A PROPOSED LANDSCAPE APPROACH FOR MANAGING LATE-SUCCESSIONAL FOREST AND RIPARIAN HABITATS FOR ASSOCIATED VERTEBRATE SPECIES

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Abstract: To address management questions involving riparian and late-successional coniferous forests, the Tahoe National Forest developed a proposed habitat management program for vertebrate species associated with these communities. This management program will be part of a comprehensive management strategy for all resource values. The proposal includes an overall landscape design and desired structural conditions for late-successional forest and riparian habitats. Our recommended landscape design consists of blocks of late-successional forest within an interconnected late-successional forest network centered on riparian areas and joined over ridges to adjacent watersheds. The objective of the habitat blocks is to maintain viable populations of wildlife that are associated with interior late-successional forest conditions. The width of the late-successional forest network increases with stream size. Network areas along small streams and in the ridgetop connectors provide wildlife travelways. Along large streams and rivers, network areas provide travelways and yearlong or seasonal habitat for associated vertebrate species. The desired structural condition in the late-successional forest areas is the maintenance of the key habitat elements most often associated with terrestrial vertebrates: large trees, large snags, large down logs, and multi-layered canopies. The goal for riparian zones is to provide all key habitat elements needed to maintain functioning riparian and stream ecosystems over time. The recommended management program is offered as a set of testable working hypotheses.

The Tahoe National Forest (TNF) is developing a comprehensive habitat management program for wildlife and fish species associated with late-successional forests and riparian areas. As part of this process, the TNF biologists proposed management recommendations for these species, which will be combined with habitat management direction for the California spotted owl (*Strix occidentalis occidentalis*). The TNF will consider the wildlife and fish recommendations and other resource values for late-successional forests and riparian areas and will develop a comprehensive strategy for managing these areas for all resources.

METHODS

A Wildlife and Fish Working Group was organized in May 1991 to develop landscape-level management recommendations for key fish and wildlife habitat elements of late-successional forests and riparian habitats. The core Working Group consisted of TNF fish and wildlife biologists. Biologists from other National Forests, the Pacific Southwest Research Station, and California Department of Fish and Game periodically joined the Group. The California Wildlife Habitat Relationships Database was used to identify individual species having strong associations with these habitats or major habitat components within these habitats in the Sierra Nevada. Identified late-successional coniferous forest species were: ensatina (*Ensatina eschscholtzi*), goshawk (*Accipiter gentilis*), pileated woodpecker (*Dryocopus pileatus*), hairy woodpecker (*Picoides villosus*), red-breasted nuthatch (*Sitta canadensis*), pygmy nuthatch (*S. pygmaea*), brown creeper (*Certhia americana*), golden-crowned kinglet (*Regulus satrapa*), winter wren (*Troglodytes troglodytes*), Hammond's flycatcher (*Empidonax hammondii*), pine grosbeak (*Pinicola enucleater*), evening grosbeak (*Coccothraustes vespertinus*), northern flying squirrel (*Glaucomys sabrinus*), Sierra Nevada red fox (*Vulpes vulpes necator*), marten (*Martes americana*), fisher (*M. pennanti*), ermine (*Mustela erminea*), and black bear (*Ursus americanus*). Identified riparian species were: ensatina, mountain yellow-legged frog (*Rana mucosa*), western terrestrial garter snake (*Thamnophis elegans*), wood duck (*Aix sponsa*), yellow-bellied sapsucker (*Sphyrapicus varius*), downy woodpecker (*Picoides pubescens*), willow flycatcher (*Empidonax traillii*), western flycatcher (*E. difficilis*), house wren (*Troglodytes aedon*), wilson's warbler (*Wilsonia pusilla*), yellow warbler (*Dendroica petechia*), black-headed grosbeak (*Pheucticus melanocephalus*), lincoln's sparrow (*Melospiza lincolnii*), song sparrow (*M. melodia*), dusky shrew (*Sorex monticolus*), vagrant shrew (*S. vagrans*), water shrew (*S. palustris*), ornate shrew (*S. ornatus*), western jumping mouse (*Zapus princeps*), and mountain beaver (*Aplodontia rufa*). The Working Group reviewed pertanent scientific literature from landscape ecology and fish and wildlife habitat relationships in late-successional forests, stream environments, and riparian areas. Literature reviews summarized the subject areas (Carlson et al. 1991, Chapel et al. 1991a, Chapel et al. 1991b).

