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DOCUMENT NO. AND TYPE	SUBJECT/TITLE	DATE	RESTRICTION
001. memo	From: Evelyn Badger, To: Mike Schmidt, Re: Names and Birthdates of participants in 4-27-93 - 1:00 P.M. meeting [partial] (1 page)	01/22/93	b(6)

COLLECTION:
Clinton Presidential Records
Domestic Policy Council
Michael Schmidt
OA/Box Number: 7349

FOLDER TITLE:
Douglas Project [Spotted Owl]

2013-0968-S
sb59

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P1 National Security Classified Information [(a)(1) of the PRA]
P2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P3 Release would violate a Federal statute [(a)(3) of the PRA]
P4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P5 Release would disclose confidential advice between the President and his advisors, or between such advisors [a)(5) of the PRA]
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b(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
b(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
b(9) Release would disclose geological or geophysical information concerning wells [(b)(9) of the FOIA]

Douglas Project

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Douglas Project Coalition

Representing Douglas County Through
County Government, Grassroots Activists, Organized Labor & Industry
3000 Stewart Parkway Suite 208
Roseburg, OR 97470
(503) 672-0757 (503) 672-3833 (fax)

To: Mike Schmidt

From: Evelyn Badger

Names & birthdate of participants in 4-27-93 - 1:00 p.m meeting.

Doug Robertson [redacted] (b)(6)
Darryl Middleton [redacted] (b)(6)
Don Johnson [redacted]
Cary Jones (b)(6)
Evelyn Badger [redacted]

Issue: long time frame

Douglas Project

- A Study of one aspect of Federal Forest Management: management of areas outside of Spotted owl Habitat Conservation areas. (HCAs)

- The main goal of such areas is to maintain adequate conditions to allow movement of owls among HCAs. * local community involvement is key

- Re-evaluate the 50-11-40 rule:
  - 50% of fed forest matrix outside HCAs will be managed to provide stands that average at least 11 inches dbh (diameter at breast height) and have at least 40% canopy closure.

This rule represents "best guess" of owl dispersal behavior, because little is known about owl dispersal behavior.

Objectives

* To provide information necessary for effective maintenance of matrix lands: 3 main areas of study
  1. Modeling of metapopulations & the role of dispersal
  2. Observations on habitat choice and survival
  3. Experimental silvicultural treatments that provide dispersal & breeding habitat in harvested areas

Douglass Project

Outcome: Development of metapopulation models that are applicable at all spacial scales. These models will ~~determine~~ evaluate the importance of different parameters (ie - different timber harvesting techniques) in determining extinction risk and population trends.

An Integrated whole

① Models of Wildlife Pop. & Dispersal
- understand dynamics of whole system
- Model of Owl Survival thru its range
- create a map that specifies location, size shape and spacing of habitat patches

use Geographic Info Systems to integrate

Use data From all 3 to determine best Forest management approach

② Study of Owl Dispersal & Dispersal Habitat
- track moving owls - data on geographic range
- understand relationships of different owl populations & predict long-term survival
- use data to validate models

Done: Early 1994

③ Silvicultural Experiments
- large scale exp. to determine effects of silv. practices on old-growth in harvested strands
- Monitor responses of vegtation, Animals, physical, social & econ

large scale replicated monitored for ecosystem impact

~~Done~~ ~~1994~~ $\boxed{10\ years}$

Pro

- Integrated Approach
- Scientifically Sound
- Will Probably result in best overall policy From ecological & Scientific standpoint

Con

- long Time Frams
- political realities not factored in
-

THE DOUGLAS PROJECT
EXECUTIVE SUMMARY

Project Background

The Douglas Project is an effort by the scientific community in Oregon and Washington to provide policymakers with high caliber, up-to-date scientific data on the effect of Federal forest timber harvesting on Spotted Owl populations. The project is slated to begin sometime in February-March 1993, and will provide short term results by late 1994.

Overall Project Goal

The purpose of the Douglas Project is to gather and provide the scientific information necessary for effective and rational management of Federal forest lands.

Project Focus

The project proposes to study one aspect of the management of Federal forest lands: management of areas outside of designated Spotted Owl Habitat Conservation Areas (HCAs). This focus was chosen for several reasons:

- This represents the largest area of forest on federal lands
- Current management guidelines for these areas are based on inadequate scientific information
- Conservation of the Spotted Owl depends on their successful dispersal between current HCAs
- By avoiding HCAs, the project avoids politically and legally controversial modifications to current owl habitats

Project Summary

To provide the information necessary for effective maintenance of forest lands, the project will conduct three studies:

Wildlife (Owl) Population Habitat and Dispersal: This study will use mathematical population models to create a computerized map that specifics the location, size, shape, and spacing of current owl habitat patches. These models will give researchers a better understanding of the relationship between fragmented owl habitats.

Dispersal of Owls and Description of Dispersal Habitat: This study will mark, track, and monitor 30-40 owls in order to gain a better understanding of owl dispersal and to gather specific data on the geographic range of Spotted Owls. This data will be used to test and validate the mathematical population models created in the study described above.

Silvicultural Experiments: Silvicultural (or forestry) experiments will be carried out to determine the effects of timber harvesting on old-growth forests. Scientists will carry out seven harvesting strategies in seven different sites, ranging from no cutting (control group) to 60% cutting (60% of trees harvested) to clear cutting (100% of trees harvested). In each experiment, researchers will monitor the responses of vegetation, soil condition, and animals in the affected sites, as well as monitoring the public responses to and economic value of each strategy.

Researchers will integrate the results of these three studies using sophisticated geographic information systems (mathematical modeling systems that overlay different layers of data to create one comprehensive map of a given geographic area). ***This will allow researchers to predict how different harvesting techniques and strategies will affect Spotted Owl habitat, dispersal, and population trends***.

Desired Project Outcomes

The Douglas Project hopes to see the following outcomes:

- The development of accurate models that will allow policymakers to understand how different harvesting strategies will affect the Spotted Owl population.

- A re-examination of the current "50-11-40" rule (50% of Federal forest land outside HCA's will be managed to provide forest strands and average at least 11 inches in diameter and have at least 40% canopy closure), which is based on inadequate scientific information.

- The development of a new Federal forest management policies that are based on sound scientific information and that provide a proper balance between ecological and environmental concerns, the conservation needs of the owl population, and the harvesting needs of the timber industry.

The Douglas Project

Executive Summary

1. The Douglas Project will carry out cooperative research of high calibre, designed to develop ecosystem management options.

2. We will carry out large-scale experiments designed to identify silvicultural and harvest techniques that allow for the maintenance or recovery of late-successional (old-growth) species (including fish, owls and other sensitive species). This effort will be carried out jointly with the other regional New Perspectives Partners. This demonstration will be long-term.

3. Other studies will focus more narrowly on management of non-reserved areas. Currently 'the matrix' is managed under the '50-11-40' guideline. This rule is not well grounded in scientific studies of owl dispersal. The Douglas Project will provide the information for rational management of these forests.

4. All research needs to be carried out in the framework of models of wildlife responses to fragmentation. These models will be developed swiftly, and can be expanded to include GIS level information, and to apply to forestry economics.

5. An important parameter in these models is dispersal behavior. Dispersal of Northern Spotted Owls is poorly understood. Given sufficient support, studies on owl movement will quickly provide this critical information. This research will be carried out in cooperation with existing owl studies.

Introduction: The Douglas Project

All parties to the debate over the future of the Northwest forests can agree on one thing: the need for more and better information. Conservation of the forest ecosystem requires sound understanding of the ecology of the species involved. This same information is critical to rational management of the forest resource, and to planning by timber dependent communities. There is an opportunity for cooperation in obtaining this knowledge. All parties will benefit from a stronger data base.

The Douglas Project will carry out cooperative research, and will involve all interested parties in planning and execution. Our goal is research that is:

- of potential conservation benefit
- of potential benefit to management
- of recognized high scientific caliber
- practical in terms of time and resources
- applicable throughout the region
- applicable to Spotted Owls **and** to other ecosystem elements

An important element in the Douglas Project is involvement of local communities in the processes and decisions that affect their well-being. Scientific research acquires a new legitimacy if it can be shown that all avenues for management have been explored. Similarly, community groups that voluntarily cooperate with scientists and planners will be better able to represent their concerns. Most importantly, resolution of resource management conflicts can best be achieved when the facts are agreed on.

What information do we need to manage federal and private forests?

The Northern Spotted Owl has focused attention on the problems of the forests of the Pacific Northwest. A great deal of effort has been expended on developing a Recovery Plan for the species; this plan will probably form the basis for forest management by both the Forest Service and the BLM. The plan has been developed by many scientists, and represents the best available science. However several shortcomings are widely recognized: most importantly, the data base is still incomplete, and the plan focuses on a single species (the owl), with less attention on the other members of the forest ecosystem.

On July 30 1992, Judge Dwyer expressed concerns regarding the Forest Service's Final Environmental Impact Statement on Management of the Northern Spotted Owl. He required that the Forest Service address management of 32 late-successional and old-growth vertebrate species. In response to these concerns, a group of 10 scientists, the Scientific Analysis Team (SAT), evaluated the effects of owl management alternatives on these other wildlife species. However the SAT did not limit themselves to considering just the 32 species, but considered the entire community of species associated with late successional forests. Their rationale for doing so was to move toward an ecosystem level conservation plan, as demanded by the Chief of the Forest Service, in late 1992.

