SURVEY PROTOCOL

FOR THE

RED TREE VOLE

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

Version 2.0

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TABLE OF CONTENTS

EXECUTIVE SUMMARY 1

NATURAL HISTORY 3
Definitions 3
Taxonomic/Nomenclatural History 4
Geographic Range 5
Biology and Habitat Requirements 6
Biology 6
Home Range/Dispersal 7
Abundance 7
Habitat 8
Nests 9

SURVEY PROTOCOL 9
Protocol Objectives 9
Implementation of Protocol 9
Trigger for Protocol Surveys 10
Survey Methodology 10
Line Transect Survey Method 11
Individual Tree Examination Survey Method 11
General Guidelines for Both Survey Methods 12
Additional Survey Guidelines for Old-Growth Conifer Stands 13
Protocol Modifications 13
Identification of Nest Structures 13
Red Tree Vole Nests. 13
Typical Signs Indicating a Nest Was Occupied At Some Time by a Red Tree Vole 14
Typical Signs of an Active Red Tree Vole Nest 14
Typical Signs of an Inactive Red Tree Vole Nest 15
Typical Signs of Nests Built by Other Rodent Species 15
Typical Signs of Very Old and Dilapidated Nests or Natural Litter Fall Accumulations . 15

SURVEYOR SKILLS AND TRAINING 15

DATA MANAGEMENT AND ISMS DATA ENTRY 16

REFERENCES 17

FIGURE 1: Known and Suspected Range of the Oregon Red Tree Vole 19

APPENDIX I 20

APPENDIX II
Field and ISMS Data Forms **21**

EXECUTIVE SUMMARY

Species: Oregon red tree vole (*Arborimus longicaudus [= Phenacomys longicaudus* of the Record of Decision (ROD) of the Northwest Forest Plan (NFP])

Taxonomic Group: Mammal

Survey and Manage Component: Component 2, Survey before ground-disturbing activities

Objectives: The objective of this survey protocol is to provide a consistent approach for locating active red tree vole sites in proposed project areas within the species' known or suspected range and habitat conditions within the Northwest Forest Plan area. This version of the protocol (Version 2.0) replaces Interim Version 1.0 that was transmitted in 1996 as an attachment to U.S. Forest Service (R6) and Bureau of Land Management (BLM) memorandum (1736-PFP BLM- OR931/1950 FS; BLM Instruction Memorandum No. OR-97-009 dated November 4, 1996) on interim guidance for the red tree vole.

Range: The Oregon red tree vole is endemic to moist coniferous forests of western Oregon and extreme northwest California and its suspected range extends from the Columbia River south through western Oregon and the Siskiyou Mountains south to the Salmon and Klamath Rivers in northern California.

Habitat: The literature on the red tree vole indicates that the species inhabits conifer forests containing Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), Sitka spruce (*Picea sitchensis*) western hemlock (*Tsuga heterophylla*) (Johnson and George 1991) and white fir (*Abies concolor*) (Manning and Maguire 1999). Carey (1991) identifies optimal habitat for red tree voles to be old-growth Douglas-fir forests. Gomez (1992) did not capture the species in hardwood stands, and generally hardwoods are not recognized as an important habitat component. Aubry et al. (1991) found that red tree voles occur in old-growth forests significantly more than in younger forests, and also suggested that the parameters associated with age (such as large, live, old-growth trees) are important habitat components. Voles do occur in younger stands (Maser 1966; Corn and Bury 1986, 1991; Carey 1991; Johnson and George 1991; Aubrey et al. 1991; Gillesburg and Carey 1991; Gomez 1992), but these younger forests are most likely population sinks rather sources (Carey 1991) and are unlikely to provide population persistence of red tree voles over the long term.

Based on the literature, old-growth habitat appears to provide optimum conditions for red tree vole populations. The tall, multi-layered canopies of old growth retain humidity and intercept fog, which functions as a climatic buffer and a source of free water. Large branches provide stable support for nests, protection from storms, and travel routes (Gillesberg and Carey 1991). Active nests have been found in remnant older trees in younger stands indicating the importance of legacy structural characteristics (Biswell pers. comm.). However, little is known about the minimum number or size of conifer trees, or other stand characteristics, required to sustain a local population of red tree voles.

Red tree voles have been documented in conifer stands from sea level to 5,500 feet in elevation (Manning and Maguire 1999). They are suspected to occur in forested stands up to 6,000 feet when stands contain some Douglas-fir trees.

Trigger for Protocol Surveys: The primary determination of whether a ground-disturbing activity (project) should be surveyed for the red tree vole is the location of the activity within the known or suspected geographic range and habitat types or vegetation communities associated with the red tree vole. The following additional factors, or triggers, should also be evaluated to determine whether pre-project surveys are needed.

These triggers encompass habitats associated with the red tree vole as reported in the literature, survey data, and personal observations. They were selected to survey primary and other habitat conditions where there is reasonable likelihood of encountering a red tree vole population.

The additional triggers are:

The ground-disturbing activity would remove or modify the conifer canopy structure of the stand or individual conifer crowns located at ≤ 6000 feet in elevation, and include activities that may isolate nest trees or alter the microclimate within the stand. Prescribed fire is considered an activity that could potentially modify the canopy and/or affect individual animals due to heat and smoke.

AND

The stand, or portion of the stand, where the ground-disturbing activity will occur consists of conifers averaging ≥ 16" dbh.

OR

The stand, or portion of the stand, where the ground-disturbing activity will occur consists of conifers averaging ≥ 10" dbh and ≤16" dbh and also contains any remnant conifers ≥ 21" dbh or greater than 120 years old.

Threats: The major threats to this species are the continued loss of small isolated sites and the increased geographic isolation of remaining populations. This species has many life history characteristics that cumulatively raise concerns for its long-term persistence such as very small home ranges, low dispersal capability, extremely low reproduction potential, and a sensitivity to stand level disturbances.

Information Needs: Current survey protocols and management guidelines could be improved with information on the species' reproductive potential, demographics, population status or trend, and the spatial extent of known sites. Generally, the scientific information needed for management cannot come solely from pre-project type surveys. To date pre-project surveys have been limited to locating new sites and collecting counts of the number of nest trees within projects. More studies are vital to improving our understanding of red tree vole ecology, range and distribution, habitat relationships, population trends and management options. Further genetic research is needed to resolve the geographic distribution of *Arborimus longicaudus* and *A.pomo* and to determine if there are any ecological differences between the two species.

NATURAL HISTORY

Introduction

The Oregon red tree vole (*Arborimus longicaudus)* is the most arboreal mammal in the Pacific Northwest (Carey 1996) and is endemic to moist coniferous forests of western Oregon and extreme northwest California. Its distribution is patchy and limited to coniferous forests west of the crest of the Cascade Mountains. Red tree voles depend on conifer tree canopies for nesting, foraging, travel routes, escape cover, and moisture (Carey 1991). Douglas-fir (*Pseudotsuga menziesii*) needles provide the primary food and building materials for nests. The vole is an important prey for the threatened northern spotted owl and other owls (Forsman et al. 1984). In southwestern Oregon the red tree vole may provide up to 50% of the items consumed by some pairs of spotted owls (Forsman et al. 1989).

Red tree voles were rated as highly vulnerable to local extirpations from habitat fragmentation or loss (Huff et al. 1992), and are recognized as closely associated with old-growth forest habitat (Carey 1989, Ruggiero et al. 1991). Significant declines in tree vole populations are expected from major reductions in old-growth Douglas-fir habitat (Huff et al. 1992).

Red tree vole nests tend to be clumped in their distribution on the landscape and may range from areas with 30 or more nests in a stand down to single isolated nest trees. Sites in old forest conditions have many nests and can cover several hundred acres. Isolated nests are generally found in low-quality habitat and are believed to be either a part of a declining residual site or associated with an individual attempting to disperse. Both types of sites are important to identify during pre-project surveys. Large sites will provide major support for tree vole population persistence, while sites with only one to a few nests may help maintain the species distribution and connectivity to higher-quality habitat throughout its geographic range.

