

**S & M Strategic Survey Studies and Analyses
Worksheet Proposal Form**

DATE OF PROPOSAL: November 17, 2000

PROJECT TITLE:

Evaluating the utility of upslope leave islands as refugia for sensitive plant and animal species in managed forests.

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OBJECTIVES OF THE STUDY:

Project Goal

This project evaluates the role that leave islands play in providing for the persistence of sensitive plant and animal species. The overall goal of this project is to provide information that can be used by biologists to improve the design and effective placement of upslope leave islands for maintaining plant and animal biodiversity consistent with Northwest Forest Plan (NWFP) standards and guidelines for Adaptive Management Areas and Matrix land allocations, with application to industrial and private managed forests. Our specific goal is to evaluate differences in microhabitat and plant, amphibian, and terrestrial mollusk abundance and diversity with respect to the size and placement of leave islands in managed forests. We envision that this research will: 1) evaluate the usefulness of leave islands in providing habitat for plants and animals, 2) provide guidance in the future design and placement of leave islands.

Project completion will occur in two phases. This study proposal is designed to accomplish the goals of Phase One. Subsequent research efforts in Phase Two will expand on the preliminary findings of the retrospective Phase One research efforts.

Phase One - Retrospective Study Objectives:

1. Relative to harvested areas and control (unharvested) areas, determine composition, abundance, and diversity in upslope leave islands of:
 - A. Amphibian communities.
 - B. Terrestrial mollusk communities.
 - C. Vascular plant and bryophyte structure and diversity.
2. Determine habitat and microclimate correlates of A, B, and C.

Phase Two - Experimental Study Objectives:

1. In upslope leave islands of different sizes, determine pre-harvest to post-harvest changes in:
 - A. Microclimate and habitat.
 - B. Amphibian community composition, abundance, and diversity.
 - C. Terrestrial mollusk community composition, abundance, and diversity.
 - D. Vascular plant/bryophyte structure and diversity.
2. In upslope leave islands of different sizes associated with non-fish bearing streams, determine pre-harvest to post-harvest changes in:
 - A. Microclimate and habitat.
 - B. Amphibian community composition, abundance, and diversity.
 - C. Terrestrial mollusk community composition, abundance, and diversity.
 - D. Vascular plant/bryophyte structure and diversity.

Background

Plant and animal diversity is commonly maintained on managed forested land by creating leave islands (undisturbed standing timber) at the time of timber harvest. Leave islands in upslope areas typically range in size from less than 1 ha to over 50 ha. Retaining patches of green trees conceptually promotes species diversity by providing refugia or centers of dispersal for multiple taxonomic groups (USDA Forest Service and USDI Bureau of Land Management 1994; Spies and Turner 1999; Olson et al. 2000). However, data supporting the value of leave islands for old-growth associated species in secondary forests undergoing continued management are few. Data are lacking to guide biologists in the size, design, and placement of leave islands in such upslope areas.

Edge-associated changes in microclimate in forest stands that are adjacent to harvested areas are documented and typically are most pronounced within 150 meters of the edge (e.g. Chen et al. 1990; Young and Mitchell 1994). Edge related changes in microclimate include more variable temperatures, increased solar radiation, reduced humidity, and reduced soil moisture. Due to a high ratio of edge to area, the microclimate of smaller leave islands (<10 ha) may be entirely altered. As a result, plant or animal species that have narrow tolerances to change in microclimate may be entirely lost from leave islands. Pertinent questions about the relationship of physical structure of upslope leave islands to their associated microclimates, flora, and fauna remain largely unanswered.

Plant distributions are strongly associated with proximity to edge (Chen et al. 1990) and with measures of microclimate environment (Chen et al. 1993). Vascular plant species with narrow tolerances to change in microclimate will respond through seedling germination, plant survival, and plant growth (Ranney et al. 1981). Vascular plant and bryophyte species that are associated with disturbed areas may increase in abundance in small leaf islands, while plant species associated with an over-story and stable microclimate may decrease (e.g. Neitlich and McCune 1997). Edge areas also have been associated with increased abundance of invasive and early-successional vegetation (Ranney et al. 1981). The usefulness of leaf islands for maintaining the diversity of plants associated with forest interior is likely a function of how well forest interior microclimate also can be maintained. The patterns of plant structure within leaf islands will ultimately affect the distribution and diversity of the animals that select leaf islands for use.