The SAT report is thus the first comprehensive attempt to manage forests to conserve biodiversity, and maintain all late-successional ecosystem members. It is probable that the President's Inter-Agency Team will use the report of the SAT as a basis for it's own management plan. It is certain that all future Northwest forest plans will address ecosystem level concerns, and that research needs to be conducted at this level.

The key strategy of the SAT was to develop a series of steps which will maintain all old-growth species. They proceeded as follows: first they examined the Spotted Owl Management Plan, and determined which species were insufficiently protected by areas set aside under the owl plan. Then additional mitigation steps were added until all species were felt to be adequately protected. The additional mitigation steps were:

Riparian Habitat Conservation Areas
Marbled Murrelet Conservation Areas
Conservation of Rare and Locally Endemic Species
Conservation of Upland Species

In essence the SAT created a series of overlays, each based on management of some key species or feature (Spotted Owls, Fish, Marbled Murrelets, etc.) and kept adding layers, until all species were protected.

This represents the first attempt at managing the entire forest ecosystem, so as to maintain all old-growth species. The strategy used by the SAT is essentially to identify a few 'indicator species'; conservation of these species will ensure that all other species are also (incidentally) protected.

The SAT strategy has many important implications for future management of the forest. It suggests that few additional species will become threatened, and that no new set-asides will be necessary; this will help in establishing a predictable resource base. The SAT strategy also establishes an approach to ecosystem management contingent on a few key species (primarily the Spotted Owl, fish, and the Marbled Murrelet). It is therefore imperative that conservation of these key species be well-grounded in science.

The overlay approach of the SAT will produce a map of forest lands subject to different management practices:

Spotted Owl HCAs/DCAs and critical habitat
The 'Matrix' managed under '50-11-40'
Riparian Conservation areas
Marbled Murrelet Conservation areas
Areas set aside for other species.

These areas differ in size, effect on timber harvest, management options available, and the quality of science that underlies that management. For instance, the Marbled Murrelet is extremely difficult to study, so that little management oriented research has been possible.

The objective of forest management on all lands must be to maintain ecosystem health, and to preserve biodiversity, while at the same time allowing a reasonable extraction of timber. We do not currently know which options will best meet these goals. The Douglas project will identify those options.

Project Focus

We will develop management options for all forest lands that maintain biodiversity, as well as a stable timber harvest. One part of the project, which will examine ecosystem responses to novel harvest and silvicultural techniques, will yield results that may apply in many situations (for instance, in Riparian Conservation Areas, or in areas set aside for other species). The remaining parts of the project focus on management of the 'matrix' outside of reserved areas. Our reasons for this focus are:

- this represents the largest area of forest on federal lands
- management guidelines for these areas are based on sparse scientific information
- conservation of the Spotted Owl depends on successful dispersal in these areas (this aspect of the biology of the species is poorly known)
- by avoiding HCAs etc. we will avoid controversial modifications to the habitat of owls. fish, or other sensitive species.

This focus meets our overall goal, in identifying an area of research of potential benefit to both conservation and forest management. It also holds the potential for these benefits to be rapidly developed. Modifications to management of HCAs are likely to be identified only after lengthy and expensive field experimentation.

Management of the 'matrix'

Most federal forest in Spotted Owl habitat is managed as "matrix" areas. The guidelines for these areas are set out in several documents, including the draft Recovery Plan for the species (see especially pages 119-125). The main goals of management of such areas are to maintain adequate conditions to allow movement of owls among HCAs. These areas will also be managed to allow some owl reproduction. As stated in the Recovery Plan, "it is expected that a wide variety of commercial timber activities will occur within the matrix, with their timing and location designed to meet the conditions specified for the matrix" (p 119). It is to be expected that, in the foreseeable future, these areas will be the main areas for timber harvest in federal forests. Four management prescriptions are identified, the most important of these being the '50-11-40' rule (p 121).

The '50-11-40' rule states:
1. At least 50% of the federal forest matrix outside of HCAs will be managed to provide stands that average at least 11 inches dbh, and have at least 40% canopy closure. Although stated as minima, these values are likely to be set as management prescriptions.
2. The rule is to be applied on a quarter-township basis, and will be based on the amount of federal land in that quarter-township.
3. Different federal agencies will make separate calculations for the rule.
4. All land that is capable of attaining the standards should be included in the calculation.
5. Hardwoods may be included in calculating the canopy closure guideline only, and there must be 6 or more feet under the bottom of a hardwood canopy.
6. Reserved areas may be included in the calculation.

This rule seems readily applicable, and will probably meet the requirements of dispersal habitat for the Spotted Owl. However it has some shortcomings:

- Application on a quarter-township basis bears little relationship to owl biology. A landscape level prescription would be better for conservation of the owl. Dispersal of juvenile owls usually takes place over distances of 5-20 miles. The quarter-township restriction ensures that older forest is preserved throughout the matrix; other alternative prescriptions could achieve this.
- Application to all federal lands cannot be equally successful. The National Forest system represents large blocks of federal matrix lands. The BLM checkerboard is more highly fragmented, and interspersed with young forest that does not meet the rule's limits. Hence the BLM/ private forest is more likely to approximate to '25-11-40' (Figure 1)

- Knowledge of dispersal behavior of Spotted Owls (particularly of juveniles) is rather limited. We do not have accurate estimates of habitat choice, and survival during dispersal in different habitats. The '50-11-40' rule represents the 'best guess' of owl biologists regarding suitable dispersal habitat.

These comments should not be seen as criticism of those scientists that developed these guidelines. They were working under conditions of limited information, and developed rules that were designed to preserve owls. However there is widespread (but not unanimous) recognition that these rules could usefully be reexamined as more information on dispersal becomes acceptable. The Final Recovery Plan for the Spotted Owl documents discussions held in Portland, Oregon, on adaptive management of dispersal habitat. These discussions, which included Recovery Team members, other owl biologists, and the Douglas Project, were aimed at the process whereby such new information might bring about changes in the '50-11-40' rule. These talks included discussion of the relaxing of the rule to a less restrictive prescription.

Objectives of the Douglas Project

The Douglas Project seeks to provide the information necessary for effective management of the forest ecosystem. This will include three main areas of study.

1. Experimental harvest and silvicultural treatments that maintain or encourage the development of old-growth species.
2. Modeling of metapopulations, and the role of dispersal in wildlife species.
3. Observations on habitat choice and survival of dispersing owls

Our goal is to carry out this research in cooperation with the New Perspective Partners, and other respected scientists. Our intention is that the information acquired be recognized as high-quality and impartial. Ultimately, implementation of changes to forest management will rest with federal agencies, and with bodies such as the Northern Spotted Owl Recovery Team. We want to ensure that the results of our research are acceptable to these groups. We have developed our proposals in close cooperation with Recovery Team members, and have made commitments to them regarding implementation of our plans (see below).

Rationale for Research

The three studies have been designed to form an integrated whole. Broadly, they can be seen as answering the following linked questions:

- Can we create habitats of different types by silvicultural treatment of harvested stands? For instance can we encourage owl dispersal habitat by some treatments, and maintain fish conservation areas with others?
- How can we evaluate the effects of different management practices on dispersal success? How will these impact the

population as a whole? Can we apply these results to other species in the ecosystem (e.g. Lynx, Goshawk, Woodpeckers)?

- How do owls disperse? What habitat is required for successful dispersal?

An important initial step in the project is development of metapopulation models that are applicable at all spatial scales. These models will evaluate the importance of different parameters in determining extinction risks and population trends. For instance, the models will be able to determine whether a change in dispersal success (brought about by e.g. silvicultural prescriptions) will have any effect on the overall survival of the species. These models will form the theoretical basis for all decisions regarding management. Discussion of the relationship of these models to existing models can be found in supporting documents.

Analysis of extinction risk and population trends will require that our models are parameterized. Good information already exists for many critical variables. An exception to this is the relative lack of data on dispersal of juvenile owls to new habitats. Forsman is currently engaged in a study that will estimate overall survival, but there is no ongoing study of habitat choice (which involves continuous monitoring of dispersing birds). This information is critical to an evaluation of '50-11-40': if juveniles can rapidly traverse large expanses of open ground, then the rule is overly restrictive. Conversely, if juveniles stay only in older forest, then a more connected landscape may be required for effective conservation.

Once we have developed information on what sort of landscape is necessary for owl survival, we can recommend changes in forest management that will produce this landscape. However there is widespread recognition that adaptive management techniques, based on alternative silvicultural treatments, may be able to produce habitat more rapidly than will natural succession following harvest. We plan silvicultural experiments that will demonstrate whether such alternatives can indeed produce suitable habitat for owls and other wildlife.

Silvicultural experiments
Demonstration of Ecosystem Management Options (DEMO)

We will carry out experiments to determine the effects of silvicultural practices on the development of old-growth characteristics in harvested stands. These experiments will be carried out with the cooperation of participants in the New Perspectives Partners programme. It will form one part of the Douglas Project. The goal of the experiment is to provide the scientific base for alternative management and harvesting techniques. The experiment will be initiated in 1993, and will run for 10 years.

