long and not as thick, typically 2–3 mm (Forsman et al. 2009b). However, cuttings up to 35 cm long may occasionally be harvested by voles but not in large quantities. Tree voles also eat the bark off of the cuttings that they harvest, and tree vole nest chambers and tunnels typically contain many small

white twigs with the bark removed that look like little pieces of toothpick. Cuttings and debarked twigs in vole nests have ends that are cut off at an angle ("chisel-cut"), whereas twigs that are broken off by wind have ends that are ragged.

b. Clumps of resin ducts are incorporated into the nest. Resin ducts may be seen in the nest, sloughing off the edge of the nest, or on the ground, trunk, or limbs below the nest.
c. Vole fecal pellets are located on top of or inside nests or on limbs below the nest. In rare cases, nests in riparian areas that look like tree vole nests and contain fecal pellets that look like tree vole fecal pellets may actually be white-footed vole nests. These nests do not contain resin ducts and are typically covered by leaves of red alder (*Alnus rubra*) or other deciduous plants, which are food for white-footed voles (Voth et al. 1983, Forsman and Swingle 2006).

2. **Confirmed non-tree vole nest**
These nests are confirmed to a species other than tree vole or are a collection of debris. Nests in this category would not have any of the vole sign described above (under "Confirmed red tree vole nest") from ground and tree climbing survey results.

Nests built by other arboreal rodents tend to be constructed of different and larger material or large amounts of moss. Nests of other arboreal rodents will have some of these characteristics:

a. The twigs and sticks that make up the base of the nest platform are larger diameter and longer than those added by red tree voles. For example, woodrats and squirrels may include twigs up to 1 cm in diameter in the nest platform.
b. The nest chamber is constructed of moss, shredded bark, grasses, lichens, or leaves of deciduous trees and shrubs. If fresh cuttings of conifers are piled on top of the nest they will typically be 2–5 times longer than cuttings harvested by voles.
c. Large quantities of cone scales or cone fragments piled on top of a nest or on the ground below a nest indicate usage by Douglas' squirrels. Occupied or recently occupied woodrat nests typically smell strongly of urine and are often very large structures composed primarily of large twigs and branches.

3. **Unconfirmed species nest**
The species using the nest is unknown, and may potentially be a red tree vole. In these cases, the species using the nest was not determined. This includes situations where the structure was not examined by a tree climber so that the builder of the nest was not determined, and therefore the structure could not be ruled out as an "active" red tree vole nest. Unconfirmed nests are to be managed as if they are "active" red tree vole nests.

Categorizing Confirmed Red Tree Vole Nests

To manage red tree vole sites and to assist in adaptive management processes, confirmed red tree vole nests should be further classified based on the occupancy status of the nest as "Active", "Inactive", or Activity "Status Undetermined". "Active" nests should then be further classified based on how recent the red tree vole activity.

The following describes characteristics to examine in order to determine the appropriate occupancy status of confirmed red tree vole nests. See Table 1 for a comparison of key diagnostic characteristics.

1. **"Active" nests**
   Diagnostic features that indicate occupancy status of red tree vole nests require close-up examination of the nest material (resin ducts, fecal pellets, cuttings) for freshness. Diagnostic features must be considered as a whole when determining occupancy or age of a nest. Most of the time tree climbers will not see the vole occupying a nest and will have to use contextual clues to make determinations.

   The color of fecal pellets can be used to indicate how recently the nest was occupied. Bright green pellets indicate newer droppings and can indicate current or recent use of the nest. Older fecal pellets are dark brown to black and become compacted into the bottom of the nest as they become wet and compressed. Occupied or very recently occupied nests will usually have a combination of fresh green and old pellets.

   Fresh, bright green to pale green resin ducts on or in the nest can indicate recent use, but ducts inside the nest can stay green for an extended time, so fresh cuttings are a better indicator of recent occupancy than are green resin ducts.

   Active red tree vole nests are categorized into one of three categories:

   a. **Animal observed** (noted as **AC AO** (Active, Animal Observed) for data management purposes): Vole seen—this is a rare event unless the nest is probed or torn apart, which is not recommended unless part of a research project.
   b. **Likely or very recently occupied** tree vole nest (noted as **AC VR** (Active Very Recently) for data management purposes): A red tree vole nest that is apparently occupied or has been used within the very recent past, but that is not disturbed by the tree climber to determine if it is actually occupied. These nests typically have fresh green cuttings piled on top of the nest or protruding from an entrance tunnel on the top or side of the nest. Green resin ducts are usually present inside or on top of the nest. Green cuttings can persist for weeks, maybe months, in a cool moist environment, but cuttings at likely or very recently occupied nests will be very fresh, with turgid needles, and will often form a plug that blocks the entrance to the nest. Fecal pellets are typically bright green.
   c. **Moderately recently occupied** tree vole nest (noted as **AC MR** (Active Moderately Recently) for data management purposes): A nest that was probably occupied by a vole within the recent past. May contain older resin ducts that have faded to a pale green. If cuttings are present, they are somewhat desiccated and the needles will often fall off the stem when touched.

2. **"Inactive"** nests (noted as **INA** for data management purposes)
   Typical signs of old vole nests with no recent use include:

   a. Nest is compacted or falling apart and the fecal pellets are dark brown to black with no green resin ducts or cuttings.
   b. Nest material is comprised primarily of a composted layer of compressed fecal pellets, orange, tan or brown resin ducts, often with a layer of debris (conifer needles, sticks, lichens, etc.) that has fallen onto the nest. The vole nest material is often in various stages of decomposition, and can become difficult to identify in very old nests.

3. **"Status Undetermined"** (noted as **UND** for data management purposes)
   A confirmed red tree vole nest where the occupancy status was not determined. For example, a nest with orange, brown, or tan resin ducts on the ground under the nest cannot be assumed to have an "inactive" occupancy status. The tree should be climbed and nest examined to determine occupancy status. If the nest is not examined by a climber, then the activity status is undetermined. (Nests classified as red tree vole, "status undetermined", are to be managed as if they are "active"). It is important to note that tree climbers will be able to document if a nest is red tree vole or not, and the occupancy status of red tree vole nests. If the tree climbers are not able to make this identification, then they should take samples of the suspected tree vole nest material to the qualified surveyor (as defined on page 25) for proper determination.

Table 1: Nest Categorization Codes and Characteristics

NEST TREE TYPE	CODE	FECAL PELLETS	CUTTINGS	RESIN DUCTS	OTHER
1. Confirmed RTV	–	On top of or inside nests, or on limbs below nest	Douglas fir, grand fir, western hemlock, Sitka spruce cuttings on top of nest or protruding from an entrance tunnel; typically 5-20 cm long and 2-3 mm thick. Some will be debarked, look like little pieces of toothpicks. Ends are often "chisel-cut", cut at an angle.	Clumps incorporated into nest; may be seen on the edge of the nest, on the ground, trunk, or limbs below the nest	Arboreal nests confirmed as belonging to red tree vole. Activity status of the nest is either "Active" (and further defined as animal observed, likely or very recently occupied, or moderately recently occupied), "Inactive", or Status Undetermined.
a. RTV Active	–	–	–	–	Arboreal nests confirmed as red tree vole with recent red tree vole activity
i. Animal Observed	AC AO	–	–	–	RTV is visually seen on or in the nest
ii. Likely or Very Recently Occupied	AC VR	Bright green	Fresh, green, turgid	Green, inside or on top of nest	
iii. Moderately Recently Occupied	AC MR	Pale green to light brown	Somewhat desiccated, needles often fall off when touched	Pale green	
b. RTV Inactive	INA	Dark brown to black	Desiccated or needleless branches	Orange, tan, or brown	Arboreal nests confirmed as red tree vole, but with no sign of recent red tree vole activity
c. RTV Activity Status Undetermined	UND	Dark brown to black on the ground under the nest	Desiccated or needleless branches on the ground under the nest	Orange, tan, or brown on the ground under the nest	Tree has not been climbed, so activity status not assessed.
2. Confirmed non-tree vole nest	–	–	Typically 2-5 times longer than RTV cuttings.	–	Nests are accumulations of twigs, needles, moss and/or lichens. Twigs and sticks comprising nest are longer and thicker. Nests do not contain any sign of RTV described above.
3.Unconfirmed species nest	–	–	–	–	Species using the nest has not been determined, and tree has not been climbed. No sign of vole on the ground below nest; no sign of vole on nest from the ground.

DETERMINATION OF RED TREE VOLE SITES AND HABITAT AREAS

Surveys completed to protocol may result in the identification of a red tree vole site. A site can be a single point representing a single nest tree or a polygon connecting the outer nest trees (all red tree vole or unconfirmed species nest trees within 100 m of one another). The identification of which nest trees to include in a site are incremental and cumulative and can result in a "linked chain" of trees that is ultimately used to define the total number of nest trees in the site and the site perimeter.