Amphibians are perhaps the most sensitive of the vertebrate fauna to changes in microclimate (e.g. Welsh and Droege, in press) and therefore are suitable for evaluating the effectiveness of leaf islands as habitat in upslope areas. Amphibians may be particularly susceptible to the loss of habitat because of their relatively low vagility and narrow range of habitat conditions they can tolerate (e.g. Nussbaum et al. 1983; Blaustein et al. 1994; deMaynadier and Hunter 1995; Pough et al. 1998). Forest management practices that range from selective harvest to clear-cutting can potentially alter the microhabitat on forest floors enough to severely impact salamander populations (e.g. Herbeck and Larsen 1999). A variety of studies have documented a reduction in salamander populations or species composition as a result of forest management activities (e.g. Blymyer and McGinnes 1977; Bury 1983; Petranka et al. 1993; Dupuis et al. 1995; deMaynadier and Hunter 1995; Ash 1988). Evidence suggests that forest harvest practices that open the forest canopy result in ground-level increases in wind, radiation and decreases in soil moisture and ground-level humidity (Matlack 1993) and structure of vegetation. However, the factors associated with forestry practices that regulate amphibian densities and spatial arrangements are not well understood (Harper and Guynn 1999).

Like amphibians, terrestrial mollusks are likely sensitive to microclimate alterations resulting from forest management activities. Habitat components important to terrestrial mollusks include downed wood, mosses, abundant leaf litter, and moist, relatively cool microclimates (USDI Bureau of Land Management 1999). Data are lacking on the potential impacts of edge effects on terrestrial mollusks.

STATEMENT OF THE WORK:

Phase One - Retrospective Study

Examination of existing leaf islands within managed forests, in comparison to matched unmanaged areas allows an initial cost-effective assessment of the role of such islands for species persistence. In western Oregon, the Bureau of Land Management Density Management Study (Tappeiner et al. 1999) has implemented leaf islands of three sizes (1/4, 1/2, 1 acre) across 13 sites with forest density management. Pretreatment data on forest amphibians and lichens/bryophytes were collected in 1995-1996 at two of these sites. Posttreatment surveys in leaf islands have not been conducted.

Study Areas - This project will evaluate two existing study sites designed for the Bureau of Management Density Management Study. Keel Mountain is administered by the BLM Eugene District while Bottom Line is located on the BLM Salem District. These are approximately 50 year old stands, naturally regenerated from clearcut harvest, which were thinned in 1997. Leave islands were maintained within managed matrix with 40, 80, and 120 Trees Per Acre (TPA). Unharvested control units have >240 TPA (Figure 1). Leave island selection for this study will include each of the 3 size classes within all 3 tree harvest densities, at both sites. A sample of leave islands will be determined after initial site reconnaissance is completed.

Microclimate Sampling - We will measure microclimate (air temperature, soil temperature, and relative humidity) using automated data loggers for a 7 day period in the summer to examine edge-to-interior gradients of leave islands of different sizes within sites. Data among sites will be collected for comparison.

Amphibian Sampling - Time-constrained sampling for salamanders will be modeled after the survey protocols specified for amphibians under the Survey and Manage provision of the Northwest Forest Plan (USDA 1999) to provide both captures per unit area and captures per person hours of search effort. Amphibian sampling will be conducted during the spring (February, March or April). There are no Survey and Manage amphibians at these sites, although one species (Oregon slender salamander, *Batrochoseps wrighti*) is proposed for Survey and Manage status due to its rarity. However, several similar plethodontid species with similar ecological constraints occur here. These species can be used as surrogate rare salamander species in this assessment.

Terrestrial Mollusk Sampling – Survey and Manage terrestrial mollusk species are documented for the study areas. Sampling for mollusks will be modeled after the survey protocols specified for terrestrial mollusks under the Survey and Manage provision of the Northwest Forest Plan (USDA 1999). Terrestrial mollusk sampling will be conducted during the spring (February, March or April).