Introduction

The Douglas Project and the other New Perspectives Partners (NPP) have been working together to develop alternatives to existing forest management practices. The overall goal of both of these groups is to design and implement techniques that allow both timber harvest and the maintenance of old-growth species and ecosystems.

Several alternative harvesting and silvicultural techniques have been proposed, which may maintain late successional wildlife species in harvested stands. Evaluation of these techniques requires rigorous scientific experimentation. The NPP have identified the essential elements of such experiments: they must be large-scale, replicated, and monitored over a timescale sufficient to detect ecosystem change. The NPP plan several such experiments in Oregon and Washington. One experiment will be carried out on the Gifford Pinchot NF and adjacent Washington state lands. One experiment will be carried out on the Umpqua NF, in collaboration with the Douglas Project. This may later be coordinated with a similar effort on neighboring BLM lands. An essential consideration is that all these experiments should follow a common design. This will allow the results from one region to be compared with those from elsewhere. The experimental protocols that follow have been developed by the scientific committee of the NPP.

Rationale of experiment

We propose to carry out experimental harvests in mature forest on the Umpqua NF. Several harvest levels will be employed, with varying degrees of retention. These areas will be monitored for forest, wildlife, and physical characteristics prior to and after harvest. The response of biotic and abiotic components to harvest will be evaluated. Our goal is to determine the sensitivity of the various components to alternative harvest methods, and to demonstrate whether harvest can be compatible with either the maintenance or recovery of old-growth characteristics.

Study Sites

The agreed common design for all experiments calls for a factorial approach with eight treatments. Each treatment should be replicated four times (4x8 design). Each replicate should be a minimum of 50 acres in size, although 100 acres is preferred. This requires that each experimental block comprise 3200 acres of forest of homogeneous character. It is also preferred that the replicates be close together, and not dispersed over wide distances.

Additional criteria used in site selection were:

1. Areas proposed for protection of Spotted Owls (DCA's) should be avoided. In addition the vicinity of such areas should be avoided, to allow for expansion of these conservation areas if necessary.
2. Edges of previously harvested areas should be avoided if possible. The rationale for this criterion was both to avoid edge-effects, and to allow the potential for expansion of the experiment.
3. Avoid variable or unique terrain. Where possible, carry out the experiment within one watershed.
4. Avoid variation in forest type.
5. Use areas that already have roads in place. The rationale here was both economic and to avoid environmentally sensitive areas.

Several candidate areas have been identified.

Design of Harvest Experiment

The agreed common design is factorial, with a randomized block arrangement. Eight treatments are proposed:

1. No cut; 100% retention (control)
2. Light cut; 80% retention
3. Light Cut; 60% retention
4. Moderate cut; 40% retention (dispersed)
5. Moderate cut; 40% retention (aggregated)
6. Heavy cut; 20% retention (dispersed)
7. Heavy cut; 20% retention (aggregated)
8. Clear cut; 0% retention.

Monitoring

Response variables to be measured and monitored will include:

1. Vegetation responses
2. Animal responses
3. Physical measurements
4. Economic and Social effects.

The details of the monitored variables are shown in the attached USDA-FS document.

An essential component of the experiments is to monitor conditions prior to any harvest. It will be necessary to carry out these base-line surveys in 1993.

Implementation

In order to meet the objectives of beginning this experiment in 1994, the following timeframe needs to be employed:

Spring 93	Lay out of experiment Development of proposal for FY1994
Summer 93	Biological and Physical Inventory of sites
1994	Timber Sales

Models of Wildlife Populations in Fragmented Habitat

Models are used to evaluate long-term survival of a species, and to design appropriate management options. We need to develop sophisticated techniques that incorporate GIS data and metapopulation approaches, to understand the dynamics of the whole system. We will use data and techniques from several sources, including forestry economics, to evaluate alternative approaches to wildlife conservation. Anticipated benefits include a comprehensive model of Spotted Owl survival throughout its range. This will be a major tool in evaluating the success of current management strategies, and for judging proposed changes. The model will also be suitable for application to other species in the forest ecosystem. Ultimately, such a model is a prerequisite for any delisting of the Spotted Owl or other federally listed species.

Introduction and Rationale

The conservation strategy of the Northern Spotted Owl is based on five basic concepts of reserve design. These concepts represent general principles that related the size, geographic configuration, and connectivity of habitat patches to the viability of the spotted owl. The strategy has resulted in a *map* that specifies the location, size, shape, and spacing of habitat patches; hence it identifies a spotted owl metapopulation within the existing habitat for future protection. Any future research must be formulated within this framework of the owl metapopulation, as identified in the conservation strategy.

Several attempts have, or are being made to develop metapopulation models for the spotted owl (Lande 1987,1988; Doak 1989; LaHaye et al in prep). The results so far emphasize the importance of three factors: dispersal among habitat patches, fluctuations in vital rates, and the degree of similarity in the fluctuations that these populations experience. These results are of great potential impact on forest management, since dispersal habitat represents by far the largest component of overall habitat. The results from metapopulation models are also of great importance for future research, as they identify those factors that are most important in determining the viability of the owl. This is especially important since these factors are also among the least understood.

Dispersal is, notoriously, among the most difficult of factors to measure in many populations, especially long-lived, vagile, secretive species such as the Spotted Owl.

Long term persistence of the spotted owl depends critically not just on the maintenance of adequate reserve areas, but also on the relationship between these areas, their degree of fragmentation, and the ease with which owls colonize vacant habitat patches. The metapopulation concept provides the necessary theoretical tools for integrating and evaluating these factors, and for developing risk analysis methods. Therefore, future research needs to be specifically formulated within the metapopulation framework, as are current conservation plans (Thomas et al 1990). Parallel implementation of experimental and modelling work will ensure that 1. experiments are designed to focus on the factors that are most important in determining the viability of the owl, and 2. models are designed to incorporate significant factors and interrelationships that emerge from continuing fieldwork.

A major advantage of using these frameworks and models is that they provide a link between the field experiments carried out in particular case studies (such as Douglas Co.) and the overall viability of the species throughout its range. Ultimately, data from all fieldwork and monitoring should be integrated into a single model of overall species viability. This will be especially important in evaluating potential changes in management practices throughout the species' range, following experimental test of these practices in case study areas.

Implementation

A detailed proposal for modeling has already been developed (see attached documentation). How fast modeling will proceed depends on the availability of resources. An initial step is to develop metapopulation models at a variety of scales, and with application to a range of problems. As these are developed, GIS applications, data analysis, and forestry economics models should also be integrated. Development of the metapopulation models can be begun as soon as resources are made available. These models will be closely coordinated with existing efforts to model the Northern Spotted Owl and other forest species.

Dispersal of Owls and Description of Dispersal Habitat

Introduction

Dispersal is perhaps the least well understood aspect of owl biology. In any organism, dispersal behavior is always a difficult subject to study. Understanding dispersal requires that we keep track of moving individuals, often over long periods and distances. This is especially difficult in the case of a nocturnal animal, occupying dense habitat, and in physically challenging terrain. It is unsurprising that we know relatively little about the dispersal of the Northern Spotted Owl (but see studies by Gutierrez et al 1985; Miller and Meslow 1985; Miller 1989; Carey et al 1992; and ongoing work by Forsman). We do know how far animals disperse under some circumstances (15 to 45 km in the first fall of life) (NSO Recovery Plan). There is also some indication that juvenile females disperse further than do males. Current studies (directed by Forsman in the Douglas Co area) are aimed at estimating survivorship during dispersal.

Our study will mark large number of animals, and track them daily. This will allow a detailed analysis of individual habitat choice during dispersal. This information is crucial to understanding the relationships of different owl populations, and for predicting long-term survival of the species. Anticipated benefits include an evaluation of current management of the matrix lands. This may result in proposals to modify the 50-11-40 rule. It must be emphasized that we cannot anticipate the direction of any modifications - we may recommend more restrictive forest management. Although this study has an owl focus, the results are designed to validate and test our models, which should be applicable to all wildlife species in fragmented landscapes.

The Recovery Plan and 50-11-40

The Spotted Owl Recovery Plan includes explicit discussion of possible modification of the 50-11-40 rule. The Plan lays out several testable hypotheses, and suggest techniques and tests of these hypotheses that might lead to modification of the rule. We will follow these suggestions in designing our own study of dispersal.

Rationale

Broadly, our goal is the first truly intensive study of dispersal by juvenile owls. We have little information on this subject, because of the difficulty and expense involved in monitoring individuals during dispersal. This higher level of effort is necessary for several reasons.

Firstly, metapopulation models indicate that colonization of new areas is a critical element in understanding the dynamics of a species. We need good information on this basic parameter in order to make predictions about owl viability.

Secondly, management of dispersal habitat is currently based on data collected for other reasons, in a limited part of the owl's geographic range, and on owls that were not dispersing. Clearly this is far from ideal, given the importance of dispersal habitat.

Thirdly, dispersal can occur rapidly. In order to obtain accurate information on habitat choice, we need to observe the bird during this brief phase. In order to ensure that we obtain this critical information, and do not miss it (e.g. by a monitoring protocol that is too long) we must use semi-continuous monitoring of a large number of owls.

We have made a commitment to The Spotted Owl Recovery Team to work closely with their members on this project. We have agreed to prepare a detailed proposal for implementation (in conjunction with recognized owl researchers) and to submit this for approval by the Team before research is carried out.