Sites can be categorized as "Biological" or "Managed" depending on nest categorization and occupancy. In general, sites with at least one confirmed red tree vole nest are considered "Biological sites" and are broken down into "Active", "Inactive", and "Undetermined Status" sites. "Active" and "Undetermined Status" sites require site management/protection following the Management Recommendations; "Inactive" sites do not. Sites with unconfirmed species nests or where managers assumed red tree vole occupancy are considered "Managed sites"; these sites are to be "Managed as Active Site" as red tree vole presence has not been documented due to incomplete survey efforts. Management Recommendations should be applied at these sites until adequate surveys are completed to determine the species using the nest, and if red tree vole, the activity status. For definitions of red tree vole site types, see Table 2 below, which was modified from the Red Tree Vole Survey Protocol, Version 2.1.

Application of the management recommendations for this species results in the creation of "Habitat Areas," delineated to maintain habitat where red tree voles are known or assumed to occur. These Habitat Areas are designed to protect the physical integrity of the nests from both management activities and natural disturbances such as wind-throw, and to provide a short-term approach to maintaining habitat at red tree vole sites.

For direction on how to delineate and manage sites and Habitat Areas, see the following documents:

1. Management Recommendations for the Oregon Red Tree Vole *Arborimus longicaudus*, Version 2.0 http://www.blm.gov/or/plans/surveyandmanage/files/mr-rtv-v2-2000-09.pdf ,

2. Supplemental Direction for Identification of Non-High Priority Sites for Red Tree Vole Within the "Pilot" Area http://www.blm.gov/or/efoia/fy2003/ib/im-or-2003-062.pdf and

3. Amendments to Survey and Manage Management Recommendations Designed to Facilitate Certain National Fire Plan Activities - Second Group: Red Tree Vole, Certain Mollusks and Amphibians http://www.blm.gov/or/plans/surveyandmanage/files/mr-fire_amendment-rtv-ig-2003-02.pdf .

In addition, there are known site management exemptions and flexibilities that have been identified through settlement agreements associated with Survey and Manage litigation. A listing of those exemptions and flexibilities may be found on the Survey and Manage General Guidance webpage http://www.blm.gov/or/plans/surveyandmanage/guidance.php.

Table 2: Definitions of Red Tree Vole Site Types

Definitions of Red Tree Vole Site Types	
Red Tree Vole Site	A red tree vole site is an individual red tree vole nest tree or a collection of red tree vole nest trees within a local area (all red tree vole nest trees in a stand and adjacent stands that are not isolated from other clumps of red tree vole nest trees by more than 100 m (330 ft)). "Red Tree Vole Site" is the term for the three specific site types described below ("Active" Site, "Inactive" Site, and "Undetermined Status" Site). Red tree vole sites are defined by **any/all** red tree vole nest tree/resin duct locations that are within 100 m of **any other** red tree vole nest tree/resin duct locations.
Biological Site-confirmed red tree vole	
"**Active" Site** Includes nests that are classified as: "Animal Observed" "Likely or Very Recently Occupied" "Moderately Recently Occupied"	A location with **one or more** confirmed occupied red tree vole nests. These sites are known sites as defined on page 76 of the 2001 Survey and Manage Record of Decision and Standards and Guidelines: http://www.blm.gov/or/plans/surveyandmanage/files/12-2001_record_decision.pdf 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/resin duct location or "unconfirmed species" nest that is considered to be part of the site.
"**Inactive" Site**	A location where **all** nests that are located within 100 m of any other nest are determined to be "inactive" red tree vole nests. (These sites could also include nests confirmed to other species, but those nests would not be used in determining the area of the site). These types of sites indicate historic red tree vole use at the site, not current use, and they do not require site management/protection.
"Undetermined Status" 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 occupied 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 100m of at least one other nest/resin duct location that is considered to be part of the site.
Managed Site	
Managed as "Active" Site "Unconfirmed species nests" "portions of stands assumed occupied by red tree voles"	Sites where the species using the nest has not been determined are assumed to be occupied for management purposes. Tree climbing did not occur and therefore the site is assumed to be currently occupied by red tree voles; 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.

SURVEY METHODOLOGY

The main objective of this survey protocol is to provide a consistent, standardized approach for locating the nests of red tree voles and assessing the occupancy status of those nests. Tree voles cannot adequately be surveyed using conventional small mammal trapping techniques (Swingle et al. 2004). Data from radio-marked tree voles has indicated that ground-based tree vole surveys alone documented around half of the occupied nests in a stand, regardless of forest age (Swingle and Forsman 2009). Detecting 100% of the nests within a stand is not possible, because some nests would be missed even if tree climbers inspected every tree within the stand, which is impractical.

This red tree vole protocol utilizes a sampling methodology in which surveyors walk through management units and visually search trees for vole nests. Trees with nests discovered from the ground are then climbed to determine if the nest is a tree vole nest, and if so, the occupancy or activity status of that nest. (The terms, "occupancy" and "activity" are used interchangeably). The goal of this protocol is to assess presence or absence of red tree vole nests within the survey area and determine the occupancy status of those nests, not to discover every nest. The protocol requires the survey of large areas within each project area, and because many vole nests are visible from the ground, the protocol should result in few situations where vole nests are present but are completely undetected by the ground-based surveys.

Because red tree vole nests may occur in low numbers and in a clumped distribution at landscape and stand level scales, surveys need to cover a large percentage of the habitat to be disturbed to ensure detection of nests. Vole nests are an indicator of a possible population and are used to identify the red tree vole site. The actual survey methodology used will depend upon the type of project. Surveyors may use either **Modified Line Transects (MLT), Individual Tree Examination (ITE)**, **Additional Survey Guidelines for Stands with Large Trees (SLT)** or a **combination** of methods depending on the scale and type of project under consideration.

The techniques included in this protocol emphasize approaches for locating potential vole nests from the ground and assessing their occupancy status through tree-climbing. It may be possible to determine occupancy status through ground-based surveys, if resin ducts are visible on the nest or fresh cuttings or resin ducts are located beneath the nest tree. However, in many cases tree climbing will be needed to determine the occupancy status. When tree climbing is conducted, all applicable Occupational Safety and Health Administration (OSHA) and agency standards must be followed (Davis 2005). Tree climbing information, Job Hazard Analysis examples, and certification are provided by the Forest Service's National Tree Climbing Program which annually hosts a workshop at the Dorena Genetic Resource Center, Cottage Grove, Oregon (see http://www.fs.fed.us/treeclimbing/).

The ground-based observer should take advantage of steep slope positions (even if outside the project area) to look into tree crowns. Surveys can be conducted during all seasons of the year but should be planned to achieve the best visibility conditions within the project area. Conditions such as snow, rain, fog, or hardwood leaves may reduce visibility in some situations.

Modified Line Transect (MLT) Survey Method

This method is appropriate for surveys that encompass stand level projects such as timber harvest. Unlike strip surveys, line transect methods do not assume 100% detection but use a detection function approach (Ramsey et al. 1987, Beavers and Ramsey 1998) to estimate detection probabilities and effective sampling area. The modified line transect method used in this protocol relies on estimated effective sampling width or sampling areas based on a sample set of transects to estimate the area sampled. Modified line transect survey results indicate that the average effective transect width ranges from 13 m in pole-sized stands to 26 m in old forest on each side of the transect line (Biswell unpubl. data). For purposes of standardizing this protocol, the effective strip width is considered to be 15 m on each side of the transect.

This protocol requires a minimum of 90 m (approximately 300 feet) of transect line per acre of survey area to be searched. Assuming an effective total survey strip width of 30 m, 90 m of transect line per acre will cover approximately 70% of the survey area on average. In general, this coverage can be achieved by placing transect lines parallel to one another, approximately 42.7 m (approximately 140 feet, range 130–150 feet) apart. This length and width of transect should provide a good assessment of the presence or absence of voles within the stand. In addition, it is recommended that transects be placed perpendicular to the slope or whatever the prevailing aspect is (use the topography to determine the best way of viewing potential nests). Transects following the slope contour are acceptable, as long as the transects follow a distinct compass bearing, and maintain consistent spacing between adjacent transects. Transects can be placed closer than 130 feet apart, based on stand specifics, or a desire for greater coverage. For a more detailed assessment showing how the transect separation was calculated and an example on how to lay out transects see Appendix I.

Once transects have been established, conduct the ground surveys by:

1. Using a predetermined starting point, slowly walk along the straight-line transect using a pre-determined compass bearing.

2. While walking along the transect, visually search the tree canopy for likely nest structures on both sides of the transect line. Look for typical signs of red tree vole nests.

3. If nest structures are observed, follow the protocol methods described below under "When Potential Nest Structures are Observed During Surveys."

4. Complete walking and visually searching all transects within the stand.

Individual Tree Examination (ITE) Survey Method

This method is used in situations where searching individual trees in a project area would be more efficient than surveying with the modified line transect method, typically in areas where the habitat-disturbing activity is fairly localized. When using this method, all potential nest trees in the project area should be surveyed regardless of size. A visual search of the live crown of all trees should be conducted from several viewpoints using binoculars. The project area can be defined as the area within one tree height of the actual potential habitat disturbance. If nest structures are observed, follow the protocol methods described below under "When Potential Nest Structures are Observed During Surveys."