Oregon red tree voles were added to Survey and Manage mitigation during the Northwest Forest Plan (NFP) Final Supplemental Environmental Impact Statement (FSEIS) (USDA, USDI 1994b) analysis because the species was believed to need more protection than provided by the standards and guidelines, Riparian Reserves, Late-Successional Reserves (LSRs) and other land allocations of the NFP. The assumption was made that each LSR would likely support large populations of red tree voles, but because each of these populations may be isolated from others, connectivity of LSRs may be necessary to provide small breeding colonies between large reserves to facilitate gene flow from one reserve to another (USDA, USDI 1994c). Therefore stable, well-distributed tree vole populations depend to some extent on maintaining sites and habitat within Matrix land allocations.

Definitions

The following definitions are provided for the purposes of this protocol:

Unconfirmed Species Nest: Any arboreal nest that is not confirmed as belonging to a red tree vole or any other species. Some of these undetermined structures may not be rodents nests but rather a bird nest or accumulations of litter fall.

Confirmed Red Tree Vole Nest: An arboreal nest that is confirmed as belonging to a red tree vole, and the activity status is undetermined.

Confirmed Active Red Tree Vole Nest: An arboreal nest that is confirmed as belonging to a red tree vole and is currently being used by a red tree vole.

Confirmed Inactive Red Tree Vole Nest: An arboreal nest that is confirmed as belonging to a red tree vole and determined not to be currently in use by a red tree vole.

Red Tree Vole Site: A red tree vole site is an individual nest tree or a collection of nest trees within a local area (all nest trees in a stand and adjacent stands that are not isolated from other clumps of nest trees by more than 100 m (330 ft).

Active Site: One or more confirmed active nests.
Inactive Site: All confirmed nests are not active.
Undetermined Site: Activity of nests is unknown.

Survey Area: An area that meets the trigger definition that is within the boundaries of the proposed ground-disturbing activity, which may be an area smaller than the project area.

Resin Duct: A structure found along the outer edge of a Douglas-fir needle that red tree voles split off and discard as feeding refuse before eating the remainder of the needle. These small, thread-like ducts accumulate in the nest and are used to line the nest chamber. A description of resin ducts as "mid-veins" is incorrect since the vascular bundle found in the middle of the needle is eaten, not discarded.

Conifer: When used in this protocol, tree species recognized as occurring in red tree vole habitat including Douglas-fir, grand fir, white fir, western hemlock, and Sitka spruce

Canopy: All dominant, co-dominant, intermediate, and suppressed conifer trees.

Stands: Stands are usually the management units which make up a forest. A stand can be defined as a reasonably homogeneous unit that can be clearly differentiated from surrounding sands by its age, composition, structure, site quality, or geography (Daniel et al. 1979, pg 38).

Ground-disturbing Activity: An activity that would remove or modify the conifer canopy structure of the stand or individual conifer crowns, including activities that may isolate nest trees or alter the microclimate within the stand. Prescribed fire is considered an activity that could potentially modify the canopy and/or affect individual animals due to smoke and heat.

Taxonomic/Nomenclatural History

The red tree vole (*Arborimus longicaudus*) was described in 1890 from a specimen collected from Marshfield, Coos County, Oregon, and given the scientific name *Phenacomys longicaudus*. Johnson (1968) proposed elevation of the subgenus *Arborimus* to full generic rank and included the red tree vole and the white-footed vole (*A. albipes*) in this new genus. In 1991 Johnson and George (1991) split the sibling species, *Arborimus pomo,* from *A. longicaudus*. Their new species included all tree voles found along the California Coast and effectively split the red tree vole's range in half near the California-Oregon border. Subsequently, Murray (1995) presented DNA information suggesting specimens from south of the Smith River drainage in Del Norte County, California, were more similar to the Oregon tree voles than to other California populations.

Taxonomists still disagree on whether *Arborimus* should have full generic status, therefore even recent scientific publications vary as to which genus they list for the species. For example, Verts and Carraway (1998) use the genus *Phenacomys* while Carey (1999), Hayes (1996) and Maser (1998) all used *Arborimus*. Some recent DNA analysis (Murray 1995) supports *Arborimus* as an independent genus but these taxonomic issues are more academic and have no effect on the survey status of this species.

Geographic Range

The Oregon red tree vole is endemic to moist coniferous forests of western Oregon and extreme northwest California. Our understanding of the geographic range of the Oregon red tree vole has improved since the issuance of the NFP ROD. Medford District BLM and Pacific Northwest Research Station conducted surveys and identified new vole sites in the Rogue, Applegate, and Illinois River Valleys that helped expand and delineate the eastern extent of the vole range in these dry forest communities. The most significant change in the species range since the NFP, however, is a clarification in the taxonomic relationship of populations in northern California.

In the original NFP Supplemental Environmental Impact Statement (SEIS) analysis, the agencies followed the range suggested by Johnson and George (1991) when they originally split the sibling species, *Arborimus pomo*, from the Oregon tree vole. They suggested there was a break in the distribution between the two species near the California - Oregon border. Murray (1995) subsequently presented DNA data suggesting specimens from adjacent to the Smith River drainage in Del Norte County, California, were more similar to Oregon tree voles than to other California populations. In addition, Maser (1998), based on his collecting in the Smith River drainage, also suggests populations from the Smith River are *A. longicaudus*.

This protocol was developed for surveys within the known and suspected range of the Oregon red tree vole, *Arborimus longicaudus*. The Survey and Manage requirements under the NFP do not apply to populations of *A. pomo* (NFP ROD USDA USDI 1993).

This protocol includes significant changes in the range of the species. Areas of the federal forest lands in the eastern Rogue River Valley were removed, and portions of northwestern California were added. These changes are a result of information gained through four years of survey effort in the dry forests of southern Oregon, and a better understanding of the tree vole populations in northern California.

The known and suspected geographic range of *Arborimus longicaudus* extends from northern Oregon near the Columbia River south along the 6,000 foot elevation contour west of the crest of the Cascade Mountains to Prospect, Oregon. From Prospect, the eastern range line extends along the Rogue River to Medford, then south along Interstate 5 to the Siskiyou Mountain crest, then west along the crest to Condrey Mountain. The boundary then extends south from Condrey Mountain south along Buckhorn Creek to the Klamath River, and west along the Klamath River to the mouth of the Scott River. From the confluence of the Scott and Klamath Rivers, the range follows the boundary between the Happy Camp and Scott River Ranger Districts of the Klamath National Forest to the Marble Mountain Wilderness, then along the west side of the Marble Mountain Wilderness to the Salmon River. The line then follows the Salmon River to the Klamath River, and continues west along the Klamath River to the Pacific Ocean.

Removal of Areas in the Rogue River Valley. The eastern boundary of the range in southern Oregon was moved west to the Rogue River and Interstate 5. This new boundary is based on survey data provided by the Butte Falls and Ashland Resource Areas of Medford BLM. Extensive surveys conducted in forests east of this boundary did not identify red tree vole nests in any project areas.

Additions to the Range in Northern California. The following information was used to derive the new geographic range extensions in northern California.

- Specimens collected in northern California by Murray (1995) were from the Wilson Creek drainage, which is just southwest of the Smith River watershed----there are no barriers to dispersal from this area south to the Klamath River.

- Maser (1998) references collections in the Smith River drainage.

- Zentner (1977) identified active *Phenacomys longicaudus* nests in Siskiyou County, California in the vicinity of Happy Camp. These nests are geographically closer to *A. longicaudus* and are many miles east of the accepted range of *A. pomo.*

- The Siskiyou Crest to Condrey Mountain along Buckhorn Creek provides a logical geographic boundary to tie the eastern suspected range on the Ashland Resource Area of the BLM Medford District and Ashland Ranger District of the Rogue River National Forest with the suspected range in northern California that occurs north of the Klamath River.