Recommendations for managing late-successional forest and riparian habitats were developed from these literature reviews. In October, 1991, the Working Group

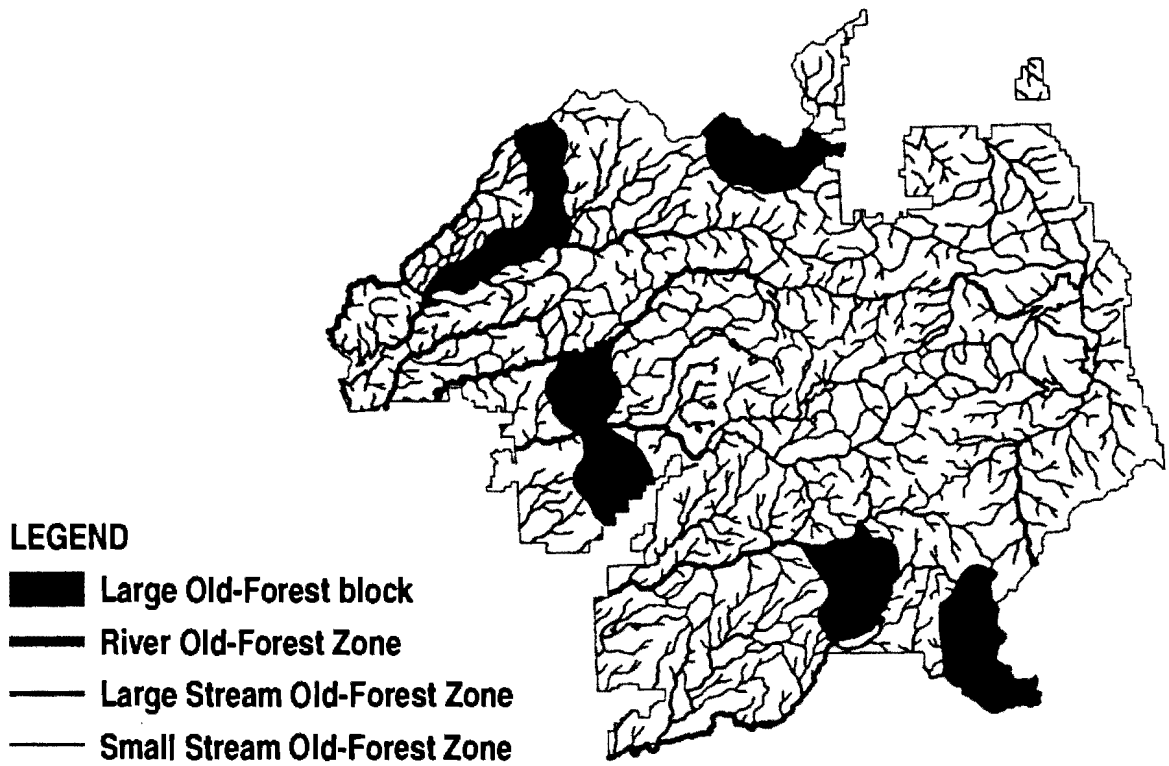

Fig. 1. A conceptual layout of the old forest/riparian system on the Tahoe National Forest.

met with scientists knowledgeable in landscape ecology, conservation biology, and fish and wildlife habitat relationships in late-successional forests and riparian areas in the Sierra Nevada to discuss and evaluate the preliminary recommendations. A draft version, which incorporated the concepts and other input from the scientists, was subsequently peer-reviewed in Fall, 1991, before the recommendations were finalized (Chapel et al. 1992).