Additional Survey Guidelines for Stands with Large Trees (SLT)

Some stands meeting the habitat descriptions described in "Criteria for Determining the need for Pre-Disturbance Surveys" have conditions that make it difficult to detect vole nests from the ground. For purposes of this protocol, these are defined as stands, or portions of a stand, greater than 2 acres in size, with 2 or more trees ≥ 36" dbh per acre, with a well-established understory or midstory that makes it difficult to fully see into the larger trees, such that MLT surveys are likely not effective in determining whether red tree voles are present in the stand.

For these types of stands:

1. Since visibility into the tree canopy from the ground is very poor, ground surveys may be skipped in the portions of the stand with these conditions, and sampled by climbing larger trees instead.

OR

2. If modified line transect or individual tree examination surveys have been conducted and no red tree vole nests were detected in the stand and based on professional judgment it is suspected that due to the habitat quality and/or visibility concerns red tree vole nests could have been missed, tree climbing should be considered to more fully evaluate whether voles are present. Only the portion of the stand that has these conditions would need to be sampled.

In both of these situations, consider the following:

1. On average sample at least two of the trees ≥36" dbh per 10 acres in the stand with the stand conditions as described above. Climb trees as near to the top as safety allows, searching for vole nests in cavities, dwarf mistletoe brooms, and on limbs in the tree crown. Only the portion of the stand that has the conditions described above would be sampled by climbing.

2. Sampled trees should include trees with large limbs with complex structure, cavities, broken tops, forked trunks, dwarf mistletoe brooms, epicormic branches, or other features that provide stable nest foundations. Trees selected for climbing are at the discretion of the biologist and the climber, but if possible should be well-distributed throughout the area being sampled. Also, consider selecting trees to climb that provide vantage points for viewing into nearby conifer crowns and viewing a range of canopy layers within the stand.

3. If no red tree vole nests are documented through the sampling, then red tree vole surveys to the stand (or portion of the stand) are considered complete.

4. If "inactive" red tree vole nests are documented through sampling, additional sampling should be conducted to determine if the stand is occupied. If an "active" red tree vole nest is documented through sampling, then for management purposes, surveys may be stopped for that particular 10 acres, and the site managed as an "active" red tree vole site. However, additional climbing should be considered to help determine the extent of the red tree vole site. In both situations, if additional sampling is conducted consider the following:

    a. Climb additional (2) large trees within the stand (or portion of the stand) within 100 m of the nest.

b. If additional red tree vole nest trees are found during this sampling, consider additional (2) sampling radiating out 100 m from those nest trees.
c. Continue with this sampling approach until:
    i. no more red tree vole nests are found.
    ii. the search radius has taken the surveyor out of the stand where the attributes that make visibility difficult exist. In these cases, surveyors may return to a ground-based assessment (MLT or ITE surveys) for additional nest structures and not use the sampling methodology presented here. If nest structures are observed using ground-based surveys, follow the protocol methods described below under "When Potential Nest Structures are Observed During Surveys".

5. Should tree climbing not be an option, line officers have the discretion to consider those portions of the stand meeting the above criteria as occupied by red tree vole, and to manage as an "active" red tree vole site.

When Potential Nest Structures are Observed During Surveys

1. When potential nest structures are located, assess the nest from the ground at various vantage points. Use the information presented in the "Nest Categorization" section above to help determine the species using the nest, and if red tree vole, the activity status of the nest. Search under the tree for nest material, particularly resin ducts. If cuttings located on the ground are the only characteristic used as a determinant for nest status, ensure that the cuttings are truly from a vole and not a sprig blown from a tree. If conducting MLT surveys, mark the location where you leave your transect with flagging or some other visible marker, so you can return to the spot along the transect where you stopped your surveys. Conduct an assessment of the nest from the ground:

    a. If 1) no resin ducts, cuttings, or fecal pellets are observed either on the ground or on the nest, 2) the interior or top of the nest can clearly be seen, and 3) the nest is old, well below the live crown, and is falling apart, then the nest can be classified as **Confirmed non-tree vole nest**. Red tree voles are known to build nests inside unoccupied nests of other species, so a determination from the ground that a nest is not red tree vole is very difficult. Document your findings on your data form and if conducting MLT surveys, return to the transect to continue surveying.
    b. If green resin ducts or fresh green cuttings are found below the tree or seen on the nest, then the nest is considered a confirmed red tree vole nest, with occupancy status as: 1) **likely or very recently occupied** (**AC VR**) if the ducts or cuttings are fresh and bright green or 2) **moderately recently occupied** (**AC MR**) if the resin ducts or cuttings are green but starting to fade.
    c. If older resin ducts or cuttings are found below the tree or seen on the nest, the nest is considered a confirmed red tree vole nest, and is classified as **status undetermined** (**UND**) since the occupancy status is still unknown and fresher material may be present in the nest.
    d. If no resin ducts or cuttings are found below the tree or seen on the nest, and you cannot conclude that the nest is not red tree vole, then the nest is considered an **unconfirmed species nest** until climbing surveys are conducted.

2. Flag or tag all trees that contain a confirmed or possible red tree vole nest (items b, c, and d above). The flag or tag for an individual tree should be labeled with the date, surveyor initials, tree number, and nest categorization, such as 2011-03-04-JSH-1-AC VR. On the Red Tree Vole Transect Survey Form

(Form #2) include a description that would help in re-locating the tree. Record the nest tree location using a GPS (NAD83 datum), and if conducting MLT surveys, the distance along transect, compass bearing off of transect, and distance off of transect. Also record tree species, tree diameter at breast height (dbh), and any notes that may help relocate the tree or nest such as approximate nest height, nest support, and number of nests.

3. For flagged trees with nests that were **unconfirmed species nests** or confirmed to red tree vole but activity **status undetermined** (**UND**), climb the trees to determine species using the nest, and if red tree vole, the activity status of the nest. After nests have been examined by tree climbers, the data and results should also be written on the tree tag. Potential results include: **confirmed not red tree vole**, **animal observed (AC AO)**, **likely or very recently occupied** (**AC VR**), **moderately recently occupied** (**AC MR**), or **inactive (INA)**. If tree climbing is not an option, for management purposes these trees should be considered "active" red tree vole nests. However, it is strongly encouraged that this be done only as a last resort, because correct assessment of species use and activity status will be essential for future annual species reviews, survey protocol updates, and modifications to management recommendations.

4. For flagged trees with nests that were identified as **moderately recently occupied** (**AC MR**), tree climbing is not required, but may be considered, as it would determine if the activity status of the nest is more recent. As above, if the tree is climbed, the data and results should also be written on the tree tag. Tree climbing is also not required for those trees identified from the ground as **likely or very recently occupied** (**AC VR**).

5. For any tree climbed, if a red tree vole is seen in or on the nest, that nest would be identified as a confirmed red tree vole nest, with occupancy status as **animal observed** (**AC AO**).

6. Consider photo documenting the nest for any tree climbed.

7. For trees with confirmed red tree vole nests (**AC AO**, **AC VR**, **AC MR**, **UND, INA**) or **unconfirmed species nests**, surveys should be conducted within a 100 m radius to determine the extent of the red tree vole site.

    a. For nests found during MLT surveys, the transect surveys may be adequate to document additional nests within the 100 m radius. If the surveyor determines that, based on professional judgment, the MLT surveys likely do not provide an adequate determination of site size, the area between the transects can be walked and viewed for additional red tree vole nests, or the approach under ITE surveys (b., below) can be followed.
    b. For nests found during ITE surveys, the 100 m search can include a walk through the stand, looking into the canopy for additional nests. If additional red tree vole or unconfirmed species nests are found through these searches, additional searches out another 100 m could be completed to help fully determine the size of the red tree vole site. Continue this until no red tree vole nests are found, or a management decision is made that additional surveys are not necessary based on project size and/or red tree vole management recommendation applications.

Survey Longevity

At the survey polygon scale, survey results which locate "active" red tree vole nests are considered valid for 10 years. Survey results where only "inactive" or no red tree vole nests were located will be considered valid for 5 years.

Surveyor Skills and Training

This protocol is designed for biologists who will be analyzing red tree vole habitat and survey results and overseeing field personnel or contractors executing red tree vole surveys on public lands managed by the BLM and Forest Service. Professional judgment is involved in analyzing habitat, conducting surveys, and interpreting red tree vole survey results. Knowledge of the biology and ecology of red tree voles and habitats will be essential for a reliable survey.

The minimum requirements for the biologist involved in supervision and interpretation of survey results are:

1. A bachelor's degree in wildlife biology or related field and/or qualification as a GS-486-9, and

2. A thorough understanding of all aspects of this protocol and a thorough understanding of the ecology and nest attributes of tree voles and nests of other arboreal species.

Field surveyors should:

1. Be familiar with techniques involved in project layout and establishing transect lines, and identification and interpretation of evidence of tree vole presence, including differentiation of their nests from those of other species and the ability to clearly describe nest characteristics on data sheets, and

2. Be trained by biologists who are knowledgeable about tree vole biology, sign, surveys, and interpretation of survey results.

