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A PROGRAMMATIC APPROACH TO THE STUDY OF OLD-GROWTH FOREST--WILDLIFE RELATIONSHIPS

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ABSTRACT

The USDA Forest Service's Old-Growth Forest Wildlife Habitat Research and Development Program was chartered to develop information that would help managers comply with The National Forest Management Act. The focus is on Pacific Northwest Douglas-fir old-growth forests (west of the Cascade Range from Canada to California)--their uniqueness, contribution to ecological diversity, and value to wildlife. The research approach consists of geographic stratification by five physiographic provinces with replicated community studies covering a broad range of moisture, temperature, and seral stages within each province. Ecological relationships evident from community studies will form the basis for species-specific studies wherein specific hypotheses will be tested and mechanisms of association elucidated. Studies of forest fragmentation will be integrated with other results to formulate recommendations for managing viable populations of plants and animals.

INTRODUCTION AND OVERVIEW

In the Pacific Northwest, timber harvesting has replaced fire as the principal regenerative disturbance. Management has changed the forested landscape; the once dominant old-growth forests are now relatively scarce. Federal policy calls for replacement of old growth by younger, faster growing forests. But public interest has focused on the remaining old growth, its ecological importance in managed forests, and its importance as wildlife habitat.

The concern for the northern spotted owl (Strix occidentalis caurina) is likely a surrogate for much larger concerns. Does old-growth support distinctive flora or fauna that may become threatened and endangered with decreases in old-growth? Is some old-growth necessary for healthy functioning of managed forests?

In recognition of these concerns, personnel of the USDA Forest Service's Pacific Northwest Forest and Range Experiment Station held meetings with representatives of concerned interest groups in autumn 1980 at Olympia, Washington, and Corvallis, Oregon. These meetings substantiated that knowledge of old-growth forests was inadequate for informed, responsible resource management.

In July 1981, the Forest Service chartered the Old-Growth Forest Wildlife Habitats Research and Development Program. The Program was to proceed as an accelerated, multiagency, interdisciplinary research and development effort.

Current plans call for $10 million worth of research by 1989. New knowledge will be concurrently applied to management problems. The Program staff, consisting of a Program Manager, Research Coordinator, and Applications Coordinator, will not conduct the research themselves, but will plan and direct needed R&D, award research agreements to universities and other researchers, coordinate research, synthesize results, and transfer information and recommendations to managers. The staff is given policy guidance by an Executive Committee comprised of leaders from cooperating agencies and special-interest organizations, and a Technical Committee of scientists who provide technical advice.

The forest communities to be studied include the lower elevation Pacific silver fir, white fir, the tanoak, and Douglas-fir series (Driscoll et al. 1981). The geographic area covered lies west of the Cascade Range, spans 8 degrees of latitude, and encompasses at least 8 physiographic provinces from Canada to northern California (Franklin and Dyrness 1973).

DEFINITION OF THE PROBLEM

A conservative estimate of the value of old-growth timber is $1.6 million per 100 acres (Meslow et al. 1981). But old-growth forests have aesthetic values and value as distinctive, stable, and potentially unique elements of the natural landscape (Franklin et al. 1981). Some undisturbed old-growth forest have occupied the same site for six centuries or more. In addition, old-growth is an especially diverse ecosystem component (Franklin 1982). And, some believe that old-growth has value as wildlife habitat with certain species best meeting their survival-related needs there (Forsman 1980, Meslow et al. 1981, Schoen et al. 1981).

The distinctive characteristics are large and highly individualistic trees, large snags, and large fallen trees on land and in streams. These features take 175-250 years to develop (Franklin et al. 1981). Maximizing production of wood requires harvesting trees when their rate of growth begins to decline--at 50-80 years in the Pacific Northwest. Harvest at this age precludes the development of old-growth characteristics.

Regulations governing management of National Forests (MacCleery 1982) bear on this problem by mandating:

> "Management prescriptions, where appropriate and to the extent practicable, shall preserve and enhance the diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species, so that it is at least as great as that which would be found in a natural forest..." (MacCleery 1982: 43051).

and

> "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species..." (MacCleery 1982: 43050).

Thus, if old-growth is a unique ecological community, some must be maintained to contributed to community diversity. Similarly, if vertebrate species are dependent upon old growth, enough old growth must be maintained to ensure viable populations.

PROGRAM DIRECTION

Objectives

The Program should answer the following questions:

1. Are old-growth forests unique components of coniferous forest ecosystems?
2. If unique, what are the characteristics of these forests, and how can their roles in coniferous forest ecosystems be perpetuated?
3. Do these forests contain distinct animal communities--do certain vertebrate groups or species depend upon old growth for survival or optimal habitat?
4. If dependencies exist, how much old growth is needed: how should it be distributed, connected, and otherwise arranged to ensure the long-term viability of dependent species populations?

To answer these questions a highly integrated programmatic approach (Ruggiero 1982, Ruggiero and Carey 1982--unpublished reports on file, Forestry Sciences Laboratory, Olympia) is necessary.