RESULTS

The recommendations offer a general framework for establishing site-specific management programs for late-successional forest and riparian habitats for vertebrate species. Our goal was to establish general standards for desired future landscape and stand conditions while allowing local planning groups to determine specific details. The application of these general guidelines are expected to vary on a project-by-project basis, within the forest-wide framework.

The recommended program consists of: 1) desired landscape configuration; 2) desired conditions for riparian areas; and 3) recommended stand conditions for late-successional forests

Desired Landscape Configuration

The recommended landscape design for late-successional forest and riparian habitats (Old-Forest/Riparian System) consists of scattered, large, late-successional forest habitat blocks connected by a Riparian/Old-Forest Network (Fig. 1). The design provides a completely connected system of habitats for associated vertebrate species. The system was designed to combine the advantages of a habitat block strategy and a habitat network and reflects the principles of conservation biology that relate to species associated with late-successional forest and riparian habitats (Diamond 1975, den Boer 1981, Harris 1984, Noss and Harris 1986, Wilcove et al. 1986, Murphy 1989, Thomas et al. 1990):

- Species that are well-distributed across their range are less prone to extinction than those that are restricted to a portion of their former range.

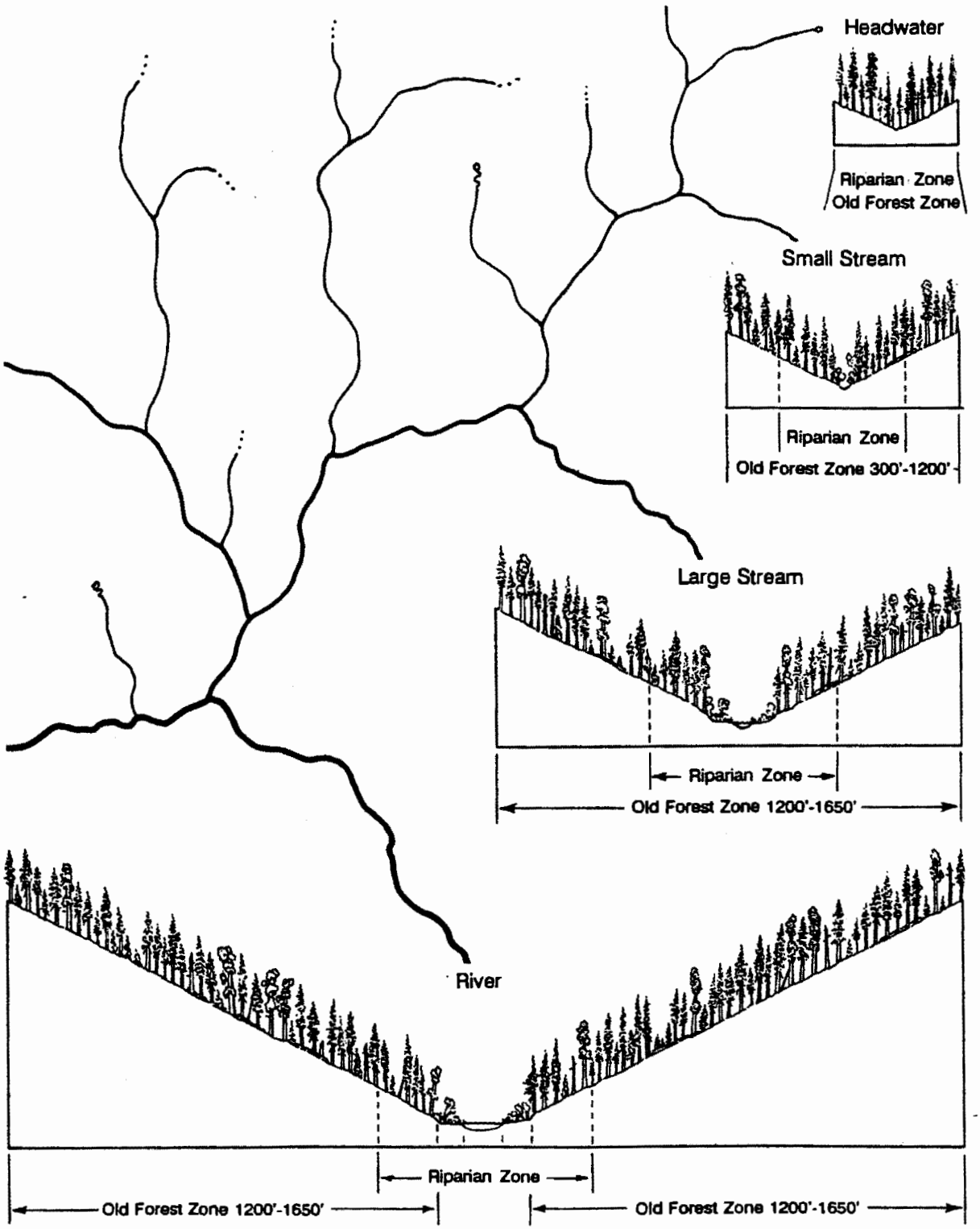

Fig. 2. The Riparian/Old-Forest Network.

Table 1. Minimum travelway width requirements for habitat adjacent to small streams and within connectors. From Freel (1991). Unfragmented habitat is habitat within late-successional stands and fragmented habitat is habitat adjacent to areas with open or no canopy.

Species	Unfragmented habitat	Fragmented habitat
Marten	91 m (300 ft)	183 m (600 ft)
Fisher	183 m (600 ft)	366 m (1,200 ft)