Data Management and Data Entry

Data forms are provided in Appendix II for the BLM and Appendix III for the Forest Service. Field units should maintain hard copies of survey plans, data forms, maps, and aerial photos used during the survey for the project record. BLM and Forest Service field units will electronically enter the data into the Geographic Biotic Observations (GeoBOB) and National Resource Information System (NRIS) Wildlife database, respectively.

Tree vole survey data are collected and recorded in a nested design with two data forms. The first data form documents the area surveyed. The second form is used to document the transect surveys, potential nest trees found during ground-based surveys, and the tree climbing results.

Records should show the location, occupancy status, and species determination of all nests observed at each survey area. Surveys where no red tree vole nests are found (negative surveys) are just as

important as positive surveys for assessing the status and distribution of red tree voles. Negative survey data are required to be entered into the appropriate agency database.

Red tree vole nests discovered incidentally are considered a known site (depending upon nest occupancy status) and will be entered into the GeoBOB or NRIS Wildlife database.

Protocol Modifications

The protocol was designed to ensure a high probability of finding at least some red tree vole nests in stands if red tree voles are present, and to provide consistency among management units in conducting surveys. But there may be site specific conditions that warrant some modification of the protocol. Biologists can make decisions concerning modifications of the protocol based on their professional judgment and sound biological reasoning. Where there is any deviation from the protocol, biologists must document the specific changes and the rationale for those changes and alert their line officers when changes or deviations from the protocol are made. In addition, the data sets collected using the modifications should be clearly identified.

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Appendix I
How Line Transect Spacing was Calculated for Line Transect Surveys

This documents how approximate spacing (130-150 feet) between line transects for red tree vole surveys was calculated. **The example provided below (except where noted) delineates transects parallel to each other throughout the survey area and parallel to the longest dimension of the rectangle because it results in the fewest number of transects.** Transects could also be delineated to be parallel to the shortest dimension of the rectangle but would result in a greater number of transects. Other methods that achieve a minimum transect length of 300 feet per acre of survey area and spacing of approximately 140 feet apart are acceptable but may be more difficult to delineate and achieve in the field. For survey areas that have more than one general topography, the survey area could be divided into two or more rectangles before applying the process described below.

1) Draw a rectangle (or square) around the project unit large enough to enclose the project area that will be habitat-disturbing for red tree voles (i.e., the survey area) with one side of the figure parallel to the desired direction the transects will run.

In figure 3: Rectangle is 1120 feet wide and 1310 long.

2) Measure each side of the rectangle and calculate its area in square feet (length feet x width feet = feet^2).

In figure 3: (1120 feet wide) x (1310 feet long) = 1,467,200 feet^2

3) Divide the resulting area in Step 2 by 43,560 feet^2 (1 acre) to calculate the total acres of the survey rectangle.

In figure 3: (1,467,200 feet^2) / (43,560 feet^2) = 33.7 acres

4) Multiply these acres by 300 feet to get the number of transect footage needed for the rectangle.

In figure 3: (33.7 acres) x (300 feet) = 10,110 feet of transect (minimum)

5) Divide the total transect footage by the length of the side of the rectangle which is parallel to the direction the transects will run. This result will be the approximate number of transect lines needed for the area within the project area. Round up to the next highest whole number to get the final minimum number of transects.

In figure 3: (10,110 feet of transect) / (1310 feet) = 7.7 transect lines. Round 7.7 up to a final answer of 8.0 transect lines needed for survey.

6) Divide the length of the other side of the rectangle that is perpendicular to the direction the transect lines will run by the number of transect lines calculated in step 5 to arrive at the approximate spacing

between transect lines. Note: Use of the sample methods described in this Appendix will result in a transect spacing value of roughly 130-150 feet (if not, this sample method was not correctly implemented). Other methods of delineating transects that result in slightly different spacing between transects are also acceptable as long as they meet the three requirements of **(a)** 90 meters/300 feet of transect per acre; **(b)** transects well distributed in the survey area; and **(c)** transects far enough apart so their effective visual width does not overlap (a minimum of 15 meters/49 feet from the transect; therefore at least 30 meters / 98 feet between two transects).

In figure 3: (1120 feet) / (8 transect lines) = 140 feet of spacing between transects (approximate).

7) The total length of transects needed to survey a survey area can be divided into varying length segments and distributed throughout the stand (with the spacing guidelines calculated in Step 6) to accommodate stands of various shapes and sizes, and different topology.

8) Recommended to delineate transects across (perpendicular to) any environmental gradients (topography) where possible.

In figure 3: Transects are run roughly perpendicular to the topography lines

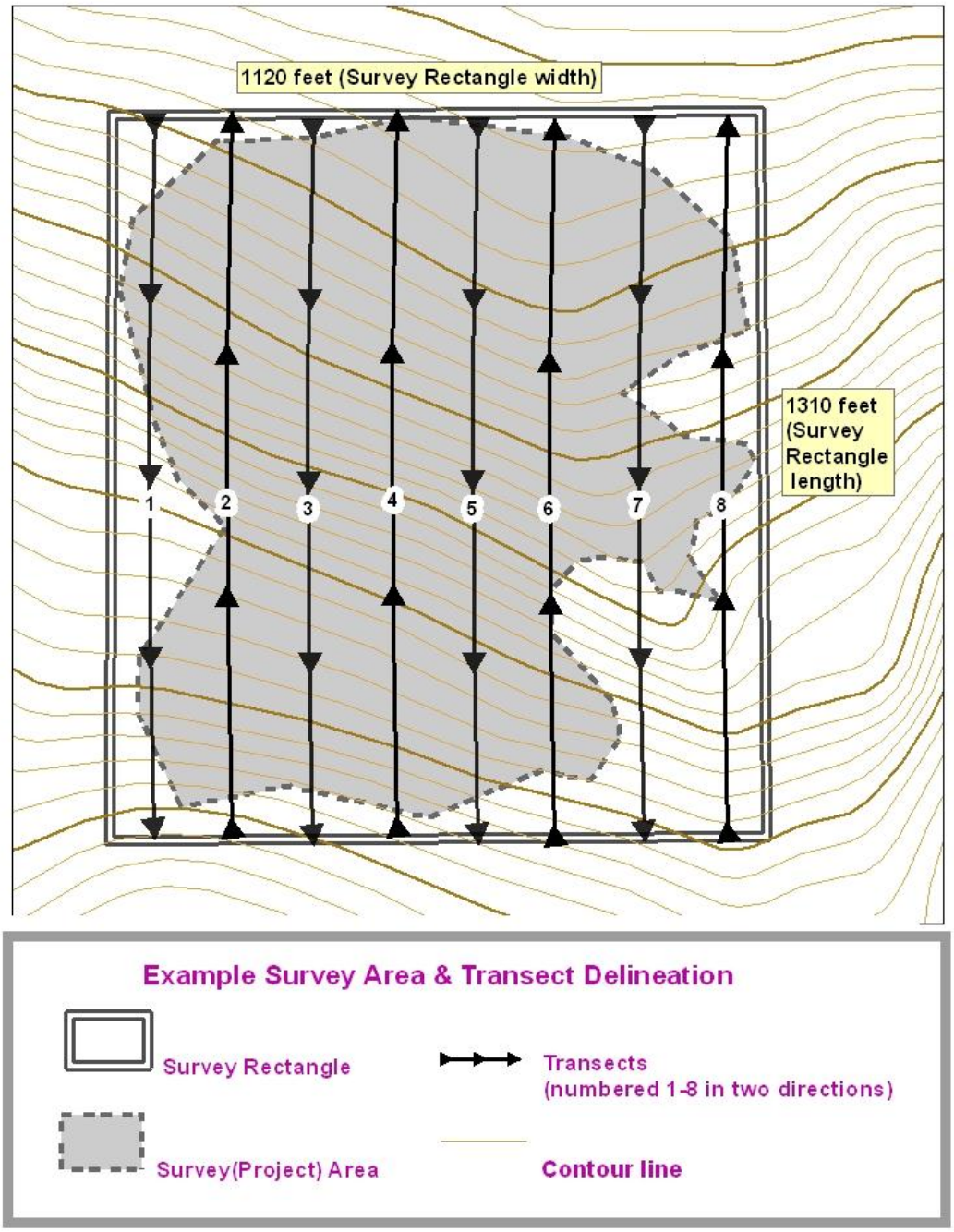
9) Delineate the first transect inside the survey area at a location approximately **one half** of the distance for between-transect spacing calculated in Step 6. Then space subsequent transects at approximately the between-transect spacing distance calculated in Step 6. As with the first transect, the last transect will be approximately **one half** of the distance for between-transect spacing from the edge of the survey area. See notes on Figure 3.

In figure 3: The between-transect spacing is 140 feet. Transect # 1 is begun approximately 70 feet from the west edge of the survey area (one half of the transect spacing distance of 140 feet). Subsequent transects are spaced approximately 140 feet apart. The last transect, #8, is approximately 70 feet from the east edge of the survey area.

10) To confirm calculations and that the transect layout effectively cover 300 feet of transect length per acre, delineate the transect lines on a project map and measure the total linear feet of transect lines within the area. It may be necessary (but unlikely) that the number of transect lines will need to be adjusted to achieve at least 300 feet of transect per acre of survey area.