The map in Figure 1 displays the known and suspected range of *Arborimus longicaudus* for the purpose of pre-project surveys conducted under this protocol.

Biology and Habitat Requirements

Biology. The red tree vole is a small microtine rodent with individual weight varying from about 25-50 grams (.87-1.75 ounces) (Hayes 1996). Total length (body and tail) for males ranges from 15.8-17.6 centimeters (6.2-6.9 inches) and females, from 17.0-18.7 centimeters (6.7-7.3 inches) (Hall 1981). The tail, which is relatively long, accounts for about 40 percent of the total length and is used for balance while moving along small branches.

The color of the dorsal pelage ranges from rust to cinnamon with some hairs tipped with black. Ventral pelage is whitish (Hall 1981). The well-haired tail is black to brown in color (Maser and Storm 1970; Whitaker 1988). Juveniles tend to be more brown in coloration with black tails (Maser and Storm 1970). Melanistic individuals have been observed (Hayes 1996).

Reproduction in this species is characterized by a long reproductive period, small litter size, and slow development of young (Carey 1991). Red tree voles can breed throughout the year, but generally litters are produced from February through September (Carey 1991). Litters range in size from one to four (Carey 1991) but average two (Howell 1926) and females can have several litters in a given year. Gestation is approximately 28 days but may extend to 48 days if the female is lactating in support of an earlier litter (Carey 1991).

The young start to venture from the nest at about 4 weeks of age (Howell 1926). Activities of immature red tree voles (once they leave the maternal nest) are unknown. Red tree voles feed primarily on Douglas-fir needles, through they will occasionally feed on grand fir, white fir, Sitka spruce, and western hemlock needles (Carey 1991). Douglas-fir needles have resin ducts along each edge which the vole discards before eating the fleshy portions of the needles (Howell 1926; Whitaker 1988). The resin ducts are used for constructing nests (Howell 1926) and are a definitive indicator of tree vole use of a nest structure. Water is obtained from dew, rain, or condensation on foliage (Carey 1991).

The main predator on this species is probably the northern spotted owl, though other owl species, raccoons, marten, ringtail, and fishers prey upon them as well (Maser et al. 1981; Whitaker 1988).

Home Range/Dispersal. The species is nocturnal, and some individuals may spend the majority of their lives in the canopy, moving from tree to tree through the canopy (Carey, 1991). Though they are almost exclusively arboreal, some terrestrial activity does occur; and occasionally individuals have been captured on the ground (Corn and Bury, 1986; Raphael, 1988). The individual home range size for this species is not well known. However, Biswell (in prep) found individual adult red tree voles that were radio-tracked for 35-106 days, used 2-7 (median=5) nests. The greatest straight-line distance between consecutively occupied nest trees was an overnight move of 75.8 m. (248.7 ft.). Mean distances moved between consecutive nest trees for males and females combined was 31.4 m. (SE=6.49) (112.8 ft). When moving to a new nest tree, adult voles re-occupied previously constructed nest structures at least 68 percent of the time. Thirty-six percent of 39 nest trees located via telemetry contained more than a single nest, and one tree contained 7 nests.

The greatest distance moved by a red tree vole was by a dispersing subadult male. Followed for 40 days, he was located in five different trees and reached a maximum straight-line distance from his natal nest tree of 340 m. (1115 ft.) (Biswell, in prep.). While moving greater distances than adults, subadults have extremely low survival rates. Red tree voles tracked using telemetry crossed small forest roads, small streams, and canopy gaps while traveling between nest trees.

Abundance. Since implementation of the NFP, in excess of 650 pre-project surveys have been conducted by Bureau Land Management and National Forest system biologists in western Oregon. These surveys have covered in excess of 85,932 acres and identified greater than 254 potential new red tree vole sites.

Vole abundance apparently varies by physiographic province, since some regions have far fewer sites than others. For example, the northern half of the Oregon Cascades including the Sandy, Clackamas, and North Santiam River basins have limited numbers of sites. In 1995 the Mt. Hood National Forest surveyed 38,611 acres including 62 % (26,976 acres) of all primary red tree vole habitat on the forest and confirmed 9 red tree vole nests (Mt. Hood National Forest, 1996). Primary habitat on the Mt. Hood included the most likely habitat conditions for finding red tree voles, and was defined as stands of large conifers (>21 dbh) located at less than 3,000 ft elevation within the western hemlock or pacific silver fir vegetation zones, and greater than 300 acres in size.

In contrast, 37,421 acres have been surveyed by the Medford District BLM accounting for approximately 44% of the total acres surveyed, 81% of all pre-project surveys conducted to date, and 83% (211) of potential new red tree vole sites.

Recent survey data supports the concern that surveys to date have resulted in many cases of occupancy being based on nests of unknown status, which overestimates the red tree vole's abundance. Furthermore, many of the newly identified sites are in low quality habitat, and may not provide for species' persistence in the Matrix. During surveys conducted in 1997 a total of 443 individual red tree vole nests were found within 117 sites. Eighty-four (19%) of the nests were confirmed active red tree vole nests and the remaining 359 nests (81%) were either confirmed as inactive or their activity status was not determined. At 71 (61%) of the sites, no active tree vole nests were confirmed. Single active red tree vole nests were located at 14 sites (12%) and 32 sites (27%) contained one or more active nests.

This species is hard to locate, generally occurring in small clumped populations, and with a patchy distribution on the landscape (Carey 1991). Generally, when a tree vole nest is located, additional tree vole nests should be in the same stand or general area.

Habitat. The literature on the red tree vole indicates that the species inhabits conifer forests containing Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), Sitka spruce (*Picea sitchensis*) western hemlock (*Tsuga heterophylla*) (Johnson and George 1991) and white fir (*Abies concolor*) (Manning and Maguire 1999). Carey (1991) identifies optimal habitat for red tree voles to be old-growth Douglas-fir forests. Gomez (1992) did not capture the species in hardwood stands, and generally hardwoods are not recognized as an important habitat component.

Huff et al. (1992) reported that voles were captured from the Oregon Cascade and Coast Ranges in 28% of the old-growth stands surveyed but in only 5% of the unmanaged young and mature stands. Because young and mature stands represented nearly 45% of the total stands surveyed in this study, the likelihood was low that red tree voles were captured in five times as many old-growth stands through chance alone. Aubry et al. (1991) found that red tree voles occur in old-growth forests significantly more than in younger forests, and also suggested that the parameters associated with age (such as large, live, old-growth trees) are important habitat components. Voles do occur in younger stands (Maser 1966; Corn and Bury 1986, 1991; Carey 1991; Johnson and George 1991; Aubrey et al. 1991; Gillesburg and Carey 1991; Gomez 1992), but these younger forests are most likely population sinks rather sources (Carey 1991) and are unlikely to provide population persistence of red tree voles over the long term.

Based on the literature, old-growth habitat appears to provide optimum conditions for red tree vole populations. The tall, multi-layered canopies of old growth retain humidity and intercept fog, which functions as a climatic buffer and a source of free water. Large branches provide stable support for nests, protection from storms, and travel routes (Gillesberg and Carey 1991). Active nests have been found in remnant older trees in younger stands indicating the importance of legacy structural characteristics (Biswell pers. comm.). However, little is known about the minimum number or size of conifer trees, or other stand characteristics, required to sustain a local population of red tree voles. The overall effect of stand size or topographic position on maintaining vole populations is also uncertain, however, captures declined in old-growth stands less than 100 acres in size in the Cascades and Oregon Coast Range (Huff and others 1992).

Red tree voles have been documented in conifer stands from sea level to 5,500 feet in elevation (Manning and Maguire 1999). They are suspected to occur in forested stands up to 6,000 feet when stands contain some Douglas-fir trees.