Vascular Plant and Bryophyte Sampling – Survey and Manage vascular plant and bryophyte species are documented for the study areas. Leave island plant communities will be described by measuring basal area of conifers and hardwoods, understory vegetative cover, topographic slope, and litter cover on the forest floor. Sampling will concentrate on vascular plant and bryophyte species and methods will be modeled after the survey protocols specified for vascular plants and bryophytes under the survey and manage provisions of the Northwest Forest Plan (USDA 1998). Plant sampling will be conducted during the summer (May, June or July).

Data Analysis - We will use multivariate analysis of variance to determine if there are overall effects of island size and presence of non-fish bearing streams using measures of microclimate, plant abundance/richness, amphibian abundance/richness and terrestrial mollusk abundance/richness. Repeated measures (pre/post treatment) analysis of variance will be used to test for effects of leave island creation. Regression techniques will be used to model the relationship between leave island structural characteristics and microclimate, plant abundance and diversity and animal abundance and diversity. We will use AIC model-based selection to help detect the most parsimonious model (Burnham and Anderson 1998). The graduate student

will develop and refine statistical procedure through consultation with statisticians in the Quantitative Sciences Group (QSG) in the Department of Forest Science and with statisticians in the Department of Statistics at Oregon State University. Analyses will be performed in the Statistical Analysis System (SAS Institute 1990, 1997).

Phase Two - Experimental Study

Phase two of this project represents an experimental approach to evaluating the effectiveness of leave islands in providing for the habitat needs of sensitive plant and animal species. Variables of interest will include the size, placement, and context of leave islands within a matrix of managed forest.

A manipulative experimental design will be used for this research (Hurlbert 1984). Treatment variables for this design include the size of leave island (expressed in acres) and inclusion of non-fish bearing streams (expressed as presence or absence) in leave islands. 3 different leave island size treatments: large islands (1 acre), medium islands (0.5 acres), small islands (0.25 acres), and uncut control. The large islands will include core areas that are likely to show little edge effects in the interior of the island. The uncut control will provide a measure of plant and animal abundance and diversity in undisturbed habitats. Eight different treatment combinations will then be replicated 4 times (4 x 2 factorial design x 4 replications, n = 32 leave islands). Detailed methodology for sampling microhabitat, vegetation, mollusks, and amphibians will be developed by a Masters of Science graduate student in the Department of Fisheries and Wildlife at Oregon State University in cooperation with a graduate committee at Oregon State University.

Study Area – The experimental study will examine managed forests sites in southwestern Oregon.

Sampling and Analyses – Methods for sampling and analysis of the experimental study data will be similar to the methods employed for the retrospective study. However, two Survey and Manage salamanders occur and a different set of mollusks, vascular plants and bryophytes are known for this area.

Timeline

Phase One - Retrospective Study:

January-to-March, 2001: Site reconnaissance, selection of leave islands

March-to-July 2001: Habitat, microclimate, flora and faunal sampling, data entry

August-to-September 2001: Analysis and manuscript preparation

Phase Two - Experimental Study:

Spring-to-Fall 2001: Partnership development, site selection

Fall 2001-to-Summer 2002: Pretreatment survey, data entry and analysis

Summer-to-Winter 2002: Timber harvest; manuscript preparation from pretreatment data

Spring-to-Summer 2002: Post-treatment surveys, year 1; data entry

Spring-to-Summer 2003: Post-treatment surveys, year 2; data entry

Summer-to-Fall 2003: Analyses and manuscript preparation

ACCOMPLISHMENTS/PRODUCTS:

Phase One - Retrospective Study:

Wessell, S.J., D.H. Olson and R.A. Schmitz. 2001 submission. The role of leave islands for rare species maintenance in western Oregon managed forest landscapes. Conservation Biology.

Phase Two - Experimental Study:

Wessell, S.J., D.H. Olson and R.A. Schmitz. 2002 submission. Forest leave islands as refugia for rare species in landscapes managed for timber harvest. Forest Ecology and Management.

Wessell, S.J., D.H. Olson and R.A. Schmitz. 2003 submission. Experimental study of the effectiveness of leave islands for rare species protection in western Oregon managed forests. Conservation Biology.