Figure 3: Example Transect Layout

NOTE: In the map, transect lines are parallel to the survey rectangle length edge. Transects are approximately equally spaced 140 feet apart. Transects 1 and 8 are approximately 70 feet from the survey rectangle length edge/survey area edge. Initial surveys (not including any subsequent 100 meter searches) would only be required within the grey area (survey-project area).



APPENDIX II
Red Tree Vole Field Forms for Use by BLM in the Geographic Biotic Observations (GeoBOB) Database

Two types of red tree vole field forms are provided for BLM use. This appendix contains instructions on how to fill out the field forms.

1. **Red Tree Vole – BLM GeoBOB Survey Form #1:** This form is used to record the area surveyed and visits. Each survey area must have a survey form completed even if no voles are located (i.e., document negative surveys). The form contains general information about the survey polygon and visits.

2. **Red Tree Vole – BLM GeoBOB Transect and Nest Tree Survey Form #2:** This form is used to track ground observations of nests and other objects detected along each transect as well as the tree climbing results. Confirmed red tree vole nests are recorded here as well as nests confirmed to other species (only vole data are required to be entered into GeoBOB, but it does not preclude you from entering other species data).

Data fields that are required in GeoBOB are **bold** on the field form and in these instructions. Additional data fields that are required by this survey protocol to be collected and entered into GeoBOB have an asterisk (*). Data fields that are required by this survey protocol, but have no specific field in the database have a plus sign ($^{+}$). Instructions are provided on where to enter these data. There are additional data fields on these forms that are generally used while conducting surveys, but are not required in the database. A GeoBOB RTV Data Entry Guide is available with screenshots and instructions specific for GeoBOB RTV data entry.

It is recommended that digital maps be printed and attached to the hardcopy field forms. Also scan the final field forms and attach to the GeoBOB record.

Red Tree Vole – BLM GeoBOB Survey Form #1

This form is used to record the area surveyed and visits. Each area surveyed must have a survey form completed even if no voles are located (i.e., document negative surveys). This form may be used to record multiple units (i.e., survey polgyons) in a single BLM project area. For example, a fuels treatment project in the Wildcat Creek watershed may be called Wildcat and have 10 separate units, which are essentially discrete survey polygons. This one form would be used to record visits to the 10 separate units. The project units are considered "Survey" polygon records in GeoBOB. The "Visits" in GeoBOB are non-spatial, tabular records.

Surveys & Visits

Survey ID: User defined identification for the survey unit (unique for all surveys within the administrative unit). This field can be pre-filled by computer before printing the form to use in the field. Everyone should begin survey ID with "RTV— ."

Admin Unit*: The BLM District on which the survey area is located. This field can be pre-filled by computer before printing the form to use in the field.

Sub Admin Unit*: The BLM District Resource Area on which the survey area is located. This field can be pre-filled by computer before printing the form to use in the field.

Location Accuracy: Describes the precision with which the recorded UTMs or lat/longs and the associated GIS digitized (electronic) point or polygon matches the actual ground site location. It is expected that a GPS unit will be used to record the survey polygon boundary. The full list of Location Accuracy values in GeoBOB are:

- GENERATED - Generated by GeoBOB application. No map accuracy
- GPS1 - GPS unit used; precision within 3 feet or less
- GPS2 - GPS unit used; precision within 30 feet or less
- GPS3 - GPS unit used; precision within 300 feet or less
- MAN1 - Mapped to within 150 feet of actual location
- MAN2 - Mapped to within 300 feet of actual location
- MAN3 - Mapped to within 1/8 mile of actual location
- MAN4 - Mapped to within 1/4 mile of actual location
- MAN5 - Mapped to within 1/2 mile of actual location
- MAN6 - Precision of mapped location cannot be determined
- TR10 - Legal description to the 1/64 section (within 10 acres)
- TR160 - Legal description to the 1/4 section (within 160 acres)
- TR320 - Legal description to the 1/2 section (within 320 acres)
- TR40 - Legal description to the 1/16 section (within 40 acres)
- TR640 - Legal description to the section (within 640 acres)
- VAGUE - Observation documented in vague descriptions

Project Name*: Project name that the survey is related to or was part of. This field can be pre-filled by computer before printing the form to use in the field.

Survey Type: The reason for doing the survey. Pre-filled with *Project Clearance*. The full list of Survey Types in GeoBOB are:

- Follow-up - A visit done to confirm a species report
- Incidental - Observation made while surveying for another species
- Inventory - List of species recorded in a survey
- Monitoring - Planned & repeated visits to existing observations/sites
- Project Clearance - Surveys done prior to project implementation
- Purposive - Surveys done in areas where the species is expected to occur
- Research - Done for research purposes only

Survey Method: The method used to complete the survey. Check one of the four methods described in this protocol.

- ITE - Individual Tree Exam
- MLT- Modified Line Transect
- SLT – Stands with Large Tree Survey

- Combo MLT/SLT – Combination of Modified Line Transect and Stands with Large Trees

Protocol Name*: The name of the protocol used to complete the survey. Pre-filled with *Survey Protocol for the RTV, v3.0*.

Survey Notes: Text field for recording comments about the survey area, which may include a description of survey, location, management notes, general information, etc. It is not required to take notes, but if any are recorded, then enter them into GeoBOB.

Unit Visit Summary

Project Unit*: Unit name or number within a project.

Start Date: Day, month, and year (DD/MM/YYYY) that the visit started.

End Date: Day, month, and year (DD/MM/YYYY) that the visit ended.

Observer 1: Primary surveyor for this survey. Write out the first and last name.

Observer 2: Secondary surveyor(s) for this survey. Write out the first and last name(s).

Total Area in Unit: The total area in the unit measured in acres (record unit of measurement if other than acres used). This is the number used to calculate the transect length as shown in Appendix 1 of this protocol. Show on the field form, but no need to enter into GeoBOB.

Total Transect Length: Total length of survey (feet) if the modified line transect survey method is used. Transect length is calculated from the steps outlined in Appendix 1 of this protocol. Show on the field form, but no need to enter into GeoBOB.

RTV Presence (Y/N/X)*: Record Y for yes or N for no depending on whether or not red tree voles were found in the project unit. Record X only if no red tree voles were found, but there is one or more sites in the project unit that have "assumed occupancy" meaning the species is "unconfirmed" and there are sites being managed as active red tree voles sites.

Visit Notes: Text field for recording comments about the survey area, which may include a description of survey, location, management notes, general information, etc. It is not required to take notes, but if any are recorded, then enter them into GeoBOB.

Red Tree Vole – BLM GeoBOB Transect and Nest Tree Survey Form #2

This form is used to track ground surveys conducted along transects and the subsequent tree climbing results. The form is designed to be used as one per project unit. Some data fields on this form are used while conducting surveys and are especially helpful to the tree climbers and project inspectors in relocating trees, but the data fields are not required in the database. Data fields that are required in GeoBOB are **bold** on the field form and in these instructions. Additional data fields that are required by this survey protocol to be collected and entered into GeoBOB have

an asterisk (*). Data fields that are required by this survey protocol, but have no specific field in the database have a plus sign ($^{+}$). Instructions are provided on where to enter these data. There are additional data fields on these forms that are generally used while conducting surveys, but are not required to be entered into the database. A separate document for BLM's GeoBOB database, the RTV Data Entry Guide, provides instructions for how to enter actual red tree vole animals as "observation" points, red tree vole nests/trees as "feature points" including how to handle situations where the RTV activity status is "undetermined," and points that are being managed as "active" red tree vole sites but where no red tree vole evidence was confirmed (i.e., "unconfirmed" species) as "assumed occupancy" feature points.

There will be cases where fresh green resin ducts are found on the ground and thus the tree not climbed and the nest examined. Clearly print in the Notes field when this occurs and what the red tree vole evidence was.

At other times, a nest may be spotted in a tree, but the tree not climbed. If confirmation to species cannot be determined from the ground and tree climbing is not considered a viable option, then this is called "unconfirmed" to species and for management purposes the nest is categorized as an "active" red tree vole nest and is managed as a red tree vole site. On the field form clearly indicate this type of point record by filling out the "Climbed Y/N" as No, "Unconfirmed Species Nest Y/N" as Yes, and "Feature Status" as "Assumed Occupancy." This record will be entered into GeoBOB as an assumed occupied feature point (see RTV Data Entry Guide for data entry instructions).

General Information

Admin Unit/Sub Admin Unit: The name of the BLM District and Resource Area. This field can be pre-filled by computer before printing the form to use in the field.

Project Name*: Project name that the survey is related to or was part of. This field can be pre-filled by computer before printing the form to use in the field.

Project Unit*: Unit name or number within a project.

Date: Day, month, and year (DD/MM/YYYY) that the survey visit started.

Transect Bearing: Direction of transect in degrees.

Ground **Observers**: Person(s) responsible for survey observations. Write out the first and last name.

Climber **Observers**: Name of the person(s) who climbed the nest tree. Write out the first and last name.

Ground Surveys

Transect # or SLT or ITE: The transect line this record is associated with. Or if it is a Stand with Large Trees (SLT) being sampled as per the protocol, then write SLT. If it an Individual Tree Exam (ITE), then write ITE.