Nests. Red tree voles build nests wherever there is a suitable foundation and a readily accessible food supply. Generally, only one adult occupies each nest but multiple nests can be found in large trees. Nests are constructed of resin ducts, lichen, feces, conifer branchlets, and fine twigs (Gillesberg and Carey 1991). Single large branches, mistletoe brooms, and re-sprouted branch clusters provide stable foundations for nests in larger trees, while whorls of branches or forked tops in smaller trees can also provide a protected location. Nests can range from 2 to 65 meters above the ground.

SURVEY PROTOCOL

Protocol Objectives

The objective of this survey protocol is to provide a consistent approach for locating red tree vole sites in proposed project areas within the species' known or suspected range and habitat conditions within the Northwest Forest Plan area. This version of the protocol (Version 2.0) replaces the Interim Version 1.0 that was transmitted in 1996 as an attachment to U.S. Forest Service (R6) and Bureau of Land Management (BLM) memorandum (1736-PFP BLM- OR931/1950 FS, BLM Instruction Memo No. OR-96-009 dated November 4, 1996) on interim guidance for the red tree vole.

Implementation of Protocol

The Bureau of Land Management Districts and National Forests listed in Table 1 have known red tree vole sites within their boundaries. All or part of the land area within their jurisdictions fall within the known and suspected range of the species. The California National Forests also have known sites of *A. pomo*, the southern red tree vole species which is not of concern under the NFP.

Table 1. Bureau of Land Management Districts and National Forests in Oregon and northern California within the known or suspected range of the red tree vole where surveys using this protocol should be implemented prior to ground-disturbing activities.

National Forests	Bureau of Land Management Districts
Oregon	
Mt. Hood National Forest (NF)	Salem District
Willamette NF	Eugene District
Siuslaw NF	Roseburg District
Umpqua NF	Coos Bay District
Rogue River NF	Medford District
Siskiyou NF	
California	
Six Rivers NF	
Klamath NF	

Trigger for Protocol Surveys

The primary determination of whether a ground-disturbing activity (project) should be surveyed for the red tree vole is the location of the activity within the known or suspected geographic range and habitat types or vegetation communities associated with the red tree vole. The following additional factors, or triggers, should also be evaluated to determine whether pre-project surveys are needed.

These triggers encompass habitats associated with the red tree vole as reported in the literature, survey data, and personal observations. They were selected to survey primary and other habitat conditions where there is reasonable likelihood of encountering a red tree vole population.

The additional triggers are:

The ground-disturbing activity would remove or modify the conifer canopy structure of the stand or individual conifer crowns located at ≤ 6000 feet in elevation, and include activities that may isolate nest trees or alter the microclimate within the stand. Prescribed fire is considered an activity that could potentially modify the canopy and/or affect individual animals due to smoke and heat.

AND

The stand, or portion of the stand, where the ground-disturbing activity will occur consists of conifers averaging ≥ 16" dbh.

OR

The stand, or portion of the stand, where the ground-disturbing activity will occur consists of conifers averaging ≥ 10" dbh and ≤16" dbh and also contains any remnant conifers ≥ 21" dbh or greater than 120 years old.

Survey Methodology

Because red tree voles tend to occur in low numbers and in a somewhat clumped distribution at the landscape and stand level scales, survey techniques need to cover a large percentage of the survey area to ensure detection of red tree vole nests. Vole nest trees are an indicator of a possible vole population and are used to identify the tree vole site. The actual survey methodology used will depend upon the type of project. Either a modified line transect or individual tree examination method can be used depending on the scale and type of project under consideration.

The survey techniques included in this protocol emphasize approaches for determining red tree vole nest use and activity status from the ground. If all ground-based methods are used and it has not been possible to confirm a nest as red tree vole or determine activity status, tree climbing may be used as a last resort. Tree climbing should only be employed according to established U.S. Forest Service Region 6 standards, safety regulations, and required job hazard analysis. If confirmation of red tree vole use cannot be determined from the ground and tree climbing is not considered a viable option, the alternative is to assume the nest belongs to a red tree vole. However, correct assessment of species use and activity status will be essential for evaluating future management options. This information will be needed for analyzing red tree vole abundance, distribution, and persistence.

Red tree vole 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 rain, fog or hardwood leaves may reduce visibility in some situations.

Survey results using this protocol should be considered valid for 5 years after completion of the survey.

Line Transect Survey Method. This method is appropriate for surveys that encompass stand- level projects. Examples of projects best suited to this type of survey include timber harvest and prescribed fire. Unlike strip surveys, the modified line transect methods do not assume 100 percent detection but are based on a modified detection function approach. Studies have shown that the average effective strip width and detection distance of vole nests, under average stand conditions, was approximately 15 meters on either side of the transect line.

The line transect survey method should follow these general guidelines:

- Establish the starting point of the first transect segment along the edge of the survey area and space any additional transect segments parallel to the first segment.
- Run the transects across any environmental gradients where possible.
- Using the pre-located starting point, slowly walk along a pre-determined compass bearing, or elevation contour using an altimeter, through the stand (walking along the transect center line) and visually search the tree canopy for likely structures on both sides of the transect.
- Inspect possible structures detected from transect at closer range to determine if they are a nest.
- A minimum of 90 meters (approximately 300 feet) of transect line per acre of survey area should be searched. Assuming a transect detection width of approximately 15 meters (49 feet) on each side of the transect line, this length of survey will visually cover approximately 68 percent of an acre of survey area..
- To determine an adequate total transect length for a stand, refer to Appendix I, *"A Sample Method for Calculating Transect Spacing for Red Tree Vole Surveys"*, for guidance in performing these calculations. This length of transect should provide a good assessment of the presence or absence of voles within the stand.
- The total length of transect needed to survey a stand can be divided into varying length segments and distributed throughout the stand to accommodate stands of various shapes and sizes.

Individual Tree Examination Survey Method. This method can be used in situations where searching individual trees in a project area would be more appropriate than surveying with the line transect method (the project also needs to be evaluated in relation to the general requirements in the "Trigger for Protocol Surveys" section). Examples of projects best suited to this type of survey include snag creation, stream restoration, and single tree removal.

Individual conifer trees $\geq$ 16 inches dbh that may be modified or affected by the project should be surveyed. Trees of this diameter within at least one tree height radius that may be affected by felling, blasting, or other activities should also be surveyed. A visual search in and near the entire live crown of all trees should be conducted from several viewpoints using binoculars or a spotting scope.

General Guidelines for Both Survey Methods

- The presence of other confirmed red tree vole nests in the vicinity of an unconfirmed nest may be an indication that the nest may be a red tree vole nest.

- Take advantage of steep slope positions (even if outside the project area) to look into tree crowns.

- Both methods should be planned to achieve the best visibility conditions within the project area. Conditions such as rain, fog or hardwood leaves may reduce visibility in some situations.

- All detected nest structures must be classified into one of the following categories:
  1. Confirmed Red Tree Vole
  2. Confirmed Active Red Tree Vole
  3. Confirmed Inactive Red Tree Vole
  4. Confirmed to a Species Other than a Red Tree Vole
  5. Unconfirmed Species Nest

When potential nest structures are observed:

- Search the nest from the ground and under the tree for possible red tree vole nest signs, particularly resin ducts (see "Identification of Nest Structures" section below). Use binoculars or spotting scopes if necessary.

- Utilize any collection or examination devices that will enable a closer view of the nest. Such devices may include visual techniques such as cameras or mirrors mounted on extension poles or techniques such as extension poles with grappler or golf ball retrievers that sample a small portion of the nest. These devices should not cause undue disturbance to the nest.

- Determine the species associated with the potential nest structure(s) and the activity status of the structures (see "Identification of Nest Structures" section).

- Mark all trees that contain a confirmed red tree vole nest, confirmed active red tree vole nest, or a confirmed inactive red tree vole nest.

- Indicate the location as accurately as possible on a map, or using GPS.

- If the nest is unconfirmed to species, mark the tree(s) that are questionable for further evaluation to determine the appropriate classification of the nest structure.