IS THIS PROJECT PART OF AN EXISTING PROJECT RELATED TO SURVEY AND MANAGE OR THE NWFP?

Yes, the Retrospective Study uses study sites developed for the existing BLM Density Management Study (Principal Investigators: J. Tappeiner and C. Thompson; and under which the Riparian Buffer Study is implemented, Olson and Chan, Principal Investigators). However, examination of the utility of leave islands for rare species protection is not an identified objective of those studies.

The Experimental Study is not related to current Survey and Manage or NWFP projects.

DESCRIBE THE ABILITY OF THE RESEARCH FINDINGS OR PRODUCTS TO BE USED FOR A BROADER APPLICATION.

Research findings will likely be instructive for the future design of upslope leave islands in adaptive management areas and matrix land allocations as well as in private and industrial managed forests. The results will provide guidance in planning the size, configuration, and placement of green tree retention patches. Knowledge of the cumulative effects of the size and placement of wildlife protection areas and the proximity to non-fish bearing streams is important in assessing the relative effectiveness of wildlife protection areas for species sensitive to changes in microclimate.

WHAT ARE THE CAPABILITIES OF THE LEAD SCIENTISTS?

S. J. Wessell. Graduate candidate, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.
3 years experience with herpetological research.

D.H. Olson, PhD.: Research Ecologist, USDA Forest Service, PNW, Corvallis, Oregon.
Survey and Manage Amphibian Subgroup, Expert, past Lead.
20 years experience with herpetological research.

R. A. Schmitz, PhD.: Assistant Professor, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.
Landscape Ecologist.
Research emphasis on demographic response to management activities and landscape structure.

IS PART OF THE WORK BEING SUBCONTRACTED? _____ YES X NO
IF YES, WHAT PERCENT OF THE WORK IS SUBCONTRACTED? (N/A) %

BUDGET:

The following funding request for this project includes two options. The first option involves a graduate school research assistant while the second option involves a one-year GS-6 term appointment. Details of both options are outlined below.

| Phase One Retrospective Study FY 2001-2002 Budget | Option 1 | Option 2 |
|---|-----------------|-----------------|
| SALARIES | | |
| Principal investigator, OSU (0.05 FTE, 12 months) | 2600 | 2600 |
| Student Summer Wage, OSU (0.55 FTE 3 months) | 3903 | |
| Research Assistant, OSU (0.5 FTE, 9 months) | 10647 | |
| GS-6 Term Appointment (1.0 FTE, 12 months) | | 27333 |
| Two (2) GS-4/5 Biological Science Technicians (1.0 FTE, 6 months) | 20986 | 20986 |
| BENEFITS | | |
| Principal investigator, OSU (0.05 FTE, 12 months) | 625 | 625 |
| Student Summer Wage, OSU (0.05 FTE 3 months) | 195 | |
| Research Assistant, OSU (0.01 FTE, 9 months) | 106 | |
| GS-6 Term Appointment (1.0 FTE, 12 months) | | 8200 |
| Two (2) GS-4/5 Biological Science Technicians (1.0 FTE, 6 months) | 6296 | 6296 |
| TRAVEL/PER DIEM/ETC. | 2000 | 2000 |
| EQUIPMENT (including computer hardware and software) | | |
| MATERIALS/SUPPLIES | 1000 | 1000 |
| PUBLICATIONS/REPORTS | 500 | 500 |
| MISCELLANEOUS (describe) | | |
| Tuition (\$2006/term, 3 terms) | 6018 | 6018 |
| SUBTOTAL | 54,876 | 75,558 |
| OVERHEAD (see note below) | | |

PROVIDE TOTAL OVERHEAD PERCENT OF THIS YEAR' CONTRACT. _____%
(to be completed if study is approved for funding by the Intermediate Managers Group)

FOR HOW MANY YEARS IS FUNDING TENTATIVELY APPROVED FOR PROJECT BY FUNDING AGENCY? _____ YR.

IF MULTIYEAR FUNDING IS TENTATIVELY APPROVED, WHAT IS TOTAL FUNDING EXPECTED FROM THE AGENCY OFFERING CONTRACT? \$ _____

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Figure 1: Schematic of existing leave island configuration.

Bottom Line Density Management Study Site
Variable Density Treatment