Study Sites and Design

Our preferred design is to work with existing owl studies, which already have large numbers of adult owls marked (with radio-telemetry devices). We will then augment these studies, and mark additional juvenile owls. These will be monitored as they move through the landscape. Dispersal in Northern spotted Owls is best studied by means of radio-telemetry. Some criticism of this technique has included suggestions that transmitters may increase mortality of owls. For this reason, the newly developed tail-mounted transmitters are preferred. These do not seem to adversely affect survival. After juveniles leave the nest areas in September-October they are then located using receivers. In Oregon, this requires that trackers maintain access to all habitat, even in winter conditions - this may require 4 wheel drive vehicles, and snowmobiles for some winter work. Often the birds may move large distances and be lost by observers - they must then be located by a wider search, by airplane.

These studies will address the important questions listed in the NSO Recovery Plan, under dispersal studies:

- How well do various habitat conditions provide for dispersal?
- How well do various spacing distances provide for dispersal?
- What is the type of use and relative degree of use of various habitat conditions by dispersing owls?

We will mark 30-40 juveniles in each year. Since not all pairs fledge young in any year, this will require us to find and examine 90 nestsites. These 40 birds will be monitored continuously, every night period (up to 16 hours). As the season progresses, some birds will die, and the level of effort will decline. We anticipate peak effort in the period September -January when many birds are still living and are moving around. These studies will require a minimum of three teams of two biologists to find and monitor nests, and 20 -25 persons to monitor dispersing owls in early fall.

After owl movements have been tracked during the night, habitat must be visited and characterized. In this way we will be able to build up a picture of how much time owls spend in different sorts of vegetation while dispersing. Vegetation type will be characterized at three scales (within stand, between stand, and at landscape scales). Vegetation type will be characterized using the protocols developed by R.Gutierrez, and will be entered into a GIS for use with models (q.v.). Vegetation data can be collected after the period of intense owl location fieldwork. We anticipate that this will be a large effort, in difficult terrain, and that 10- 12 hours per week of airplane/pilot charter will be necessary to maintain contact with all birds.

It is important to stress that our estimate of 30-40 birds followed every year represents an average. In occasional years many birds fail to breed at all, and we can anticipate little success in marking individuals at these times. In other years we may follow 50 birds or more.

Implementation

This project has both short and long term goals and requirements. Within the first year of study we will have the best existing data on habitat choice by dispersing juveniles. These will allow us to determine whether dispersing birds use landscapes that resemble '50-11-40' or use forest with a different structure. However full evaluation of the effectiveness of 50-11-40 as a rule for ensuring dispersal success will require several years of data, under a range of conditions.

Given the practicalities of this large effort, and the very short timeframe, it is probable that we will begin with small numbers of owls being marked, and increase our study size in subsequent years.

HARVEST CUTTING STUDIES
Consensus of Science Coordination Team
Northwest Forest Ecosystem Research Partners
December 4, 1992

PROBLEM

Forests provide numerous benefits in addition to fiber. Demands are being placed on forest resource managers to continue to provide substantial levels of wildlife habitat, watershed qualities and recreation on forest lands used for fiber production. One proposed solution is retaining trees through harvest, which is hypothesized to recreate late successional habitat more quickly than after clearcutting.

STUDY OBJECTIVES

To test different levels and patterns of tree retention through timber harvest to determine the effectiveness and cost of using retention to recreate late successional forest structure and conditions (and presumably function) more quickly than after a traditional clearcut. These forests with the structure of late successional forests may function as breeding or foraging habitat for the northern spotted owl.

This study is expected to measure selected responses to the cutting treatment including:

-residual and new forest trees,
-vertebrates and some arthropods,
-physical conditions,
-economic costs and benefits, and
-social acceptability.

Below are more specific descriptions of the responses to be measured.

PHYSICAL AND TEMPORAL SCOPE AND DESIGN

Physical Scope. The literature indicates that treatment patches must be at least 60 acres, to contain a sufficient sample of home ranges of the most widely ranging organisms whose response will be measured (birds and small to medium sized mammals), and to limit edge effects to acceptable levels. It may be possible to have treatments as small as 50 acres; 100 acre treatments are very desirable. Multiple (four?) replications of seven treatments each will be required for an installation of the experiment, requiring a minimum of 1400 acres, but 2800 acres would be better.

Temporal Scope. The planned duration of the study will be ten years, with a major report at that time. The science coordination team recognized that it is desirable to obtain results in 2-10 years, but that conclusive results on the effect on commercial rotations will not be available for decades. Sampling will have to be done before treatment, immediately after treatment, and at periods after treatment which are appropriate for the response being measured. Conducting more than one year of pre treatment animal surveys is highly desirable. A significant report of initial post treatment results should be produced two years after treatment. Some responses may not be tracked after five system will be the most efficient for each site and prescription.

RESPONSES
Response variables are expected to include:

I. Vegetation

- Survival of Residual and New Stand
-Mortality (cause and rate) and growth
-Mast years for seed production
-% Cover

- Growth and Yield of New Forest
-Diameter (DBH),outside bark
-Total tree height and vigor
-Height to live crown and crown width
-5 year radial growth
-Mortality (rate and cause)
-Density of tree species
-Vertical profile of foliage

- Regeneration
-Stems per acre by species
-Natural or artificial
-Terminal/Lateral growth
-Height and basal caliper growth

- Understory
-Percent cover by species
-Top foliage height
-Seed production

- Lichen and epiphyte
-Survival and inoculation

- Fungal Composition and Change
-Fungal abundance or presence, community structure, and habitat use, and fruiting body production.

II. Animal

- Vertebrate
-Absolute and relative abundance, community structure, and Habitat Use
-Northern flying squirrel, red-backed vole, bushy-tailed woodrat, bats, cavity-nesters, neo-tropical migrant birds, other song birds, ravens and jays, predators, amphibians

- **Invertebrate Composition and Change**
    - -Invertebrate trophic structure (feeding guild), community structure and habitat use (canopy, bole, and ground dwelling)

III. Physical measurements

- **Ambient temperature, humidity, wind speed and light intensity.**

- **Forest floor and soil conditions**
    - -Soil compaction and disturbance (and effects on regeneration)
    - -Temperature, moisture

- **Debris and Snag Density**
    - -Species, size, and decay class

IV. Economics and Social Science

- **Cost of harvesting**

- **Damage to residual stand**

- **Public acceptability**

- **Economic value of residual trees**

- **Value of non-commodity benefits of residual trees**

DEMONSTRATION OF ECOSYSTEM MANAGEMENT OPTIONS (DEMO)

Research Aspects of the DEMO Project

HISTORY

The value in taking a broader approach to the demonstration is apparent in the history of management systems employed on west-side National Forests. During the past 60 years, three general approaches have been used in harvest/regeneration cutting. Selective cutting was normal practice from the 1930s to about 1950. Staggered settings of 40-acre clearcuts, followed by burning and planting, dominated the late 1950s to the mid-1980s; this led to most of the young stands in the present forest landscape. The system currently in vogue includes retention of green trees in various amounts and patterns, ranging from a few "wildlife" trees to a shelterwood. Each of the above approaches met a specific need when adopted and soon came to be applied to the near exclusion of other methods. The first two were found wanting as additional problems or desires became important or other changes occurred.

DESCRIPTION OF DEMONSTRATION

Goals and Objectives

The D.E.M.O. Project will demonstrate and evaluate alternative silvicultural systems for maintaining or enhancing the biodiversity, health, and productivity of managed forest ecosystems. The project will be implemented in mature forest stands, and thus, different methods of harvest/regeneration cutting will be examined. The principal goal of all of the management options is to retain or accelerate establishment or re-establishment of some of the attributes and species associated with old-growth or late-successional forests.

Basic Design or Layout

The eight treatments will be imposed on units of at least 50 acres. Previous work has indicated that a square to slightly rectangular (length:width ≤ 1.5) grid consisting of approximately 100 points, spaced 40 meters (~ 130 feet) apart, is needed. Treatments will be established in blocks, four each on the Gifford Pinchot and Umpqua National Forests. Each block will consist of one each of the eight treatments, with all treatments applied in stands having similar composition, environment, and surrounding landscapes.

The Systems or "Treatments"

The project will evaluate eight strategies which include even-aged, two-aged, and uneven-aged management systems. Specific "treatments" which create a complete spectrum of initial disturbance levels (approximated by percent retention of original stand) include:

1. 100% Retention -- Uncut, unmanaged "control" stand

2. 80% Retention -- Initial harvest will occur in small patch cuttings (e.g., 1-2 acres or width equal to two times the height of dominant trees). Such patches will be randomly distributed throughout the stand and will occupy about 20% of the area. The intent is to foster a multi-aged (3 to 5 age classes), multi-storied stand via the group selection system. Future regeneration cuttings will probably occur on 20- to 30-year cycles; some intermediate thinnings may be done at the same time.

3. 60% Retention -- Initial harvest will be a combination of small patch cuttings as described above and some thinning dispersed throughout the stand. Patches will occupy 20 to 30% of the area. The intent is similar to the previous treatment; group selection will result in three age classes, with cutting cycles of approximately 30 years.