- If a confirmed, confirmed active or confirmed inactive nest is located, surveys should be conducted within 330 feet (100 meters) to determine the extent of the site. This distance is based on the maximum distance (75.8 meters) voles moved between consecutive nests from a sample of 7 adults that were radio-tracked for approximately 110 days (Biswell in prep.). Due to the small sample size and potential variation in movement among different stand types, 100 meters was used.

Additional Survey Guidelines for Old-Growth Conifer Stands

The primary objective of the protocol is to determine the presence of red tree vole nests. Some old-growth conifer stands (up to 10%) have conditions that make it exceptionally difficult to detect red tree vole nests from the ground. This is due to such things as the height to live crown, high crown density, and lack of good vantage points into the canopy. These conditions may be encountered in stands or portions of stands with structures that include uniform tree density, trees averaging 36 inches dbh or greater, heights to the first live branch greater than or equal to 75 feet, and few mid-canopy conifers. If line transect or individual tree examination surveys do not reveal red tree vole nests in these conditions and it is suspected that, based on the habitat quality, 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.

A sufficient number of trees should be sampled to conclude that red tree vole nests are not likely to occur in area examined. When a red tree vole nest is confirmed during sampling, no additional climbing is needed and the stand is considered to be occupied. Further sampling may be conducted to determine the extent of the site. Trees selected for climbing are at the discretion of the wildlife biologist and the climber, but should be well distributed throughout the area being sampled, and provide vantage points for viewing into adjacent conifer crowns. If trees are climbed, methods and conditions must meet Forest Service Region 6 tree-climbing standards, and personnel must be certified.

The manager has the discretion to decide that climbing is not an option, and to assume that red tree voles are present.

Protocol Modifications

The protocol was designed to ensure a high probability of finding red tree vole nests across the species' range. The protocol, as written, should be followed and a minimum of 68% of each acre in the survey area should be covered . There may be specific conditions which may warrant some modification of the protocol. Biologists should make the decision concerning any modifications of the protocol based on their professional judgment. Where there is any deviation from the protocol, biologists must document the specific changes and the rationale for those changes. In addition, the data sets collected using the modifications should be clearly identified.

Identification of Nest Structures

Red Tree Vole Nests. From the ground, red tree vole nests generally appear as dark haphazard accumulations of twigs, needles, moss, and/or lichens on the topside of a large branch or whorl of branches against the bole of a tree. Closer inspection will reveal diagnostic characteristics that will help differentiate a red tree vole nest from other arboreal rodent or bird nests. Finding or observing Douglas-fir resin ducts or seeing a red tree vole are the definitive indicators a nest has been or is occupied by a red tree vole.

There are five other arboreal rodents that build nests in trees that can be confused with the nests of the red tree vole. In addition, tree voles and other rodent species may reuse the same nest platform at different times. Therefore, you may see an old nest built by a Douglas squirrel that has an occupied red tree vole nest built on the top of the old squirrel nest.

Typical Signs Indicating a Nest Was Occupied At Some Time by a Red Tree Vole (Confirmed Nest). Below are typical signs that may indicate a nest structure is or was used by a red tree vole, but do not confirm current activity. These characteristics may or may not be visible from the ground using binoculars or a spotting scope.

- Green Douglas-fir cuttings or branchlets piled on top of the nest structure.

- Clumps of resin ducts incorporated into the nest material. Clumps of resin ducts may be seen in the nest, sloughed off to the edge of the nest or sometimes may be found on the ground or other locations under the nest tree

- Tunnels leading into the underside of the nest.

- Evidence of hedging on branches adjacent to the nest. Foraging activity by red tree voles near very large old nests can change the growth form of small Douglas-fir branchlets due to the heavy removal of the branch tips. This clipping of the small branchlets causes the development of many new buds that sprout and give the branches a bushier look than normal. Branches around old nests can have a sheared, rounded bushy appearance much like a hedge. This hedged look, when it occurs, can help indicate long-term use of a nest site by red tree voles. This hedged appearance occurs more in old stands and may be difficult to see from the ground by an inexperienced observer.

- Large quantities of fresh cone scales or cores piled on top of a nest may indicate usage of the nest by a squirrel. The nest may or may not have been a tree vole nest at sometime in the past.

Typical Signs of an Active Red Tree Vole Nest (Confirmed Active Nest). Diagnostic features that indicate an active red tree vole nest include most of the characteristics above but require further qualification often only available by close-up examination of the material for freshness. These features maybe visible from the ground or a sample may need to be collected and examined in hand or the tree may need to be climbed for a close-up examination of the nest. Diagnostic features must be considered as a whole when trying to determine activity status of a nest. Most of the time observers will not see the vole occupying a nest and will have to use these context clues to make determinations.

- Fresh cuttings of Douglas-fir clipped from the ends of branches, usually the current or last year's growth. These are generally 2-3 mm in diameter and 10 to 20 cm long.

- Fresh, dark green to pale green to slightly orange or light tannish resin ducts on or in the nest can indicate recent usage of the nest.

- Upon close-up examination of a nest structure in the tree, the color of the feces can sometimes be used to indicate the freshness of the fecal pellet. Bright green pellets indicate newer droppings and can indicate present or recent usage of the nest. Older fecal pellets are dark brown and become compacted into the bottom of the nest as they become wet and compressed.

Typical Signs of an Inactive Red Tree Vole Nest (Confirmed Inactive).

- Nest material is dark brown and compacted with no green resin ducts or cuttings.
- No other sign of recent activity at the nest.
- Compacted nest material is comprised primarily of a humus layer consisting of compressed feces, brown resin ducts, and small stripped twigs.

Typical Signs of Nests Built by Other Rodent Species. Nests built by the other five arboreal rodents whose ranges overlap the tree vole's tend to use slightly different and larger material. These other rodents do not create resin ducts and if resin ducts are found in a nest being used by another rodent, the resin ducts indicate a tree vole used the nest at some time. The other arboreal nests will have some of these characteristics:

- The twigs and sticks that make up the base of the nest platform can include sticks of a larger diameter and length than those added by red tree vole. For example, woodrats and the larger squirrels may include twigs up to 1 cm in diameter in the nest platform.
- The nest chambers or ball of nest material on top of platforms of sticks will be constructed of moss, shredded bark, grasses, lichens, or leaves of deciduous trees and shrubs.

Typical Signs of Very Old and Dilapidated Nests or Natural Litter Fall Accumulations. Many of the structures that surveyors detect within the forest canopy will be very old and dilapidated rodent nests or natural accumulations of litter and broken branches. From the ground, these generally appear as dark haphazard accumulations of twigs, needles, moss, and/or lichens on the topside of a large branch or whorl of branches against the tree bole just like active tree vole and squirrel nests. However many of these dilapidated nests are very compacted and do not contain any fresh material. Many will have major holes through the nest material, or the nest material will be falling off the structure. Samples of this fallen material can often be seen on the ground under the nest.

SURVEYOR SKILLS AND TRAINING

The protocol is designed for field biologists who will be analyzing red tree vole habitat and supervising red tree vole surveys on federal land within the range of the northern spotted owl. ``Field biologists" are defined as those individuals currently employed as professional biologists, biological technicians, or volunteers who are supervised by a professional biologist.

Professional judgment is involved in analyzing habitat, conducting surveys, and interpreting red tree vole survey results and habitat use. Knowledge of the biology and ecology of the species and habitats will be essential for a reliable survey. The following qualifications are provided as a requirement for the personnel involved red tree vole surveys:

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

- A bachelor's degree in wildlife biology or related field and/or qualification as a GS-486-9/11, and

- A thorough understanding of all aspects of this protocol.

Field surveyors should be familiar with:

- Techniques involved in project layout and establishing transect lines, and

- Identification and interpretation of visual evidence of red tree vole, including differentiation of their nests from those of other species.

It is highly recommended that potential surveyors be trained by a wildlife biologist who has received training from an expert on the species and is knowledgeable about red tree vole biology, sign, surveys, and interpretation of survey results.