Unique Feature ID/Tree ID: Unique user-defined code for each nest tree found during a project. The code cannot be repeated within a project. It will be entered into GeoBOB as the Feature ID.

Feature Type: A prominent or distinguishing characteristic of a species Observation that is being or may be used by the species of interest. Pre-filled with *Tree*.

Feature Species/Tree Code*: The species code of the feature, in this case the feature is the tree. The tree species code is unique and based on the species scientific name with the first two letters of the genus and the first two letters of the species plus a tie-breaking number. Use the codes provided by the USDA PLANTS database (http://plants.usda.gov).

Tree DBH*: The nest tree diameter-at-breast-height (inches).

Nest Height: The nest's height above ground (feet). If more than one nest, record the height of the largest, freshest nest.

Nests: The number of nests observed in the tree from the ground. Write "NNV" for no nests visible if RTV evidence such as resin ducts were found on the ground at the base of a tree.

Distance along Transect: Enter the distance (in feet) perpendicular to detected nest tree.

Azimuth off of Transect: Enter the direction (degrees) the detected nest is located from the transect.

Distance off of Transect: Enter the distance or estimated distance to the detected nest tree (in feet) from the transect line.

Location Accuracy: Check the appropriate box for whether the GPS precision is within 3 feet or less, 30 feet or less, or 300 feet or less.

UTM Easting: Universal Transverse Mercator (UTM) Easting (Zone 10 - NAD 83) coordinate of the nest tree (6 digits).

UTM Northing: Universal Transverse Mercator (UTM) Northing (Zone 10 - NAD 83) coordinate of the nest tree (7 digits).

Climbing Surveys

Climbed (Y/N)$^{+}$: Was the nest tree climbed? Yes or No.

Date Climbed: Day, month, and year (DD/MM/YYYY) that the survey started.

General Results

Confirmed to other Species (Y/N): Was the nest confirmed to be that of another arboreal species? Yes or No.

Unconfirmed Species Nest (Y/N): Is this a nest where the species is unconfirmed? Yes or No.

Feature Use (RTV Nest Y/N): A description of how the feature is being or could be used. For our specific purposes, record in this data field if this is a red tree vole nest. Yes or No. A new GeoBOB feature use has been added, "RTV nest." This is the only place in the GeoBOB Features table where it is recorded that this is record is for red tree vole. Feature Use in combination with Feature Status, both mandatory fields in GeoBOB, will be used together to query red tree vole records and their activity and/or management status (see Feature Status).

Feature Status: A description of the feature occupancy status. Only the following Feature Status list of values will be used for red tree vole data. The additional meaning for red tree vole data is shown as italicized text.

- Assumed occupancy - It is assumed that the feature is occupied. *If confirmation of red tree vole occupancy cannot be determined from the ground and tree climbing is not considered a viable option, then for management purposes the nest is categorized as an "active" with "assumed occupancy" red tree vole nest and is managed as a red tree vole site.*
- In use - Feature is being used. *A nest tree where red tree vole presence has been confirmed as "active."*
- Not in use - Feature is not being used. *An old vole nest with no sign of recent use. It is "inactive."*

RTV Occupancy Status[+]: If the nest is confirmed to be red tree vole, what is the activity and occupancy status?

- AC AO – Occupied, animal observed, "active". Vole seen—this is a rare event unless the nest is probed or torn apart, which is not recommended unless part of a research project.
- AC VR – Very recently occupied, "active". A red tree vole nest that is apparently occupied or has been used within the very recent past, but that is not disturbed by the tree climber to determine if it is actually occupied. These nests typically have fresh green cuttings piled on top of the nest or protruding from an entrance tunnel on the top or side of the nest. Green resin ducts are usually present inside or on top of the nest. Green cuttings can persist for weeks, maybe months, in a cool moist environment, but cuttings at likely or very recently occupied nests will be very fresh, with turgid needles, and will often form a plug that blocks the entrance to the nest. Fecal pellets are typically bright green.
- AC MR – Moderately recently occupied, "active". A nest that was probably occupied by a vole within the recent past. May contain older resin ducts that have faded to a pale green. If cuttings are present, they are somewhat desiccated and the needles will often fall off the stem when touched.
- INA – "Inactive". An old vole nest with no sign of recent use. Signs include the nest is compacted or falling apart and the fecal pellets are dark brown to black with no green resin ducts or cuttings. Or the nest material is comprised primarily of a composted layer of compressed fecal pellets, tan or brown resin ducts, and small debarked twigs, often with a layer of debris (conifer needles, cones, lichens, etc.) that has fallen onto the nest. The vole nest material is often in various stages of

decomposition, and can become difficult to identify in very old nests.

- UND – Undetermined. A confirmed red tree vole nest where the activity status and thus the occupancy status was not determined. (Nests classified as red tree vole, "status undetermined", are to be managed as if they are "active").

Notes: Text field for recording notes. It is strongly recommended that notes be recorded on the arboreal species, structures and nests (use other species codes and nest support codes). The Notes field is not required in GeoBOB, but if anything is recorded, then enter it into the database because it may be important in the future. The BLM RTV Data Entry Guide has specific instructions for entering the data fields required in the survey protocol for which there is no data field in GeoBOB so that these data can be more easily queried out of GeoBOB in the future.

Other Arboreal Nesting Species

- ARAL – *Arborimus albipes* (White footed vole)
- TADO – *Tamiasciurus douglasii* (Douglas' squirrel)
- GLSA – *Glaucomys sabrinus* (Northern flying squirrel)
- SCGR – *Sciurus griseus* (Western gray squirrel)
- NE – *Neotoma* spp. (Woodrat)

Nest Support

- BW – Branch whorl
- CAV – Tree cavity
- FT – Forked top
- MT – Mistletoe cluster
- PBC – Palmate branch cluster
- SB – Single large branch

Red Tree Vole – BLM GeoBOB Survey Form #1

Bold indicates GeoBOB mandatory data field (circle one, if options shown). Asterisk * and plus sign + indicate mandatory RTV Survey Protocol data fields.

Survey & Visits

Attach Digital Maps

Survey ID: RTV-	Admin. Unit*:	Sub Admin. Unit*:	**Location Accuracy:** GPS1 / GPS2 / GPS3 If other loc accuracy, describe:
Project Name*:	**Survey Type:** Project Clearance	**Survey Method**: ☐Individual Tree Exam (ITE), ☐Modified Line Transect (MLT), ☐Stands with Large Tree Survey (SLT), ☐Combo MLT/SLT	Protocol Name**:** Survey Protocol for the RTV, v3.0
Survey Notes:			

Unit Visit Summary

Project Unit*	**Start Date**	End Date*	**Observer 1 Name**	Observer 2 Name	Total Area in Unit (ac)	Total Transect Length (ft.)	RTV Presence Y/N/X+	Visit Notes

GeoBOB Data Management Record Created By: Date: http://intra.or.blm.gov/geobob/Support/Documentation/default.asp Form dated June 22, 2012

RTV PRESENCE

Y = Yes N = No X = Assumed Occupancy

Red Tree Vole BLM GeoBOB
Transect and Nest Tree Survey Form #2a

Bold indicates GeoBOB mandatory data field. Asterisk * and plus sign + indicate mandatory RTV Survey Protocol data fields.

Admin Unit/Sub Admin Unit*:	Project*:	Project Unit*:	**Visit Date:**
Transect Bearing:	Ground **Observers:**	Climber **Observers:**	

Ground Surveys												**Climbing Surveys**		**General Results**					
Transect # or SLT or ITE	**Unique Feature ID | Tree ID**	**Feature Type**	Feature Species / Tree Code*	Tree DBH* (inches)	Nest Height (feet)	# Nests (NNV=no nests visible)	Distance along Transect (feet)	Azimuth off of Transect	Distance off of Transect (feet)	NAD 83, UTM zone 10 **Location Accuracy** Precision within ☐ 3 ft; ☐ 30 ft; ☐300 ft **UTM Easting** (generated from GPS)	**UTM Northing** (generated from GPS)	Climbed (Y/N)+	Date Climbed	Confirmed to Other Species (Y/N)	Unconfirmed Species Nest (Y/N)	**Feature Use** (RTV Nest Y/N)	**Feature Status**	RTV Occupancy Status+	Notes+ on arboreal species, structures and nests (use other species codes and nest support codes). Enter data in GeoBOB Feature Notes field.
		Tree																	
		Tree																	
		Tree																	
		Tree																	
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		Tree																	
		Tree																	
		Tree																	

FEATURE STATUS:

U – In Use (Active RTV)
NOT – Not in Use (Inactive RTV)
AS OC – Assumed Occupancy (RTV not confirmed, managed as Active RTV feature)

RTV OCCUPANCY STATUS:

AC AO – Animal observed, active
AC VR – Very recently occupied, active
AC MR – Moderately recently occupied, active
INA - Inactive
UND – Undetermined

OTHER ARBOREAL NESTING SPECIES

ARAL – *Arborimus albipes* (White footed vole)
TADO – *Tamiasciurus douglasii* (Douglas' squirrel)
GLSA – *Glaucomys sabrinus* (Northern flying squirrel)
SCQR – *Sciurus griseus* (Western gray squirrel)
NE – *Neotoma* spp. (Woodrat)

NEST SUPPORT:

BW – Branch whorl
CAV – Tree cavity
FT – Forked top
MT – Mistletoe cluster
PBC – Palmate branch cluster
SB – Single large branch

Please ensure all Transect and Nest Tree Survey Forms (form 2) and maps showing transect and tree locations remain attached to the Survey/Visit form (form 1) throughout the field and office processes.