4. 40% Retention/Dispersed -- Residual trees will be dispersed throughout the unit and will consist of all species and size classes. The intent is to develop a two-aged, multi-storied stand. In future entries, trees in younger age classes will be thinned and some of the large trees of the original stand may be harvested and will provide high quality wood for special uses; others will be retained for structure, some eventually becoming large snags for cavity-nesting wildlife.

5. 40% Retention/Aggregated -- Residual trees will be grouped throughout the unit in patches of approximately 2 acres. No cutting will occur within the patches; all green trees will be cut in the rest of the unit. The intent of this treatment is to provide an undisturbed reservoir of biological material via the patches which may lead to rapid recolonization and recovery of species in the harvested and regenerated areas.

6. 20% Retention/Dispersed -- Specifications and intent of this treatment are similar to the 40% Retention/Dispersed treatment, except fewer trees will be retained. This treatment will look like a shelterwood cutting and will lead to a two-aged, multi-storied stand. Future entries may include thinning of trees in the new age classes and harvest of some of the overstory trees; however, some of the large trees will always be retained for wildlife habitat.

7. 20% Retention/Aggregated -- Specifications and intent of this treatment are the same as for the 40% Retention/Aggregated treatment, except that fewer 2-acre patches will be retained.

8. 0% Retention -- This involves a clearcut, control area, where all green trees will be cut. This treatment will complete the disturbance or retention spectrum; more important, it will provide a baseline against which to judge the effectiveness of some of the other treatments in accelerating recovery and recolonization of selected features in managed forests.

Several matters pertaining to all treatments are listed below:

a. All snags, coarse woody debris, and advanced reproduction will be retained to the degree practicable and appropriate.

b. Harvested areas will be planted with sufficient numbers of trees to provide a new stand of 300 trees per acre, including acceptable advanced reproduction. Planting and other management practices will foster diversity in tree species composition.

c. Site preparation and competition control will be limited to that needed to secure regeneration and foster the principal goal of fostering late-successional characteristics. Minimal amounts of "jack pot" burning may be necessary.

Data Collection, Management, and Analysis

Collection -- An interdisciplinary team of National Forest employees and scientists from several agencies and academic organizations will collect data. The same principal investigators will guide work in specific areas on both forests; the areas include vegetation (DeBell-PNW), wildlife (Raphael-PNW), soils and fungi (Amaranthus-PNW), social perceptions (Ribe-U of O), and economics (Brooks-PNW). Other principal investigators may be designated as needed. Scientists from Oregon State University, the University of Oregon, the Douglas Project, the University of Washington, Olympic Natural Resources Center, and Washington Department of Natural Resources will be involved in various aspects.

Data Management -- All data management will be centralized at the Olympia Forestry Sciences Laboratory. A team led by Gary Clendenen (PNW) will help develop collection protocols and programs to edit, summarize, and analyze data. All data will be non-proprietary, but agreements will be developed among participants to govern publication activities.

Data Analysis -- The demonstration project is a randomized block design, consisting of 8 blocks of 8 treatments each. As such, it can be analyzed by standard analysis of variance procedures. Differences between the two Forests could be accounted for and examined by the inclusion of "installation" as a source of variation. Covariance analyses can be used to reduce variation associated with initial differences in stand conditions and wildlife populations. Some trends may be modeled over time or treatment using regression techniques.

Evaluation Criteria

Some of the high priority items are listed below for five general subject categories:

Vegetation
- Survival, damage, and growth of residual trees.
- Establishment and growth of tree seedling regeneration.
- Survival, damage, and growth (or re-growth) of advanced tree reproduction and other components (woody and herbaceous) of the understory.
- "Survival" and dynamics (decay) of snags and down trees.

Wildlife

- Population densities and habitat use by several species of small mammals, birds, amphibians, reptiles, and invertebrates.
- Habitat use by mammalian carnivores, ungulates, corvids, owls, and raptors.

Soils and Fungi

- Disturbance and compaction of forest floor or surface soil.
- Abundance and community structure of fungal fruiting bodies.

Social Perceptions

- Public perceptions of management options in relation to attitudes, politics, and use of the Forest
- Public perceptions of management options in relation to amount of information about the intent of each.

Economics

- Financial evaluation of harvesting costs, stumpage value, and future stand growth.
- Economic values of residual trees and commodity and non-commodity benefits.

Outputs

What will we learn?

- In the short run, the DEMO will help us to measure the relative cost of implementing a wide range of harvest systems, and will allow us to measure the relative outputs and economic returns from these systems.

- It will enable us to assess public perceptions of the same wide range of treatments. The DEMO will provide us with a large demonstration that is a coordinated series of treatments, that has value for public involvement and educational activities.

- Many of the biological effects will take longer to determine; initial assessments will be made approximately 2 years after harvest. This initial assessment and later results will be of great value in giving us data with which to plan and to evaluate our future management actions. It will serve as the first scientific basis to evaluate many of our treatment regimes

- The DEMO will help us assess the capability of various options in maintaining or accelerating the establishment or re-establishment of late successional forest conditions.

- Most (perhaps all) of the options are likely to play a useful role in managed multiple-use ecosystems. All seem feasible, biologically and operationally on most sites; economics may be another matter. Each is likely to have its time and place on the managed forest landscape of the Pacific Northwest.

The Douglas Project

Modeling Populations
and
Developing Management Options

Applied Biomathematics
Eugene, OR and Setauket, NY

Executive summary

Models are essential to assess management options in a cost-effective way

Models used in spotted owl research must be a synthesis of GIS and metapopulation approaches, applicable at different spatial levels.

Modeling effort will be large in early years, since this will drive fieldwork by prioritizing research objectives.

The need for modeling

Models are mathematical representations of natural processes and systems, such as changes in a population. In ecology and conservation biology, models are used to predict future population trends and to assess extinction risks of species and populations. Models are essential tools for organizing available information on the ecology of a species and data from field studies on the dynamics of its populations. Without such an organization, it is not possible to utilize the results of field studies efficiently.

Population models were extensively used in the process of listing the spotted owl as threatened. They will also be used to estimate recovery chances, and to evaluate the effect of conservation measures on the persistence of the spotted owl. Therefore they will form the basis of any decision to de-list this subspecies.

Models must also be used in the design of experimental and field studies. The role of modeling in field work is the identification of the factors most influential in determining extinction risk or recovery chances. By concentrating the field efforts on these most important factors, models help effective planning of research efforts and efficient use of limited resources.

A very important role of models in applied research is the identification of management options. Trial-and-error methods for determining management alternatives are very costly and time-consuming, if not impossible. An interface between modeling and field research allows the managers to identify the most feasible options and estimate their likely impact on population persistence. In the proposed research this interface will be achieved by integrating the population biology models with forest stand development models through the use of geographic information systems (GIS). Plans for this integration are explained below.

The metapopulation approach

A collection of populations of the same species in the same geographical region is called a metapopulation. Metapopulations occur where the habitat a species requires for survival and breeding occurs in patches. This patchy distribution of habitat may occur either naturally, or as a result of habitat loss and fragmentation. In the case of the northern spotted owl, logging has resulted in a patchy distribution of the old-growth forests that the spotted owl is dependent on (Ripple et al. 1991). The creation of a system of reserves, such as the habitat conservation areas for the spotted owl also produces a spatial structure that is most appropriately modeled with a metapopulation approach.

Research on metapopulation ecology has shown that extinction risk cannot be assessed only from data and models of the single populations that make up the metapopulation. One cannot estimate the risk of extinction of the entire species based on the risk of extinction of its separate populations because of the interdependency of and the interactions among the populations.

Studying the question of the effect of land use patterns on the extinction risk of species has two components. The first one is the prediction of changes in the habitat (from the point of view of the endangered species in question) as a result of changes in land-use patterns. We call this component habitat prediction. The second component is the prediction of the effect of changes in the habitat of a species on its persistence, i.e. assessing the extinction risk of a species as a result of changes in its habitat. We call this component extinction risk assessment.

There are a number of approaches to studying metapopulation dynamics, and several approaches to studying and predicting changes in landscape and land-use. The aim of the proposed research is to integrate these two types of approaches in order to make extinction risk assessments for the owls based on alternative habitat changes. This integration of the spotted owl metapopulation models and mapped information from a Geographic Information System (GIS) overcome the deficiencies of the two approaches when taken in isolation: metapopulation models generally ignore specific predictions about future habitat patterns, and geographic information systems do not make predictions about species viability or assess extinction risks.

This integration will be achieved by developing software which will combine GIS, which analyzes and predicts landscape patterns and changes in the structure of a species' habitat, with a metapopulation model which incorporates dynamic spatial structure and estimates the extinction risk of the species that utilizes the habitat. The resulting model will utilize information both on land-use patterns and the spatial structure of a species' habitat and on the demographic and ecological characteristics of the species.

Habitat prediction: GIS

In the case of the Spotted Owl, simply mapping the usable habitat will not be sufficient for modeling the metapopulation. We must be able to document the quality of habitat both for breeding and dispersal, as well as make predictions of how the habitat will change over time as a result of management decisions. This will require integration of forest stand development models, various forest economics models, as well as alternative Spotted Owl population models.

GIS has been used to do cartographic modeling for many years (e.g. McHarg 1969, Buitenhuis et al. 1982 and Densham and Rushton 1992). Cartographic modeling focuses on overlaying maps to summarize disparate thematic information into comprehendible map coverages. This approach however will only give us a snapshot in time, we must expand our system to handle predictions of the future of habitat change.