minimum patch size requirements of the associated vertebrates. A width of 503 m (1650 ft) equals the diameter of a circular 20 ha (50 ac) minimum patch size for goshawk and pileated woodpecker and would accomodate circular home ranges for the other target species, except marten and fisher (Chapel et al. 1922). The Working Group and scientists hypothesized that the combination of the Old Forest/Riparian Network and the habitat blocks would provide sufficient connected habitat for marten and fisher, which have larger minimum patch size requirements and generally use long, narrow areas. This assumption and the effectiveness of the proposed habitat configuration are management hypotheses which need to be tested.

Connectors

The objectives for connectors are to provide linkages between the late-successional habitat Blocks and the Riparian/Old-Forest Network across the landscape and to function as travelways (Table 1). Connectors should be arranged so that each planning subwatershed (roughly 809 to 4,047 ha or 2,000 to 10,000 ac) is linked by at least one connector with all adjacent subwatersheds. Some factors which can be used site-specifically to determine optimum placement and frequency of connectors are: location of existing or potential natural vegetation; topography; areas with historical sightings of associated species; known migratory corridors; and areas known or suspected to be especially valuable to wildlife, such as the confluence of multiple headwaters.

Desired Conditions for Riparian Areas

The management strategy recommended for riparian areas is to maintain the composition and arrangement of the key habitat elements that are correlated with high habitat quality. The Working Group recommended that management activities which disturb soils, waterflow, or vegetation be prohibited in these areas, except for activities which directly benefit riparian-dependent resources. Compatable management activities that maintain or restore riparian areas should be determined site specifically.

Recommended Stand Conditions For Late-Successional Forest Habitats

The recommendations for late-successional stand conditions apply to the habitat Blocks of late-successional forests, the Old-Forest Zone of the Riparian/Old-Forest Network, and the Connectors. However, these recommendations should not be applied to the upland (forested) portion in the riparian zones (Fig. 2), where management should follow the desired conditions for riparian areas.