GeoBOB Data Management Record Created By: Date: http://intra.or.blm.gov/geobob/Support/Documentation/default.asp

Red Tree Vole BLM GeoBOB
Transect and Nest Tree Survey Form #2b

Bold indicates GeoBOB mandatory data field. Asterisk * and plus sign + indicate mandatory RTV Survey Protocol data fields.

Admin Unit/Sub Admin Unit*:	Project*:	Project Unit*:	**Visit Date:**
Transect Bearing:	Ground **Observers:**	Climber **Observers:**	

Ground Surveys												**Climbing Surveys**		**General Results**					
Transect # or SLT or ITE	**Unique Feature ID | Tree ID**	**Feature Type**	Feature Species / Tree Code*	Tree DBH*	Nest Height	# Nests	Distance along	Azimuth off of Transect	Distance off of Transect	NAD 83, UTM zone 10 **Location Accuracy** (Recorded from GPS) UTM Easting (generated from GPS)	NAD 83, UTM zone 10 **Location Accuracy** (Recorded from GPS) UTM Northing (generated from GPS)	Climbed (Y/N)	Date Climbed	Confirmed to Other Species (Y/N)	Unconfirmed Species Nest (Y/N)	**Feature Use** (RTV Nest Y/N)	**Feature Status**	RTV Occupancy Status+	Notes+ on arboreal species, structures and nests (use other species codes and nest support codes). Enter data in GeoBOB Feature Notes field.
		Tree																	
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GeoBOB Data Management Record Created By: Date: http://intra.or.blm.gov/geobob/Support/Documentation/default.asp

Form dated August 2, 2012

APPENDIX III
Red Tree Vole Field Forms for Use by Forest Service in the NRIS (National Resource Information System) Wildlife Database

Two types of red tree vole field forms are provided for Forest Service use. This appendix contains instructions on how to fill out the field forms.

3. **Red Tree Vole – USFS NRIS Wildlife Survey Form #1:** This form is used to record the area surveyed and visits. Each survey area must have a survey form completed even if no voles are located (i.e., document negative surveys). The form contains general information about the survey "administrative site" and visits.

4. **Red Tree Vole – USFS Transect and Nest Tree Survey Form #2:** This form is used to track ground observations of nests and other objects detected along each transect as well as the tree climbing results. Confirmed red tree vole nests are recorded here as well as nests confirmed to other species (only vole data are required to be entered into NRIS, but it does not preclude you from entering other species data).

Data fields that are required in NRIS Wildlife are **bold** on the field form and in these instructions. Additional data fields that are <u>required by this survey protocol</u> to be collected and entered into the NRIS Wildlife database, but have no specific field in the database have an asterisk (*). Instructions are provided on where to enter these data. There are additional data fields on these forms that are generally used while conducting surveys, but are not required in the database. An NRIS Wildlife RTV Data Entry Guide is available with screenshots and instructions specific for NRIS Wildlife RTV data entry.

It is recommended that digital maps be printed and attached to the hardcopy field forms. Also scan the final field forms and attach to the NRIS Wildlife record.

Red Tree Vole – USFS NRIS Wildlife Survey Form #1

The first section on the survey form is labeled "Survey" and the second section is "Site & Visit." These labels correspond to the different types of records in the NRIS Wildlife database. In the database, Surveys are non-spatial tabular records. The "Site" in this context is "administrative" rather than biological and refers to the polygon area being surveyed, thus it is essentially the survey area polygon. One Forest Service project may have multiple administrative survey "sites," which we in the Forest Service often refer to as "units." The Visits in NRIS Wildlife are non-spatial, tabular records.

<u>Survey</u>
Forest/District: The name of the National Forest and the District. This field can be pre-filled by computer before printing the form to use in the field.

Survey Name (Project): The name of the survey, which is often referred to as a "project" in the Forest Service. The survey name must be unique by National Forest. This field can be pre-filled by computer before printing the form to use in the field.

Target Species: Target species for this survey. Pre-filled with *Arborimus longicaudus*.

Detected: Circle either the Y for yes or N for no depending on whether or not red tree voles were found in the survey/project area.

Survey Status: Status of the survey.

Data Origin: Was the data collected by the Forest Service, including biologists under contract to the Forest Service, or a Non-Forest Service organization (e.g., State Heritage, BLM, Private Timber Companies, etc)?

- Forest Service
- Non-Forest Service

Start Date: Day, month, and year (DD/MM/YYYY) that the survey started.

End Date: Day, month, and year (DD/MM/YYYY) that the survey ended. In NRIS Wildlife, End Date is required for a "completed survey."

Survey Protocol: The survey protocol followed. Pre-filled with *Survey Protocol for the RTV, v3.0*.

Primary Surveyor: Primary surveyor for this survey. Write out the first and last name.

Quals: The qualifications of the Primary Surveyor.

- EXP – Experienced
- L EXP – Limited experience
- No EXP – No experience
- UNKN – Unknown

Survey Steward: The steward (biologist) for this survey. Write out the first and last name.

Survey Method: The method used to complete the survey. Check one of the four methods described in this protocol.

- ITE - Individual Tree Exam
- MLT- Modified Line Transect
- SLT – Stands with Large Trees
- Combo MLT/SLT – Combination of methods using Modified Line Transect and Stands with Large Trees

Comments: Text field for recording comments about the survey area, which may include a description of survey, location, management notes, general information, etc. It is not a required field, but if any comments are recorded, then enter them into NRIS.

Sites & Visits

Site Category: Category of the site. Pre-filled with *Adminstrative* since this site represents the survey area polygon and is not biologically derived.

Site Type: Type of site, which in this case is the survey area polygon represented by a site/unit or multiple sites/units. Pre-filled with *Sample Area*.

Site Status: Status of the site at the time of the Visit. Pre-filled with *Not Applicable* because this is an administrative site record.

Site Condition: Condition of the site at the time of the Visit. Pre-filled with *Not Applicable* because this is an administrative site record.

Site Name: Unique local name of the site, which in the Forest Service we often refer to as a "unit."

Start Date: Day, month, and year (DD/MM/YYYY) that the site was established or the visit started. In NRIS Wildlife, the start date goes in both the site and the visit record.

End Date: Day, month, and year (DD/MM/YYYY) that the visit ended.

Observer: The name of the person who performed this visit. In the NRIS site record it is called the "originator," but in the NRIS visit record it is called the "visitor." Write out the first and last name.

Quals: The qualifications of the person who makes the Visit. Education and field experience generally define the level.

- EXP – Experienced
- L EXP – Limited experience
- No EXP – No experience
- UNKN – Unknown

Total Area in Unit: The total area in the unit measured in acres (record unit of measurement if other than acres used). This is the number used to calculate the transect length as shown in Appendix 1 of this protocol. Show on the field form, but no need to enter into NRIS.

Total Transect Length: Total length of survey (feet) if the modified line transect survey method is used. Transect length is calculated from the steps outlined in Appendix 1 of this protocol. Show on the field form, but it is not required to enter into NRIS. If Transect Length is entered into NRIS, it goes in the Visits comments field.

Comments: Text field for recording comments about the site or the visit. It is not a required field, but if any comments are recorded, then enter them into NRIS.

Red Tree Vole – USFS Transect and Nest Tree Survey Form #2

This form is used to track ground surveys conducted along transects and the subsequent tree climbing results. Some data fields on this form are used while conducting surveys and are especially helpful to the tree climbers and project inspectors in relocating trees, but the data

fields are not required in the database. Data fields that are required in NRIS Wildlife are **bold** on the field form and in these instructions. Data fields that are required by this survey protocol to be collected and entered into the NRIS Wildlife database, but have no specific field in the database have an asterisk (*). Instructions are provided on where to enter these data. The Data Entry Guide also provides instructions for how to enter actual red tree vole animals as "observation" points, red tree vole nests/trees as "site" points including how to handle situations where the RTV activity status is "undetermined," and points that are being managed as "active" red tree vole sites but where no red tree vole evidence was confirmed as "administrative site" points.

There will be cases where fresh green resin ducts are found on the ground and thus the tree not climbed and the nest examined. Clearly note in the Comments field when this occurs and what the red tree vole evidence was.

At other times, a nest may be spotted in a tree, but the tree not climbed. If confirmation to species cannot be determined from the ground and tree climbing is not considered a viable option, then this is called "unconfirmed" to species and for management purposes the nest is categorized as an "active" red tree vole nest and is managed as a red tree vole site. On the field form clearly indicate this type of point record by filling out the "Climbed Y/N" as No, "Unconfirmed Species Nest Y/N" as Yes, and write in the Comments field "MANAGE AS ACTIVE SITE." This record will be entered into NRIS Wildlife as an administrative site point (see RTV Data Entry Guide for data entry instructions).