Program Management Goals

Program results must be comprehensive. The Program must resolve the issues of vertebrate dependency and managing old-growth as an ecosystem component; hence, the Program's mission is comprehensive by definition. Studying a limited number of potentially dependent plants and animals will not suffice. The reasons for the Program demand that all existing native vertebrates and animal communities be accounted for. Because such an accounting is not possible based on extant scientific literature (Taber and Raedeke 1982--unpublished report on file, Forestry Sciences Laboratory, Olympia), the Program must strive to produce comprehensive, original results. Falling short of this goal may not mean failure, but to overlook this reality by design would be to plan only part of the needed effort.

Program results must be generalizable to the geographic area of concern. This means that results must be applicable to all planning units within the geographic area--without reliance on untested extrapolations.

Program results must be reliable, both statistically and in terms of rigorous application of scientific methods (see Romesburg 1981). Correlations, current understanding, and theory must be used to generate testable hypotheses about ecological mechanisms. Correlations alone do not explain why relationships exist and may be inadequate for specific management recommendations.

Overview of Existing Information

Harris (in press) developed comprehensive guidelines for managing west-side old-growth to ensure viable populations of wildlife. His scheme is defensible; indeed, it's unlikely that better guidelines could be produced from existing information. Harris' guidelines could be used in lieu of an accelerated research effort, and his work should be viewed as the prevailing scientific input to management decisions until such time as new research provides more precise or different information.

Wildlife habitat relationships compilations and natural history reports on species provide an overview of what is known or believed about species' habitats. (The most pertinent compilation is an excellent unpublished report by Jones and Stokes, Inc., [on file, Forestry Sciences Laboratory, Olympia] to the Northwest Timber Association and Western Forest Industries Association, 1980.) Wildlife habitat relationships compilations were reviewed by Taber and Raedeke (unpublished report on file, Forestry Sciences Laboratory, Olympia) who produced a list of 75 vertebrate species that have been reported to be dependent upon or find optimum habitat in Pacific Northwest old-growth forests. The compilation is based on 12 reports, 6 published (Hagar 1960, Meslow 1978, Meslow et al. 1981, Sanderson et al. 1980, Silovsky and Pinto 1974, and Wright 1974), and 6 unpublished. Taber and Raedeke suggest that some of these species do not require old growth for their survival and conclude that the literature is inadequate as a basis for discrimination. (It should be noted, however, that for 20 of the 76 species listed, 4 or more of the 12 authors agree on close association with old-growth).

Commenting on the reliability of existing wildlife habitat relationships compilations, Taber and Raedeke state:

> "The information is a mixture of established fact, professional observation, hearsay, and conjecture. It seems most prudent to treat these statements as testable hypotheses and, in current and future field work, obtain reliable data concerning their validity. The inconsistencies...strongly suggest an insufficiency of reliable data".

And, in the introduction to Wildlife Habitats in Managed Forests, Thomas (1979) states:

> "This book is based on the collective knowledge of one group of resource professionals and their understanding about how wildlife relate to forest habitats. The book represents a reasonable facsimile of the way managed forests and wildlife interrelate. In this sense, the entire book may be termed a working hypothesis. It is a place to start and a way to derive tentative responses to questions for which there are no certain answers."

Conceptual Framework

Several fundamental concepts were considered in developing Program direction. Perhaps the most basic is the notion that wildlife habitat relationships research must examine patterns of species abundance within years, among years, and in a community context if habitats are to be reliably described (see Van Horne 1983 and Carey 1981). Such an approach facilitates the development of hypotheses about the specific nature of species' associations with particular elements of the landscape (including the degree of association, the mechanism of associations, and reasons for association). Through testing of these hypotheses, specific ideas about dependency (including consideration of intraspecific and interspecific interactions) are accepted or rejected. Because patterns of species abundance are strongly influenced by major environmental gradients (for example, moisture, temperature, and forest structure) these factors are also included in the Program design.

Patterns of vertebrate abundance change in some instances as old-growth forests are fragmented by timber harvesting (see Burgess and Sharpe 1981, Harris in press). As fragments become smaller, suitability may diminish for certain species (Fritz 1979, Robbins 1979, Samson 1980, see also Diamond 1978, Gilbert 1980). And, as fragments become further removed from like environments, the existence of dependent populations is jeopardized (see Soule and Wilcox 1980).

Dependency is a complex concept, and the essential operational definition has not been fully developed. But, because the notion of dependency is basic to our mission, the Program has begun developing a definition--see Carey (in press) in these proceedings. We began by rejecting the commonly used terms "obligatory" and "facultative" for describing wildlife habitat relationships because these terms suggest the existence of obvious (black and white) ecological differences rather than continua of suitability characterized by subtle, time-specific, long-term relationships. Accordingly, the terms "facultative" and "obligatory" have little practical value for our purposes.

RESEARCH APPROACH

Planned Program research is divided into five integrated components: vegetation community ecology, vertebrate community ecology, species specific studies, insular ecology, and a miscellaneous category called other studies. An overview of studies planned in each component follows--a more detailed discussion is presented in the Program Action Plan (unpublished report on file, Forestry Sciences Laboratory, Olympia).