Studies of wildlife and fish habitat relationships in late-successional forests of the Sierra Nevada are few compared to other regions, such as the Pacific Northwest, and local habitat relationships information was largely extrapolated from other regions. There are several habitat elements, large trees, large snags and downed logs, and vertical structural diversity, which have been consistently correlated with high habitat quality for wildlife associated with late-successional forests. Large trees in the overstory vegetation provide a critical habitat component for wildlife, primarily passerine birds (Franzreb and Omart 1978) and some amphibians, reptiles, and mammals (Raphael 1988). The large trees indirectly regulate the cool, moist condition on the forest floor that is needed for many amphibians (Welsh and Lind 1988). The large trees are the recruitment pool for large snags and logs over time. Large snags and logs are the most important factors for many wildlife species associated with late-successional forests (Aubry et al. 1988, Maser et al. 1988, Ralph et al. 1991). Therefore, large overstory trees should be managed to provide canopy habitats, cool and moist soil conditions on the forest floor, and recruitment of large logs and snags in late-successional forest habitats. Bird abundance and diversity has been correlated with vertical structural diversity (MacArthur 1964, Temple et al. 1979). The Working Group recommends focusing management of late-successional forest habitats in the Sierra Nevada on these structural components.

The Working Group used data from the Ecosystem Classification Project of the Pacific Southwest Region's Ecology Program (USFS 1992) to generate management guidelines which approximate potential natural ranges of large trees, snags, downed logs, and vertical structural diversity. The Ecosystem Classification Project provides useful data for these attributes by site productivity class for the major forest types in the Sierra Nevada. The guidelines can then be used to explore potential silvicultural methods for perpetuating the desired

arrangements of key habitat elements over time. A variety of management activities can occur within these areas, with the objective of maintaining these key components over time.

DISCUSSION

The recommended program for managing late-successional forest and riparian vertebrate species is a system of habitat blocks connected within a network of linear late-successional forest centered on riparian areas. The program is similar to the strategy recommended for the northern spotted owl by Thomas et al. (1990), which consisted of habitat blocks (HCAs) interspersed within at least some habitat suitable for owl dispersal. There is also some support in the work by McGarigal and McComb (1992), which indicates that upland areas may be more important to birds than riparian areas. Their suggested management includes expanding riparian corridor widths for species associated with late-successional forests and upslope areas and maintenance of within-stand structure, such as snags and large conifers.

The TNF is acquiring analytical tools to computer model the recommended management strategy so that forest-wide landscape placement and acreage totals can be estimated. Further analysis will wait until Region 5 of the Forest Service has finished the Draft Environmental Impact Statement for the 5-10 year strategy for managing the California spotted owl, expected in Spring, 1994. In the meantime, each project planned on the TNF is analyzed for its effects on maintaining options for implementing the proposed program. If the spotted owl strategy does not provide sufficient habitat for other late-successional stage species, the Working Group will need to determine the size and placement of habitat blocks needed to conserve stable subpopulations of a selected surrogate species.

The program recommended by the Working Group for managing late-successional forests and riparian habitats is offered as a set of working hypotheses deserving rigorous scrutiny and testing (Murphy and Noon 1991). Several tools, such as a Geographic Information System, Vegetation Change Simulators, Wildlife Species Simulators, and integrated software, are necessary to evaluate alternative management strategies in relation to conservation of individual wildlife populations, timber yield, water yield, and economics. Further, these tools would allow the TNF to test hypotheses and analyze the adequacy of the proposed program for conserving populations of wildlife species. Monitoring is necessary to validate the recommendations and model assumptions. Basic monitoring elements include compliance monitoring and monitoring trends in habitats and some wildlife populations.

Many research projects could yield data to improve management of late-successional forests, riparian areas, and biological diversity in the Sierra Nevada. Three projects with particular value are: 1) researching patterns of pre-European settlement forests at several landscape scales; 2) evaluating the appropriate management methods for wildlife species associated with late-successional forest in eastside pine, a poorly known habitat type; and 3) describing potential natural conditions for key fish and wildlife habitat elements in late-successional forests and riparian areas. We believe projects to address these subjects should be a high priority for the Forest Service in the Sierra Nevada.

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