GIS has only recently been recognized as a tool for predictive modeling of dynamic spatial processes (Johnston 1992). Dynamic process modeling has been used to predict changes at a range of spatial scales. Climatic change has been modeled at the global scale (Gahn et al. 1982, Hansen et al. 1983, Schlesinger and Mitchell 1987), while some vegetation change models have been constructed at the scale of hundreds of kilometers (Costanza et al. 1988) to the scale of five hundred meters (Botkin, Woodby and Nisbet 1991).

We recognize the importance of being able to handle a variety of spatial models of vegetation, economics and owl populations. It is further critically important, in this developing field, to design systems that will be able to interact with each other. Our successful efforts at Applied Biomathematics to prototype a GIS for assessing environmental quality (Downer, Kurtz and Ferson 1992) that supports independent spatial model design demonstrates the feasibility of this approach.

The integrated model should permit the user to make predictions of environmental quality on a regional scale based on a stack of maps which represent multivariate spatial heterogeneity across a region. This system that we envision is more than a geographical information system (GIS), however, since the maps are tied together by specialized expert submodels that represent the relationships among the displayed variables and integrate the interactions among them. This infrastructure allows the user to graphically manipulate multiple dependent submodels (such as timber harvest options) to evaluate the impact of various management options and model assumptions. The system therefore permits analysis of the overall effects on spotted owl persistence and economic parameters of user-specified changes to input maps or model parameters. The kernel of the system couples and integrates the various submodels and is further responsible for detecting and resolving circular references. The design of the system must include the use of a distributed network of computers, allowing models to be run on specific machines for which they were developed.

Its main objective is to go beyond the geographic information system (GIS) concept of a stack of thematic maps (Fig. 1) to an internally structured network of maps linked by specialized models which characterize relationships among the variables (Fig. 2). This is analogous to passing from a simple data file, in which the organization of the data has no inherent meaning, to a spreadsheet in which cells are related to one another by their positions. The system will allow a user to apply and evaluate models *without* spending the time to become familiar with each model's idiosyncratic operation. Models can be executed in a batch-like fashion, with the execution parameters pre-defined by the author of the specific model. This will permit evaluation of alternative forest stand development models and proprietary forest economics models without compromising their security.

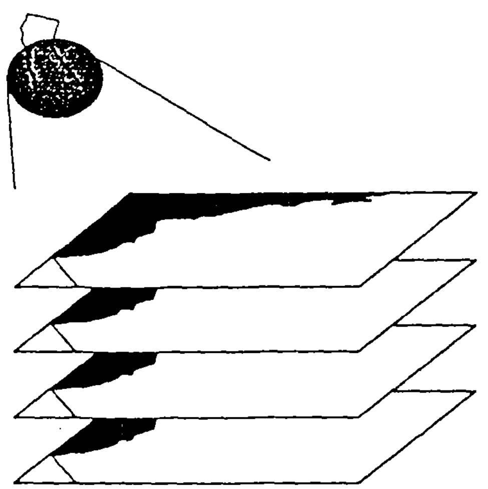

Figure 1. Typical GIS overlay.

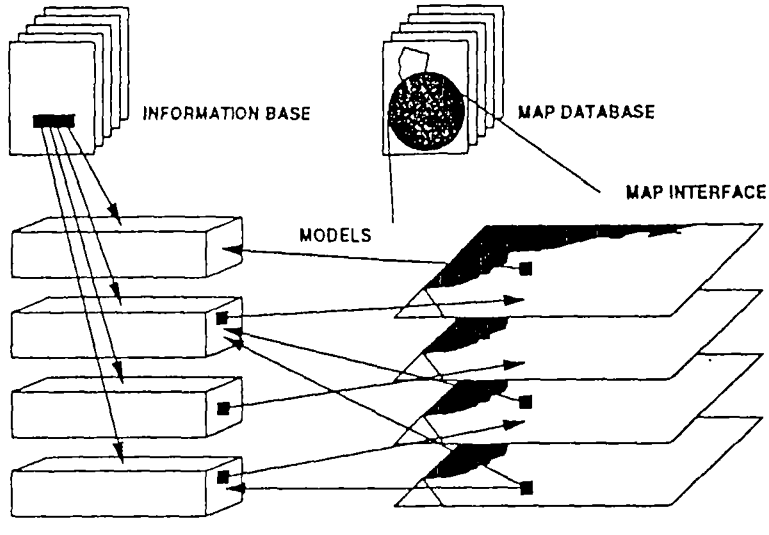

Figure 2. Network of maps and models in proposed system.

One technique that has been used successfully to quantify habitat quality is the habitat suitability index (HSI) which was developed by the U.S. Forest Service to assess the value of a given geographic area for a specific species. This quantitative assessment, using various environmental parameters, produces values ranging from zero through one, were one denotes ideal environment for that species. We will use this system as the spatial base of our modeling effort but use a Geographic Information System (GIS) to perform the HSI calculations. Though we recognize the limits of such an approach, it will serve us well in the assessment stage of this research and can be easily modified as improved approaches to quantification of habitat quality become available.

The habitat map production will be done by cartographic overlays of various parameters critical to the use of an area by the owl. These maps would include such data as precipitation, elevation, and forest structure. These simple cartographic models will follow standard HSI methodology applied over a variable geographic space but be constrained to yield patches as described above. These maps will be produced using GRASS, a GIS widely used by governmental and academic institutions. To facilitate the generation of these habitat maps all cartographic modeling will be done in a raster format. This may mean that some conversion of existing maps from their original vector format to raster will be necessary.

There are two separate tasks to be accomplished in this section: development of software for model integration (3 person years) and acquisition of spatial data (4 person years). Acquisition of the data will be the hardest part in terms of time and effort. Much of the information already exists but will need to be collected at one site. Further, this data exists at differing spatial scales and will need to be geo-rectified so that it can be of use to the modeling effort. We have received indication from private industry as well as local, state and federal agencies that they will be willing, if the Douglas County project is funded, to avail us of their data for the Spotted Owl research.

Research plan

The ultimate aim of the modeling work is to produce the integrated model described above. This integrated model will be developed in several stages. The intermediate products at each of these stages will be models at different levels of spatial scale and different levels of complexity and integration. These intermediate models will be used to provide tentative answers to questions at the local and county levels. This will allow the development of management options and prioritization of research objectives in the short-term, before the final product becomes available. The intermediate models will make it possible to reach our short-term objectives (stated in the report *Objectives for 1992-93*), and to evaluate the progress of ongoing field work.

We envision the development of the integrated model by increasing its complexity in two dimensions. First, we will start from a local (DCA) level and progress into county and regional levels. Second, we will start from simple models and progress by adding biological complexity. The table in the following page summarizes this development. For each combination of model and spatial scale, the development is summarized by three objectives. The first objective is to gather and organize the data to be used by the model. The data will usually be geographic in character, and will be organized by a GIS. The second objective is the development and testing of the model. The last objective is the prioritization of research objectives and management options using the model with the geographic data. The table also includes the projected completion times for these three objectives. A second table presents the same plan as a time schedule.

	Level (Spatial scale)		
Model:	**Local (within a DCA)**	**County**	**Regional**
Population Model	Geographic data: 6th month Model development: 6th month Research priorities: 6th month	Geographic data: 12th month Model development: 12th month Research priorities: 12th month	*Not applicable*
Unstructured Metapopulation Model	*Not applicable*	*Not applicable*	Geographic data: 6th month Model development: 6th month Research priorities: 6th month
Structured Metapopulation Model	*Not applicable*	Geographic data: 12th month Model development: 18th month Research priorities: 18th month	Geographic data: 2nd year Model development: 3rd year Research priorities: 3rd year
Forest stand development model	Geographic data: 12th month Model development: 12th month Research priorities: 18th month	Geographic data: 18th month Model development: 2nd year Research priorities: 3rd year	Geographic data: 4th year Model development: 4th year Research priorities: 5th year +
Forest economics model	Geographic data: 12th month Model development: 18th month Research priorities: 2nd year	Geographic data: 18th month Model development: 2nd year Research priorities: 3rd year	Geographic data: 4th year Model development: 5th year + Research priorities: 5th year +
Population × Forest	Geographic data: 2nd year Model development: 3rd year Management options: 4th year	Geographic data: 2nd year Model development: 3rd year Management options: 4th year	*Not applicable*
Metapopulation × Forest	*Not applicable*	Geographic data: 3rd year Model development: 3rd year Management options: 4th year	Geographic data: 5th year + Model development: 5th year + Management options: 5th year +

Time schedule for model development

Time	Model	Tasks to be completed
6th month		
	Population model at the *local level*	Geographic data acquired Model development completed Research priorities established
	Metapopulation model at the *regional level* (Unstructured)	Geographic data acquired Model development completed Research priorities established
12th month		
	Population model at the *county level*	Geographic data acquired Model development completed Research priorities established
	Metapopulation model at the *county level* (Structured)	Geographic data acquired
	Forest stand development model at the *local level*	Geographic data acquired Model development completed
	Forest economics model at the *local level*	Geographic data acquired
18th month		
	Metapopulation model at the *county level* (Structured)	Model development completed Research priorities established
	Forest stand development model at the *local level*	Research priorities established
	Forest economics model at the *local level*	Model development completed
	Forest stand development model at the *county level*	Geographic data acquired
	Forest economics model at the *county level*	Geographic data acquired
2nd year		
	Forest stand development model at the *county level*	Model development completed
	Forest economics model at the *local level*	Research priorities established
	Forest economics model at the *county level*	Model development completed
	Metapopulation model at the *regional level* (Structured)	Geographic data acquired
	Population-Forest model integration at the *local level*	Geographic data acquired