Vegetation Community Ecology

The vegetation community ecology component of the Program will quantify the composition and structure of young, mature, and old-growth Douglas-fir forests. Unique characteristics associated with older forests will be identified, a standard definition and classification scheme will be developed, and quantitative comparisons between managed and unmanaged stands will be made (to the extent that managed stands can be located). Analysis of the variation in composition and structure across the geographic area covered by the Program will be facilitated by physiographic stratification after Franklin and Dyrness (1973).

Five physiographic provinces (or combinations thereof) being considered are the Olympic Peninsula and Northern Washington Cascades, the Southern Washington Cascades, the Cascades of Oregon, the Coast Ranges of Oregon, and the Klamath Mountains of northern California and southwestern Oregon. Within each of these provinces, stands will be preferentially selected to represent a wide range of moisture, temperature, and forest developmental conditions. At least 20 stands in the following categories will be sampled within each province: modal young (50-70 y), modal mature (100-120 y), modal old growth (200 y), dry old growth, and wet old growth.

Vertebrate Community Ecology

Patterns of species abundance will be studied in up to three geographically distinct areas within each province. Fifteen stands per area (or a total of 45) will be selected from the vegetation study stands. The 45 stands will include 9 replicates of each forest condition described above. Large stands will be selected to minimize the influence of surrounding environments because we are interested in describing potential old-growth communities, and bias is introduced when relatively small stands are surrounded by disparate environments.

Each province-specific, vertebrate-community study has been planned to run for 3 years. Specific study techniques and final sampling guidelines will be based on pilot studies that will be completed in the spring of 1984 for bird, mammal, amphibian and reptile communities. Final sampling guidelines will stress the sampling of species (and their closest ecological associates) that appear to be most closely tied to old-growth forests. Community-study results will be used to develop specific hypothesis about the relationships of vertebrates to old-growth forests.

Species-Specific Studies

Hypotheses about species:old-growth relationships will be tested in species-specific studies. With few exceptions (e.g., the northern spotted owl) species-specific studies will begin after sufficient insights have been gathered from community studies. These studies may focus on key elements of the landscape or communities within the landscape. In addition they may quantify species' responses to both intercommunity and intracommunity variables

including competitive and predator-prey relationships, examine most aspects of the species' population biology, or concentrate on population dynamics, dispersal behavior, and minimum area requirements. Studies should result in specific management guidelines for maintaining a pattern of abundance of old-growth stands in conjunction with silvicultural options that will ensure species viability.

Insular Ecology

The insular ecology component will assess the impact of old-growth forest fragmentation on patterns of species abundance. This information, in conjunction with the results of the vertebrate community and the species-specific studies, will be used to formulate management alternatives.

The consequences of forest fragmentation depend on the patterns of abundance of remaining old-growth stands. The smaller the stand and the more disparate (i.e., the earlier the stages of forest development) the environment surrounding the stand (the stand context), the greater the pressure will be on old-growth species from early seral species. In other words, in a small old-growth stand surrounded by grass/forbs, shrubs, and sapling stages, one would expect to find a vertebrate community characterized more by generalist and early successional species than by old-growth specialist species just because of the competitive advantage (i.e., the larger base populations) of the generalist and early successional species. The small stand would be devoid of some species just because they require a larger resource base. Furthermore, small stands would be less heterogeneous than a large forest and thus less capable of supporting a diverse array of species. If the stand was only marginally capable of supporting populations of old-growth-dependent species and if it was not near (relative to the dispersal abilities of those species) other old-growth stands, these species populations would sooner or later become extinct. Additional causes of the species/area effect are unknown, but presumably could be operational in these situations. And, finally, at some threshold of "smallness" a stand would begin to lose its old-growth characteristics because of environmental influences alone (e.g., being more exposed may result in a drier microclimate within the stand).

Implementation and design of the insular ecology component will depend upon vertebrate community ecology study results.

Other Studies

The Program charter calls for examining economic aspects of management alternatives, evaluating silvicultural options, and completing an old-growth forest inventory. Research planning has focused primarily on collecting ecological and inventory data. The other study needs will be considered as the appropriate information is developed. Studies to evaluate silvicultural options will be planned after basic data on habitat relationships are collected. Including managed stands in the community ecology studies will provide a basis for evaluation of silvicultural options and for generating testable hypotheses about the effect of management activities.

An old-growth inventory will be conducted by the National Forest System in the Pacific Northwest. A strategy for proceeding with this effort is currently being developed in cooperation with the Program.

Other studies play an important role in satisfying immediate management informational needs. Such studies have been planned to supplement key Program research, and one dealing with the effectiveness of northern spotted owl management practices will begin in early 1984.

Synthesis and Development

Due to the interweaving of the research approach, the results of several studies will have to be integrated by Program staff or assigned to additional investigators. Synthesis of results will result in several types of products, but ultimately these products will be integrated into management recommendations and data bases useful to the National Forest System, National Park Service, the Bureau of Land Management, and other potential users of the information. Workshops and symposia are planned as part of the development and technology transfer efforts.

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