General Information

Forest/District: The name of the National Forest and the District. This field can be pre-filled by computer before printing the form to use in the field.

Survey Name (Project): The name of the survey, which is often referred to as a "project" in the Forest Service. The survey name must be unique by National Forest. This field can be pre-filled by computer before printing the form to use in the field.

Site Name (Unit): Unique local name of the site, which in the Forest Service we often refer to as a "unit."

Date: Day, month, and year (DD/MM/YYYY) that the survey started.

Transect Bearing: Direction of transect in degrees.

Ground **Observers**: Person(s) responsible for survey observations. Write out the first and last name.

Climber **Observers**: Name of the person(s) who climbed the nest tree. Write out the first and last name.

Ground Survey Results

Transect # or SLT or ITE: The transect line this record is associated with. Or if it is a Stand with Large Trees (SLT) being sampled as per the protocol, then write SLT. If it an Individual

Tree Exam (ITE), then write ITE.

Unique Tree ID: Unique user-defined code for each nest tree found during a Survey. The code cannot be repeated within a Survey. This data will be entered into NRIS Wildlife Site form in the Local ID field.

Tree Species Code*: Unique code based on the species scientific name with the first two letters of the genus and the first two letters of the species plus a tie-breaking number. Use the codes provided by the USDA PLANTS database (http://plants.usda.gov). This data will be entered into the biological site comments field (see RTV Data Entry Guide for data entry instructions).

DBH*: The nest tree diameter-at-breast-height (inches). This data will be entered into the biological site comments field (see RTV Data Entry Guide for data entry instructions).

Nest Height: The nest's height above ground (feet). If more than one nest, record the height of the largest, freshest nest.

Nests: The number of nests visible in the tree from the ground. Record "NNV" if no nests are visible, but RTV evidence is found at the base of the tree.

Distance along Transect: Enter the distance (in feet) perpendicular to detected nest tree.

Azimuth off of Transect: Enter the direction (degrees) the detected nest is located from the transect.

Distance off of Transect: Enter the distance or estimated distance to the detected nest tree (in feet) from the transect line.

UTM Easting: Universal Transverse Mercator (UTM) Easting (Zone 10 - NAD 83) coordinate of the nest tree (6 digits).

UTM Northing: Universal Transverse Mercator (UTM) Northing (Zone 10 - NAD 83) coordinate of the nest tree (7 digits).

Climbing Survey Results

Climbed (Y/N)*: Was the nest tree climbed? Yes or No.

Date Climbed: Day, month, and year (DD/MM/YYYY) that the survey started.

Confirmed to other Species (Y/N): Was the nest confirmed to be that of another arboreal species? Yes or No.

Unconfirmed Species Nest (Y/N): Is this a nest where the species is unconfirmed? Yes or No.

Confirmed RTV Nest Tree (Y/N): Is this a nest that is confirmed to be red tree vole? Yes or No.

RTV Occupancy Status*: If the nest is confirmed to be red tree vole, what is the activity and occupancy status?

- AC AO – Occupied, animal observed, "active". Vole seen—this is a rare event unless the nest is probed or torn apart, which is not recommended unless part of a research project.
- AC VR – Very recently occupied, "active". A red tree vole nest that is apparently occupied or has been used within the very recent past, but that is not disturbed by the tree climber to determine if it is actually occupied. These nests typically have fresh green cuttings piled on top of the nest or protruding from an entrance tunnel on the top or side of the nest. Green resin ducts are usually present inside or on top of the nest. Green cuttings can persist for weeks, maybe months, in a cool moist environment, but cuttings at likely or very recently occupied nests will be very fresh, with turgid needles, and will often form a plug that blocks the entrance to the nest. Fecal pellets are typically bright green.
- AC MR – Moderately recently occupied, "active". A nest that was probably occupied by a vole within the recent past. May contain older resin ducts that have faded to a pale green. If cuttings are present, they are somewhat desiccated and the needles will often fall off the stem when touched.
- INA – "Inactive". An old vole nest with no sign of recent use. Signs include the nest is compacted or falling apart and the fecal pellets are dark brown to black with no green resin ducts or cuttings. Or the nest material is comprised primarily of a composted layer of compressed fecal pellets, tan or brown resin ducts, and small debarked twigs, often with a layer of debris (conifer needles, cones, lichens, etc.) that has fallen onto the nest. The vole nest material is often in various stages of decomposition, and can become difficult to identify in very old nests.
- UND – Undetermined. A confirmed red tree vole nest where the activity status and thus the occupancy status was not determined. (Nests classified as red tree vole, "status undetermined", are to be managed as if they are "active").

Comments: Text field for recording notes. It is strongly recommended that notes be recorded on the arboreal species, structures and nests (use other species codes and nest support codes). If a tree was not climbed, no red tree vole evidence was found, but it is going to be managed as an "active" RTV point, write "MANAGE AS ACTIVE SITE" in the Comments so that it is clear how this point is being handled. The Comments field is not required in NRIS, but if any comments are recorded, then enter them into the database because they may be important in the future (see RTV Data Entry Guide for data entry instructions).

Other Arboreal Nesting Species

- WFV – White footed vole
- DSQ – Douglas' squirrel
- WRT – Woodrat
- NFSQ – Northern flying squirrel
- WGSQ – Western gray squirrel

Nest Support

- BW – Branch whorl

- CAV – Tree cavity
- FT – Forked top
- MT – Mistletoe cluster
- PBC – Palmate branch cluster
- SB – Single large branch

Red Tree Vole – USFS NRIS Wildlife Survey Form #1

Bold indicates NRIS mandatory field (circle one, if options shown).

Survey

Attach Digital Maps

Forest/District:		**Survey Name:** *(Project)*		
Target Species	Detected	**Survey Status:** Active / Cancelled / Completed / Inactive / Pre-Survey		**Data Origin:** FS / Non-FS
Arborimus longicaudus	Y / N	**Start Date:**	End Date:	**Survey Protocol:** Survey Protocol for the RTV, v3.0
Primary Surveyor:		**Quals:**	**Survey Steward:**	Survey Method: ☐Individual Tree Exam (ITE), ☐Modified Line Transect (MLT), ☐Stands with Large Tree Survey (SLT), ☐Combo MLT/SLT
Comments:				

Site (RTV Survey area polygon) & Visit

Site Category: Administrative	**Site Type:** Sample Area	**Site Status**: Not applicable	**Site Condition**: Not applicable

Site Name *(Unit Name)*	**Start Date**	**End Date**	**Observer 1 Name and Quals**	**Observer 2 Name and Quals**	**Observer 3 Name and Quals**	Total Area in Unit (ac)	Total Transect Length (ft)	Comments

QUALS:

EXP – Experienced
L EXP– Limited Experience
No EXP – No Experience
UNKN - Unknown

http://fsweb.nris.fs.fed.us/products/Wildlife/documentation.shtml

NRIS Wildlife Data Management	Record Created By:	Date:

Form dated June 22, 2012

Red Tree Vole – USFS Transect and Nest Tree Survey Form #2

Bold indicates NRIS mandatory fields. Asterisk * indicates data field not available in NRIS Wildlife, but required data entry into NRIS nest tree SITE Comments field for nests confirmed as RTV or managed as RTV. Other data fields intended for project tracking and hardcopy permanent record.

Forest/District:	Survey Name: *(Project)*	Site Name: *(Unit)*	**Date:**
Transect Bearing:	Ground **Observers:**	Climber **Observers:**	

Ground Survey Results											Climbing Survey Results						
									NAD 83, UTM zone 10								
Transect # or SLT or ITE	**Unique Tree ID**	Tree Species Code*	DBH*	Nest Height	# Nests (NNV=no nests visible)	Distance along Transect	Azimuth off of Transect	Distance off of Transect	**UTM Easting** (generated from GPS)	**UTM Northing** (generated from GPS)	Climbed (Y/N)*	Date Climbed	Confirmed to Other Species (Y/N)	Unconfirmed Species Nest (Y/N)	Confirmed RTV Nest Tree (Y/N)	RTV Occupancy Status*	Comments: Notes on arboreal species, structures and nests (use other species codes and nest support codes)

OCCUPANCY STATUS:

AC AO – Animal observed, active
AC VR – Very recently occupied, active
AC MR – Moderately recently occupied, active
INA - Inactive
UND – Undetermined

OTHER ARBOREAL NESTING SPECIES

WFV – White footed vole
DSQ – Douglas' squirrel
WRT – Woodrat
NFSQ – Northern flying squirrel
WGSQ – Western gray squirrel

NEST SUPPORT:

BW – Branch whorl
CAV – Tree cavity
FT – Forked top
MT – Mistletoe cluster
PBC – Palmate branch cluster
SB – Single large branch

http://fsweb.nris.fs.fed.us/products/Wildlife/documentation.shtml

NRIS Wildlife Data Management	Record Created By:	Date:

Form dated
August 2, 2012