	Population-Forest model integration at the *county level*	Geographic data acquired
3rd year		
	Metapopulation model at the *regional level* (Structured)	Model development completed Research priorities established
	Forest stand development model at the *county level*	Research priorities established
	Forest economics model at the *county level*	Research priorities established
	Population-Forest model integration at the *local level*	Model development completed
	Population-Forest model integration at the *county level*	Model development completed
	Metapopulation-Forest model integration at the *county level*	Geographic data acquired Model development completed
4th year		
	Forest stand development model at the *regional level*	Geographic data acquired Model development completed
	Forest economics model at the *regional level*	Geographic data acquired
	Population-Forest model integration at the *local level*	Management options evaluated
	Population-Forest model integration at the *county level*	Management options evaluated
	Metapopulation-Forest model integration at the *county level*	Management options evaluated
5th year and beyond		
	Forest stand development model at the *regional level*	Research priorities established
	Forest economics model at the *regional level*	Model development completed Research priorities established
	Metapopulation-Forest model integration at the *regional level*	Geographic data acquired
	Metapopulation-Forest model integration at the *regional level*	Model development completed
	Metapopulation-Forest model integration at the *regional level*	Management options evaluated

Resources required for 1992-3

The modeling effort will be the largest in the early years of the project, since this will drive fieldwork by prioritizing research objectives. In the first year of the project, work will be initiated for all models (population, metapopulation, forest development, forest economics), as well as for the GIS that will be used in their integration. Parallel to this work will be the data acquisition effort. The total work will require employment of 7 scientists, and purchase of hardware and software to insure the flow of data among them.

REVIEW OF SPOTTED OWL MODELS

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Leslie matrix models

Initial models of spotted owl population dynamics were based on Leslie matrix. These models lacked spatial structure. Marcot and Holthausen (1987) and the Forest Service (USDA 1988) used age-structured, linear (i.e., without density dependence), stochastic models based on the Leslie matrix. Noon and Biles (1990) also developed a matrix model.

These models lack spatial structure, thus are not relevant to the spatially explicit questions we are attempting to address.

Individual territory models

Lande (1987, 1988) developed a stage-structured model based on the recognition of individual territories as habitat patches where local extinction and recolonization take place. This model assumed random or even distribution of territories. It ignored the fact that spotted owl territories have a clumped distribution, and that territories overlap considerably with neighboring territories (Forsman 1984), making it impossible to recognize each territory as a separate habitat patch.

A similar model was developed by Lamberson, McKelvey, Noon and Voss (1992). This is the "individual territory model" described in Appendix M of Thomas et al. (1990). The difference between the models of Lande and Lamberson et al. was mostly in the analysis: while Lande based his conclusions mostly on a deterministic and equilibrial analysis, Lamberson et al. used simulations to explore nonequilibrium situations and effects of environmental stochasticity. The assumption of the random distribution of territories means that these two models (like others before) do not incorporate important components of spatial structure.

Territory cluster models

Doak (1989) developed a model for the Northern spotted owl that recognized groups of clumped territories. However, this model also did not have explicit spatial structure because it made two important assumptions. First, it assumed that the survival and reproduction probabilities were independent among populations (even within a population), i.e., where a population is or how close it is to another population makes no difference in how similar its dynamics are to dynamics of the nearby population. This assumption of independent population dynamics may lead to an underestimation of extinction risk.

Second, it assumed that the rate of dispersal between all populations was equal. The distance between the northern spotted owl subpopulations (i.e., territory clusters), ranges from a few km to hundreds of km. Thus it is not possible that dispersal between any pair of populations can be equal to dispersal between other pairs.

A model comparable to Doak's is the "territory cluster model" developed by Lamberson, Noon and Voss (1992), and described in Appendix M of Thomas et al. (1990). However, this model does not make the second assumption of equal dispersal from any cluster (subpopulation) to any other. It simulates the dynamics in an explicit landscape. The assumptions in this model include:

1. The simulated landscape is a hypothetical one, based on statistics of spotted owl habitat (such as percent suitable habitat within and outside clusters of territories, number of territories per cluster, etc.), and not an actual GIS (however, they may have later developed a link with GIS).

2. Each territory is the same size (e.g., 2500 or 3000 acres). Since the simulations are based on individuals moving among territories, this assumption is crucial.

3. The spatial coverage is not stated. This may be considered irrelevant if the simulated landscape is hypothetical. However, if there is a GIS connection to real landscape data, how much of the owl's total range is modeled becomes important. It *probably* (this is only a guess) cannot cover the whole range of the spotted owl.

4. The demographic parameters in each cluster (even in each territory within a cluster) seem to be sampled independently (i.e., with zero correlation). In another application of the same model (to California subspecies), Noon and McKelvey (1992?) state that they assumed complete correlation. In either case, the correlation is not explicitly considered.

A third model that recognizes the clumping of territories is the one I developed for the California subspecies with Bill LaHaye and R. Gutierrez. This is a much less detailed model which summarizes the dynamics within clusters of territories (subpopulations) with a scalar model (that may be different for each subpopulation, and may include both demographic and environmental stochasticity, density dependence, Allee effects, habitat loss, etc., but not age or stage structure). The advantages are:

1. The spatial structure is based on the actual landscape.

2. Although the simulated landscape was modeled at a very crude scale, it is not as crucial as for the previous model, since the model is not individual-based.

3. The spatial coverage includes all of southern California. When applied to the northern subspecies, it may include the whole metapopulation within the U.S.

4. Both dispersal and within-population dynamics are explicit functions of the spatial scale. The similarity of environmental fluctuations and the rate of dispersal between two populations depend on their geographic position.

The proposed model

The most important thing about the proposed model is that it is not a single model, but a series of models. The models we will develop will include a larger range of spatial scale, level of detail and coverage than any other single model developed so far. The important aspects of the proposed models are described in more detail below.

Spatial scale and level of detail

Some modelers feel that including more details (i.e., parameters) improves the realism of model, while others argue that in most practical cases, available data permit only the crudest models, and attempts to include additional details are made at the expense of insights that can be gained and usually result in decreased predictive power and understanding.

We believe that the level of detail should be determined according to the objectives of the model. Models intended to identify research objectives, to help in long-term experimental design and to analyze relative importance of factors in overall metapopulation persistence will probably include fewer parameters than those intended to predict next year's distribution of breeding pairs within a local population.

We also believe that management decisions that can potentially affect the extinction risk or recovery chance of the spotted owl should be based on a series of models with different levels of detail. This will decrease the risk of making a wrong decision because of an implicit assumption in one of the models.

Our proposal is to begin the modeling effort at two levels of abstraction. At the larger scale, our method (similar to the method used in RAMAS/space) will permit us to include the largest amount of appropriate information with the lowest complexity. This model will be used to model the entire northern spotted owl metapopulation in Washington, Oregon and California, to obtain crude estimates of the overall extinction risk, and to investigate effects of spatial factors such as dispersal and spatial correlations (see below). At the smaller scale, we will develop a detailed model of the dynamics of an owl population. This will be similar to the "territory-cluster" model (as described in Thomas et al. 1990), and perhaps will also be individual-based (but at a different resolution; see below).

Spatial range (geographic coverage)

We believe that any management decision should be evaluated with respect to its impact on the overall species persistence. This will make sure that cumulative effects of management practices in different parts of the owl's range are taken into account in a comprehensive way. We also believe that it is not practical at this time (due to data deficiencies as well as technical difficulties) to develop a very detailed model of the owl populations over all of the species' range. Even if such models can be developed, their results would probably be unreliable. Our solution is to use a series of models with increasing regional coverage accompanied by decreasing local detail. In this way, detailed local models will be used in connection with less detailed overall (large-scale, regional) models when making management decisions. As data accumulate, we will extend the range of the detailed models, and add more details to the large-scale regional models.

Spatial autocorrelations

One factor that is very important in the dynamics of fragmented populations is spatial structure. In our analysis of the dynamics of California spotted owl metapopulation (with Bill LaHaye and Rocky Gutierrez), we found that results (extinction risks) were particularly sensitive to one aspect of the spatial structure: the correlation among population growth rates. It is well-known that correlated (synchronized) fluctuations decrease the chance of recolonization ("the rescue effect"), thereby decreasing the persistence of metapopulations. Most metapopulation models in the literature have ignored this factor, hence probably *underestimated* extinction risks. These include some models developed for the spotted owl. One solution is to assume completely correlated fluctuations, and some models (probably including the "territory-cluster" model in Thomas 1990) have made this assumption.