DATA MANAGEMENT AND ISMS DATA ENTRY

The field and Interagency Species Management System (ISMS) database forms that should be used to record survey data are provided in Appendix II. Field units should maintain hard copies of survey plans, field forms, maps, and aerial photos used during the survey. Data sheets for each nest tree must clearly indicate the surveyor's level of confidence in the determination of vole use and activity status. Hard copies of all field data will be stored at each administrative unit and electronically entered into the ISMS database. The hard copies of field forms should be maintained by the units for a sufficient period of time to answer questions on the surveys during any regional analysis of the ISMS data.

The red tree vole survey data is collected in a nested design with three levels of data: A polygon level referred to as site data, a nest tree level or species observation data, and nest level data. The nest data is auxiliary data that will help describe the characteristics of the nests. When entering tree vole locations into the ISMS database, each nest tree should be entered as a species observation. The area delineated as the red tree vole site should be entered using the Arcview link so a polygon enclosing the site can also be digitized.

Clear records must be maintained that show which species observations occur in each red tree vole site. When entering tree vole locations there will be some cases where there is only one active tree vole nest at a site. It is important to make sure that these single nest tree sites are included in ISMS to help provide information on the species' local and regional distribution.

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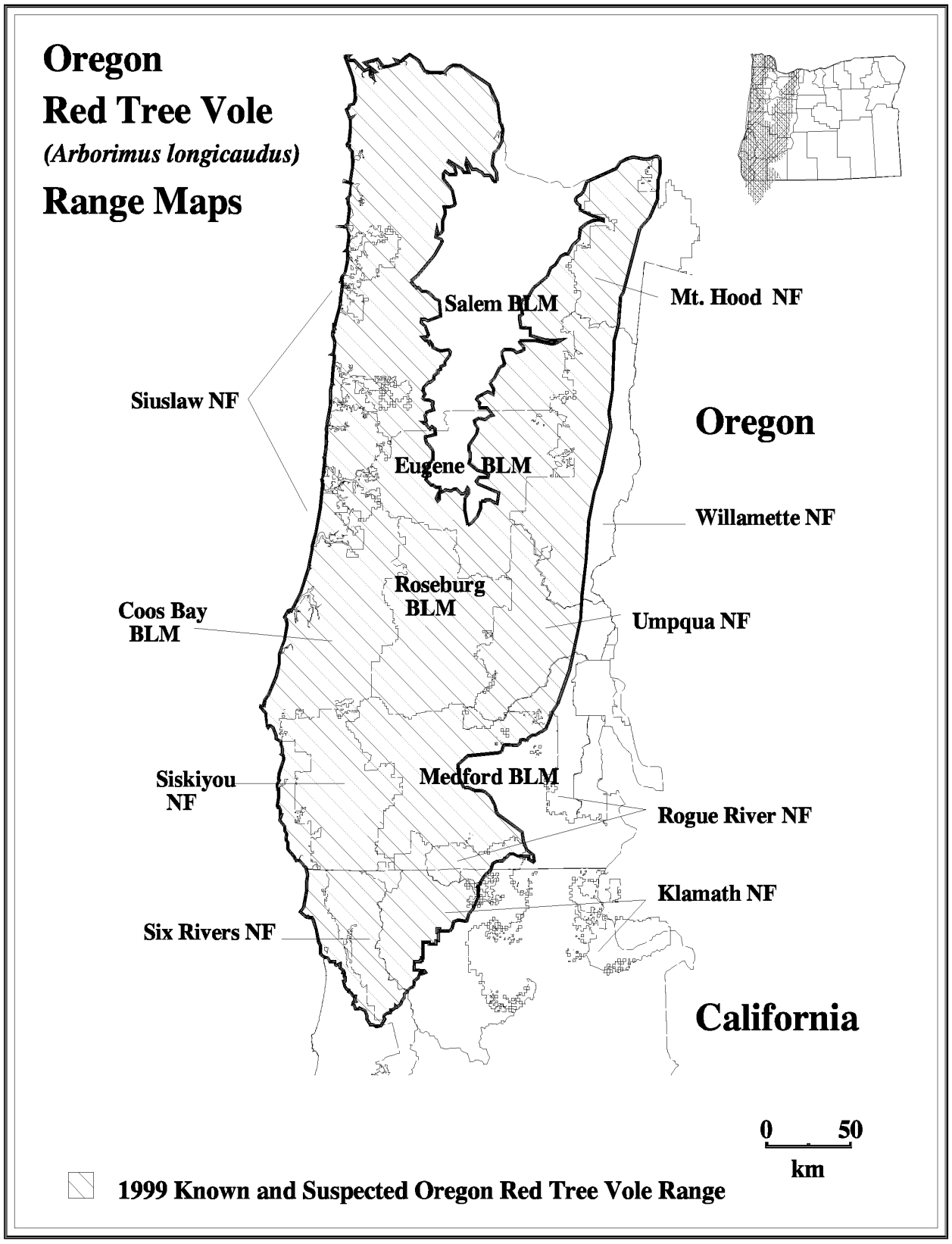
FIGURE 1: Known and Suspected Range of the Oregon Red Tree Vole (*Arborimus longicaudus*)



APPENDIX I

A Sample Method for Calculating Line Transect Spacing Using the Line Transect Survey Method for Conducting Red Tree Vole Surveys. This is a sample method for calculating the approximate spacing between transects in a project.

- Draw a rectangle (or square) around the project unit large enough to enclose the area that will be ground-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.
- Measure each side of the rectangle and calculate its area in square feet.
- Divide the resulting area by 43,560 feet to equal the total acres of the rectangle.
- Divide these acres by 300 feet to get the minimum number of transect footage needed for the rectangle.
- 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 will indicate the approximate number of transect lines needed for the project area.
- Divide the length of the other side of the rectangle (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.
- Lay out the transect lines on a project map and measure the total linear feet of transect lines within the area to be surveyed to ensure at least 300 feet of transect line per acre of survey area will be surveyed. It may be necessary to adjust the number of transect lines after this step.

APPENDIX II
Field and ISMS Data Forms

RED TREE VOLE SURVEY AREA DESCRIPTION & SUMMARY DATA FORM (FORM #1)

Data Form for Field Use & ISMS
Version 2.0 : 12/99:
Survey Date: ----/-----/ -------

Observer(s) _____ Survey Method _____

Loc_id	Alt_Loc_ID	Survey ID		MAP_ACCURACY:
Admin_unit	SubAdmin_Unit	Project Name		Unit

SURVEY LOCATION:						UTM's of Population Site Center: Polygons Centroid		
GIS Poly #	Twnshp	Range	Section	1/4 Sec	1/16 Sec	Base_Meridian W H MD	UTM-Easting	UTM-Northing
Site Elevation [median elevation in ft.]	Total transect length	Total acres in unit	Acres surveyed in unit	Plant Association Code	HUC5 NAME			

STAND INFORMATION						
Stand age	Over-story Size Class	Mid-story Size Class	Remnants Trees Present? Y N	Management History Code	Location's Habitat Condition	Site Status

SUMMARY OF THE NUMBER OF NEST TREE DETENTIONS						
# Confirmed RTV Nests --	# Confirmed Active RTV	# Confirmed inactive RTV nests	Total RTV nests	# Unconfirmed nests	# of Nest Trees Confirmed to Another Species	Total # of all nest Trees
Directions:						
Loc Notes:						
Survey Notes:						

RED TREE VOLE NEST TREE and NEST DATA FORM (FORM #3):
Data Form for Field Use & ISMS
Version 2.0 : 12/99

Survey Date: ____/____/ ____ Observer(s) _____ Page _____ of _____

Loc_id	Admin_unit	SubAdmin_Unit	Project Name	Project Unit #
Survey_ID	Transect #			

Nest Tree Information:

Tree_ Id:	UTM-East	UTM-North	Aspect @ tree	Slope @ tree	Nest Tree Species Code	Tree DBH (in.)	Nest Height	# of nests in tree

NEST DATA FIELDS:

Confirmed RTV Nests Y N	How Confirmed? Resin Ducts Cuttings	Confirmed Active RTV Y N	Other confirmed RTV nests within 100 meters? Y N	Climbed? Y N

Date Confirmed	Confirmed by Whom?	How Confirmed Active?	NEST SUPPORT SB BW PBC MT FBC CAV

Tree Obs. Notes:

RED TREE VOLE SURVEY & MANAGE (FORM #2)

Data Form for Field Use & ISMS
Version 2.0 : 12/99

DAILY TRANSECT OBSERVATION DATA FORM			
Loc_id	**Admin_unit**	**SubAdmin_Unit**	**Project Name**
Project Unit:	**Date: _____/ _____/ 2000**		**Page** **OF**
Survey_ID			
Transect	**Stand Type**	**Transect Bearing (deg)**	**Observers**

		Nest Tree Confirmation								
Transect #	Tree_ID	**Confirmed RTV Nest Tree**	**Confirmed Active RTV**	**Confirmed Inactive RTV**	**Confirmed Other Species**	**Unconfirmed**	**Distance Along Transect**	**Distance From Transect**	**Distance off Transect**	**Notes on arboreal structure or nest tree**

RTV DATA SHEET FIELDS & DATA CODES

The red tree vole data sheets were developed to assure the collection and management of data collected during pre-project surveys for the red tree vole. This effort is an interagency effort spanning two agencies and two states, therefore, the data fields on the forms are an attempt to meet the data management requirements of this effort. Some fields on the data forms may seem unneeded at a local level but are necessary if this data is to be useful for regional analysis.

Three types of red tree vole data sheets are provided in this protocol. Two of the data sheets contain information that will be entered into the ISMS database. The third form is provided as a tracking form to use while conducting the surveys but this information will not be entered into ISMS. The three data forms consist of :

1. **RED TREE VOLE SURVEY AREA DESCRIPTION & SUMMARY DATA FORM (Form #1):**
   This form is used to ID the vole site or survey area if no confirmed vole nests are detected. The form contains general information about the survey site. Stand level data are to be collected for the median stand condition and represent the general characteristics of the area surveyed.

2. **TRANSECT OBSERVATION DATA FORM (Form #2):**
   The observation data form can be used to track nests, suspected nest, or other objects detected along each transect until a final confirmation is determined. This data form can be used to maintain an informal record of other arboreal rodent species nests detected along the transect route but this form will not be entered into ISMS.

3. **RED TREE VOLE NEST TREE and NEST DATA FORM (From #3):**
   The nest tree data form is used to record ID's for confirmed RTV nests and record information measured on each confirmed red tree vole nest tree. A few items are recorded on nests detected in a confirmed nest tree but field crews do not have to record measurements on every nest observed in a confirmed RTV nest tree.

Each data sheet has a code sheet that describes the fields contained on the form and the appropriate values or ISMS codes for each field.

[M] = Indicates a mandatory data field for inclusion into ISMS database.

General Comments of ID Data Fields

Several ID fields are provided to keep track of the different red tree vole sites and surveys. In general we tried to use ISMS names for data fields. Some fields are repeated on each data form only as a header to keep track of your survey forms and effort.

The fields listed below are common header fields used on each data form:

Loc_ID:	Unique ID Number for the Area inclosing the tree vole populations (polygons around all nest trees a site)
Alt_Loc_id:	Alternate ID can be used to relate two or survey areas to each other as a "population or meta-population".
Survey_ID:	ID that can be used to track return surveys to the same area.
Tree_ID:	ID used to track individual nest trees within a survey area
Admin_unit:	Administrative Unit that manages location --- Use ISMS code list for data entry
SubAdmin_unit:	BLM District's Resource Area or National Forest's district conducting survey

FORM #1 – RED TREE VOLE SURVEY AREA DESCRIPTION & SUMMARY DATA FORM CODE SHEET

Where possible field names on the RTV data sheet match appropriate ISMS data fields.

[M] = Indicates a mandatory data field for inclusion in ISMS database.

Loc_ID *[M]:* Unique ID Number for the Area inclosing the tree vole site (a polygons you draw around all nest trees at a site)

Alt_Loc_id: Alternate ID can be used to relate two or more survey areas to each other as a "population or meta-population".

Survey_ID: ID that can be used to track return surveys to the same area.

Admin_unit *[M]:* Required; Administrative Unit that manages location (use ISMS codes).

SubAdmin_unit *[M]:* Required; Sub-Administrative Unit responsible for managing location (use ISMS codes)..

Project Name *[M]:* Timber Sale Name or other survey project identifier.

Project UNIT # *[M]:* Timber Sale Unit number or other survey project identifier number

GIS_POLY *[M]* Identification number(s) from the agency's GIS coverage where site is located.

Next set of fields for the legal location : ISMS will accept down to 1/16 sec.

Twnshp *[M]*	Township (example 25 S)
Range *[M]*	Range (example 4 E)
Section *[M]*	Section Number
1/4 Sec	Quarter Section
1/16 Sec	1/16 section

BASE_MERIDIAN *[M]* Meridian system used to identify site legal locations
W = Willamette
H = Humbolt
MD = Mount Diablo

UTM: Location should be recorded in UTM zone 10, using the NAD 27 datum.

UTM_East *[M]*	6 digits = UTM X axis
UTM_North *[M]*	7 digits = UTM Y axis

SITE ELEVATION *[M]:* Enter median elevation of site or survey area in feet.

TOTAL TRANSECT LENGTH (ft.) Total length of survey (if line transect or strip transect)

TOTAL ACRES IN UNIT *[M]:* Enter the total number of acres in unit.

SURVEY ACRES IN UNIT *[M]:* Enter total number of acres surveyed in project unit, survey area, or timber sale unit.

PLANT ASSOCIATION CODE [M]: See ISMS for list of codes: Enter standard ISMS Code for plant sub-series *[Minimum] or* plant association if known.

HUC5_NAME: 5^{Th} field watershed name or HUC5 numbers of site.

STAND AGE (in years) *[M]*: Enter the age or estimated age of stand (in years) when the survey was conducted.

OVER-STORY STAND SIZE CLASS *[M]:* See below

MID-STORY STAND SIZE CLASS *[M]:* See below

--- Size class codes for the above two fields:

Stand size	Code	Stand size description
Giant	**5**	**Trees >= 32 in. d.b.h.**
Large	**4**	**Trees 21-31.9 in. d.b.h.**
Medium	**3**	**Trees 9-20.9 in. d.b.h.**
Pole	**2**	**Trees 5-8.9 in. d.b.h.**
Sapling	**1**	**Trees 1-4.9 in. d.b.h.**
Seedling	**0**	**Seedlings < 1 inches diameter**
Unspecified	**U**	**Unspecified stand tree size**

REMNANT TREES PRESENT IN STAND? [*M*]: Yes No

STAND MANAGEMENT HISTORY CODE *[M]:*

NS Natural stand, No past management of stand visible.
RS Residual stand after partial cutting of mature stand (shelterwood)**.**
TH Stand has been thinned but has more stems per acre than a shelterwood cut**.**
SL Minor salvage or single tree removed from stand**.**
P Plantation or other planted stand**.**
U Unspecified.

Location's Habitat Conditions (LOC_COND): Condition of the habitat needed to support the species at the location or site at the time of the survey

Code	location condition description
Excellent	Excellent habitat conditions
Fair	Fair habitat condition
Good	Good habitat condition
Poor	Poor habitat condition
Unknown	Unknown if habitat condition good for species**.**

SITE STATUS (LOC_STATUS) Indicates presence or occupancy of species at this location**.**

CODE	Location status description
Extinct	The species no longer exists.
Extirpated	Species and habitat no longer exist at this site.
Occupied	Location occupied by species.
Undetected	Species not detected on this survey but "Unoccupied" not confirmed.
Unoccupied	Location confirmed not occupied by species.
Unknown	Not known if species is present.