However, in a metapopulation with a wide geographic distribution, such as that of the northern spotted owl, this assumption is obviously wrong; it will lead to overly conservative results (i.e., overestimate extinction risks), and will almost certainly be challenged. It is possible (but nit likely) that the "territory cluster" model does have a spatial correlation factor; however, even if it does, it probably assumes that correlation is constant between any two populations. It is unrealistic to assume that populations that are separated by a few miles or by hundreds of miles, or those that are on the same side or different sides of mountain ranges, will all have the same correlation. I believe a solution might be (i) to incorporate this factor explicitly, and perhaps to define it as a function of the spatial structure, and (ii) to make sensitivity analyses with intermediate levels of correlation, based on observed spatial autocorrelations in environmental patterns such as rainfall.

For example, in the southern California metapopulation, we assumed that the similarity of environmental fluctuations between two populations is also a function of distance, i.e., closer populations are more likely to experience similar patterns of environmental fluctuations. In a region such as southern California where weather patterns have strong spatial correlation, we believe this is a more reasonable assumption that complete independence or complete dependence of population dynamics. Incidentally, I later learned that Michael Gilpin has also independently used the same approach in analyzing the metapopulation dynamics of the Steven's Kangaroo Rat in southern California. He used the correlation in rainfall pattern across the range of the species as an upper bound for correlation among population growth rates. (Unfortunately, the case is currently in court, or otherwise in dispute, so the results will not be published, and he could not even give me a copy of his analysis).

Resolution

At the finest scale, our approach differs from others in that we will use the scale appropriate to the habitat. The "territory-cluster" (described in Thomas et al. 1990) model has a resolution that defines the size of each spatial "cell" as the *mean* territory size. This assumes a fixed territory size for the owl irrespective of the quality of the habitat, and non-overlapping territories. We know that territory size varies a great deal in this species, and territories do overlap to a considerable extent. Whether or not an individual based approach is required in this effort, cell size of the underlying map should have a resolution of 4 to sixteen times that of the species territory being modeled. If the resolution is not this fine then the location of the grid could bias the results. Also, areas that can be used by owls would not be modeled as usable habitat if they do not fill a model cell. This would result in excessively conservative results in a irregular patches and less so in regular boarded patches, yielding unpredictable results and thus weakening the robustness of the model.

April 23, 1993

LEGISLATION TO IMPLEMENT THE DOUGLAS PROJECT

SECTION 1

The Douglas Project. There is hereby established a cooperative applied research project within the Departments of Agriculture and Interior which shall be known and referred to as the "Douglas Project."

SECTION 2

(a) Purpose of project. The Douglas Project is intended to generate scientific research results that will further the understanding of how forests may be managed to ensure the viability of forest-dependent wildlife species and provide for a wood products resource. The goal of the Douglas Project research is to find ways to:

(1) protect forest ecosystems, structures, and functions, including habitat for anadromous fish and wildlife;

(2) maintain the stability and independence of timber dependent communities by providing a reliable and sustainable timber supply;

(3) develop scientific data on wildlife in managed forests; and

(4) gain knowledge and expertise in timber harvest practices that minimize adverse ecological impacts.

(b) Elements of the project. The Douglas Project shall include the following research elements:

(1) applied silvicultural research, which will include but not be limited to the harvest of timber on lands managed by the Departments of Agriculture and Interior within the Douglas Project area using silvicultural prescriptions developed by the Douglas Project. This research will address questions of how to manage forested ecosystems to protect the habitat of threatened, endangered, and sensitive wildlife species, as well as other ecosystem elements, while maintaining a reliable and sustainable timber supply and the stability and independence of timber dependent communities;

(2) development and testing of models to predict the behavior and population dynamics of the northern spotted owl, anadromous fish and other threatened, endangered, and sensitive wildlife species in a variety of forested environments; and

(3) study of northern spotted owl demography and dispersal, as well as the demography of other threatened, endangered, and sensitive wildlife species.

(c) Implementation of the project.

The Douglas Project shall be implemented through the joint efforts of the Secretaries of Agriculture and Interior, acting through the Forest Supervisors and District Managers of the Forests and Districts within the Douglas Project. The Douglas Project Advisory Committee will advise and assist these officials regarding the Douglas Project. With the advice and assistance of such Committee, the agencies shall prepare a joint annual implementation plan for the project no later than August 1 of each year for the following federal fiscal year. The Secretaries of Agriculture and Interior shall have 21 days to review, revise, and approve the final plan. Each annual plan must implement the purpose and goal stated in this section and the fiscal requirements established in Section 4. The agencies may retain such consultants as may be advisable to implement the Douglas Project.

SECTION 3

(a) Geographic boundaries. The Douglas Project area shall include all of Douglas County, Oregon and those portions of Coos and Lane Counties, Oregon that are identified on a map entitled "The Douglas Project" which is on file at the office of the Forest Supervisor of the Umpqua National Forest.

(b) Federal lands. Research conducted by the Douglas Project shall be carried out within the boundaries of the Umpqua National Forest, and the Roseburg and Coos Bay Districts of the Bureau of Land Management; Provided That no timber harvest shall occur within any federally designated Wilderness Area or Natural Research Area.

(c) Private lands. Douglas Project research may also be carried out on any private lands within the Douglas Project which the applicable landowner agrees to make available.

(d) State and county lands. Douglas Project research may also be carried out on any state or county lands within the Douglas Project area which the applicable entity agrees to make available.

(e) Coordinate with other research. The Douglas Project research may be coordinated with and may utilize research being conducted by any federal, state, local, or private entity.

(f) Project output. As research results become available, the Douglas Project will make the same available. Research results may be published through the Pacific Northwest

Forest and Range Experiment Station, the Research Division of the Bureau of Land Management, or directly by the leading researchers working on the Douglas Project. Research status reports will be provided to the Secretaries of Agriculture and Interior no less than annually.

SECTION 4

(a) Authorization and appropriation. Funding for the Douglas Project is authorized and appropriated out of the agencies' share of receipts (as calculated under applicable law) generated by the sale of federal timber made to further the applied silvicultural research undertaken pursuant to subsection 2(a) of this Act. This authorization and appropriation is for $6,000,000 (six million) for each fiscal year 1994 through 2003. No other agency funds from timber receipts may be used to pay for the Douglas Project except that during fiscal year 1994 agency funds from other timber receipts will be advanced to the Douglas Project, but shall be repaid by the Douglas Project receipts no later than the end of fiscal year 1996.

(b) Sharing of funds. Funds appropriated for the Douglas Project may be shared by the agencies in whatever manner is agreed to by the Forest Supervisor and District Managers.

(c) Gifts, etc. In addition to the foregoing, the Secretaries of Agriculture and Interior are authorized to accept, hold, and administer gifts, donations and bequests of money, real and personal property, and personal services from any source not prohibited by law and to use the same in implementing the Douglas Project.

SECTION 5

Advisory Committee. There is hereby established a Douglas Project Advisory Committee comprised of the following persons:

(a) the Forest Supervisor of the Umpqua National Forest;

(b) the District Managers of the Roseburg and Coos Bay Districts of the Bureau of Land Management;

(c) the Dean of the College of Forestry at Oregon State University;

(d) a member of the Douglas County Board of Commissioners designated by the Commissioners and approved as provided for below;

(e) a member of the Coos County Board of Commissioners designated by the Commissioners and approved as provided for below;

(f) an Oregon state government official or employee designated by the Governor and approved as provided for below;

(g) a resident of the Douglas Project area who represents the environmental community within the Douglas Project area;

(h) a resident of the Douglas Project area who owns a tree farm of 2,500 acres or less;

(i) a resident of the Douglas Project area who is a representative of the so-called "grassroots" community and has a demonstrated interest in assisting the members of the local community in maintaining local economic independence, and employment and community stability;

(j) a representative of organized labor who represents the wood workers of the Douglas Project area;

(k) a resident of the Douglas Project area whose business purchases federal timber for processing at its facility located within the Project area.

The Forest Supervisor of the Umpqua National Forest and the District Managers of the Roseburg and Coos Bay Districts shall jointly approve or appoint (as applicable) persons to fill the positions identified in subsections (d) through (k) above. Prior to making these appointments, the Supervisor and District Managers will seek input from interested persons and organizations, including but not limited to persons who have promoted and supported the legislation creating the Douglas Project.

Failure of the appointed or designated agency members in subsections (c) through (f) above to agree to serve on this Advisory Committee shall not affect the Committee's function. The Supervisor and District Managers may replace any vacancies that may occur. The Committee may act based on such rules as it may adopt from time to time. The Committee shall meet from time to time and shall at its first meeting elect a chair. Until such time, the Forest Supervisor will act as its chair. Meetings may be called at the chair's initiative or at a request directed to the chair by any four Committee members. The Committee shall not be subject to the Federal Advisory Committee Act, as amended.

SECTION 6

(a) To the extent that this Act calls for the harvest of timber as a part of its applied silvicultural research, compliance with the terms of this Act, including but not limited to the review of the implementation plans by the Secretaries of Agriculture and Interior as provided in Section 2, such harvest shall occur without further need for procedural or substantive compliance with any other federal statutes that may otherwise apply to the planning, sale, and harvest of such timber, as well as to the subsequent management of the harvested areas as a part of the Douglas Project. This shall also mean that no person or entity, whether federal, state, local, or private, shall be considered to be in violation of any such federal law if such person is conducting activities that are a part of the Douglas Project.

(b) Any new or revised planning documents applicable to the Umpqua National Forest or the Roseburg and Coos Bay Districts of the Bureau of Land Management shall be made to reflect and be consistent with the Douglas Project.