Next 5 fields are summary counts of the number of nest tree detected in survey unit.

 # CONFIRMED RTV NEST(s) [M]: Number of confirmed RTV nests but not confirmed active (current status unknown).

 # CONFIRMED ACTIVE RTV NEST(s) [M]: Number of active or occupied red tree vole nests detected**.**

 # CONFIRMED INACTIVE RTV NEST(s) [M]: Number of Confirmed RTV nest tree(s) also confirmed to be not currently used by a RTV.

Total RTV_NESTS [M]: Total of RTV nests in survey area (sum of the above 3 fields above).

 # UNCONFIRMED NEST(S) [M]: Number of nest or nest like structure where survey could not determine if nest was a red tree vole or some unknown specie's nest.

 # OF OTHER SPECIES NEST(s) CONFIRMED [M]: Enter the number of arboreal nest confirmed to be another species.

TOTAL # OF ALL NEST TREES IN SURVEY [M]: Enter the sum of all above nest catigories.

SURVEY_METHOD_CODE [M]: Required. Survey or specimen capture method (code) used to survey location for red tree vole specimens or nest trees.

Code	Method
MLT	Modified line transects (method used in the RTV protocol
TLT	True line transects sampling methodology.
ICD	Incidental detection
TCW	Time constrained walk-about sampling
PFTS	Pitfall trapping site.
SNAP	Snap trapping collection site
ROAD	Road Surveys for nests.
RS	Research Site, Other capture methods
SCS	Specimen collected at site.
RTL	Nest tree detected as a result of radio telemetry locations

MAP_ACCURACY Describes the precision with which the ISMS recorded UTMS or lat/longs and the associated GIS digitized (electronic) point or polygon matches the actual ground site location. Use National Map Accuracy Standards as a guide. **(Use the following ISMS codes)**

MAP ACCURACY	Map Accuracy Description
<1.5 mile	Mapped within 1.5 mile
<1/2 mile	Mapped within 1/2 mile
<1/4 mile	Mapped within 1/4 mile
<1/8 mile	Mapped within 1/8 mile
<150 ft	Mapped within 150 feet
<1 mile	Mapped within 1 mile
<300 ft	Mapped within 300 feet
<30 ft	Mapped within 30 feet
<3 ft	Mapped within 3 feet
<5 mile	Mapped within 5 miles
>5 mile	Map accuracy beyond 5 miles
Questionable	Possible error

DIRECTIONS: Short note or information on direction to site.

LOC_NOTES: Optional notes on or about Locations.

SURVEY_NOTES: Optional notes on survey effort.

FORM # 2 – RED TREE VOLE NEST TREE SURVEYS
TRANSECT OBSERVATION CODE SHEET

This optional data sheet will not be directly entered into the ISMS data base but is provided as a way to keep track of individual observations along a transect. The sheet should help you relocate objects along a transect and determine which trees may need to be climbed to confirm usage by a red tree vole.

Header Fields ---

Loc_ID *[M]:* Unique ID Number for the Area inclosing the tree vole site (polygon you draw around all nest trees).

Admin_unit *[M]:* **Required**; Administrative Unit that manages location **(use ISMS codes)**

SubAdmin_unit *[M]:* **Required;** Sub-Administrative Unit responsible for managing location. (use ISMS codes)

PROJECT NAME *[M]:* Timber Sale Name or other survey project identifier.
PROJECT UNIT # *[M]:* Timber Sale Unit number or other survey project identifier number
Date *[M]* Date transect was searched

Survey_ID: ID used to track return surveys to the same site.

Transect: Identify which set of transects this sheet is associated.

Transect Bearing: Transect bearing in degrees.

Observers: List the observers for this transect.

Data Fields ---

Transect: # Identify which transect line this record is associated.

Tree_ID [M]: All confirmed red tree vole nest trees should be assigned a unique tree ID and this id should also appear on the Nest Tree Data Form (Data form #3).

Confirmed RTV Nest Tree [M]: Enter code for sign (from below list) used to confirm nest was an RTV's.

Confirmed <u>Active</u> RTV Nest Tree [M]: Enter code for sign (from below list) used to confirm nest was an active RTV's.

Sign used for positive confirmation of red tree vole use or current activity

Code	Description
RD	Resin ducts present
FGRD	Fresh Green Resin Ducts found
C	Douglas-fir cuttings found
FC	Fresh Douglas-fir cuttings found.
SA	Saw animal leave nest.

Confirmed Inactive RTV nest tree [M]: Check if nest confirmed to be old inactive RTV nest.

Other species confirmed [M]: Enter species code when another species in confirmed as using a nest tree on survey

Unconfirmed: Check if nest tree is unconfirmed to species**.**

Next three fields are used to relocate nest along transect.

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

Direction from Transect: Enter the direction (left or right) the detected nest is located relative to direction of travel on transect

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

Notes on nest tree or objects: Enter notes or comments about this nest tree or object.

FORM # 3 – RED TREE VOLE NEST TREE AND NEST DATA FORM CODE SHEET

Where possible field name match appropriate ISMS data fields.

[M] = Indicates a mandatory Data field for inclusion into ISMS database.

Header Fields NOT re-entered into ISMS ---

Loc_ID [M]: Unique ID Number for the Area inclosing the tree vole site (a polygons you draw around all nest trees at a site)**.**

Alt_Loc_id: Alternate ID can be used to relate two or more survey areas to each other as a "population or meta-population".

Survey_ID: ID that can be used to track return surveys to the same area.

Admin_unit *[M]:* **Required;** Administrative Unit that manages location **(See ISMS codes).**

SubAdmin_unit *[M]:* **Required;** Sub-Administrative Unit responsible for managing location **(See ISMS codes)**.

PROJECT NAME [M]: Timber Sale Name or other survey project identifier.

PROJECT UNIT # *[M]:* Timber Sale Unit number or other survey project identifier number

Nest Tree Data Fields ----

TREE_ID [M] Unique code for each nest tree found at site

UTM: Location should be recorded in UTM zone 10, using the NAD 27 datum.

UTM_East *[M]* 6 digits = UTM X axis
UTM_North *[M]* 7 digits = UTM Y axis

ASPECT (deg): Enter aspect at nest tree.

SLOPE (deg): Enter slope at nest tree.

NEST TREE SPECIES CODE: Enter standard 4 letter code for tree species (First 2 letters of genus plus first 2 letters of species name)

TREE DBF (in.): Enter the nest tree's d.b.h. in inches.

NEST HEIGHT: Enter the nest's height above ground. If more than one nest record the largest freshest nest detected.

# of RTV NESTS IN TREE: Enter the number of confirmed Red tree vole nest found in tree.

NEST DATA FIELDS --

CONFIRMED RTV NEST [M]: **YES or NO.**

HOW CONFIRMED RTV [M]: Enter code for sign (from below list) used to confirm nest was a red tree vole's.

How Confirmed <u>Active</u> RTV Nest Tree [M]: Enter code for sign (from below list) used to confirm as active RTV.

Sign used for positive confirmation of red tree vole use or current activity

Code	Description
RD	Resin ducts present
FGRD	Fresh Green Resin Ducts found
C	Douglas-fir cuttings found
FC	Fresh Douglas-fir cuttings found.
SA	Survey saw animal.

OTHER CONFIRMED RTV NEST WITHIN 100 meters [M] : Yes or No.

CLIMBED? [M] : Was tree climbed? **Yes or No.**

DATE CONFIRMED: List date vole nest tree was confirmed. Could be different than survey date if tree had to be climbed before making final determination**.**

CONFIRMED BY WHOM: List the person who made the final determination of red tree vole usage.

NEST SUPPORT Llist type of structure support the red tree vole nest.

Code	**Description**
SB	Single large Branch
BW	Branch Whorl
PBC	Palmate Branch Cluster
MT	Mistletoe clump
FBC	Forked top
CAV	Tree Cavity

TREE OBSERVATIONS NOTES: Optional, notes on nest tree or nest(s) within this tree.