PROPOSAL REVISION:

EFFECTS OF SPLAT DISTRIBUTION ON SPOTTED OWL OCCUPANCY, SURVIVAL, AND REPRODUCTION

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Project Narrative

- **Need for Revision**
- **Objectives**
- **Revised Methods**
- **Estimated Cost**
- **Recommended Course of Action**

Need

This proposal revision reflects the results of the 2007 spotted owl field season conducted under the auspices of the Sierra Nevada Adaptive Management Project (SNAMP). A revision of the original spotted owl plan is necessary because of the low number of owls we found on the northern study site (see Figure 1 below). Based upon the locations of territory centers, we found 1 occupied owl territory within a treatment fireshed, 3 territories within the control firesheds, and 6 territories within the buffer zone. We defined a territory center as: 1) the initial location that fledglings were found at (for breeding pairs), or 2) the mean roost location of non-breeding owls. We believe this sample is not large enough to detect an effect on owl occupancy or reproductive output over the duration of the project. As a result, we suggest 4 options in this revised proposal to increase the owl sample size. In addition, we recommend a course of action for assessing our preferred options (Options 1 and 2) before the 2008 field season.

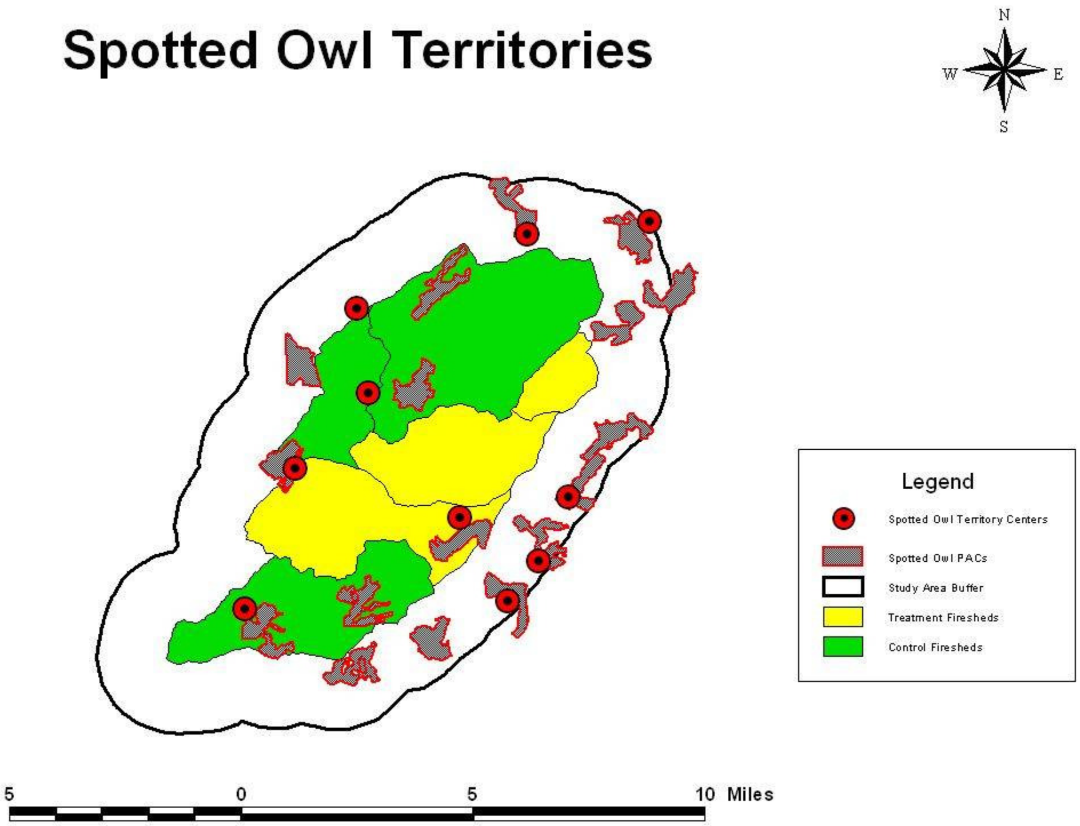

Figure 1: Location of spotted owl territory centers within the SNAMP owl study area, April–August 2007.

The Sierra Nevada Framework has a central management proposal to distribute an array of Strategically Placed Land Allocation Treatments (SPLATs) across the landscape. The purpose of these SPLATs is to reduce the rate of spread of wildfire. Because SPLATs are fuel reduction measures, they are a function of tree removal, which affects ground vegetation, canopy closure, tree diameter distribution, and tree density. Thus, they could impact spotted owls and other forest wildlife. The goals of the SNAMP owl component have not changed due to our findings this past summer or the offering of this revised proposal.

It is well known that California spotted owls are habitat specialists (Verner et al. 1992). They select habitats that have higher canopy closure, larger trees, and more vertical structure, more mature/old forest, and larger patch sizes than other available habitats (e.g., Gutiérrez et al. 1992, Chatfield 2005). SPLATs will directly affect some of these elements by reducing canopy closure, vertical structure, and patch size. There is substantial uncertainty about the way in which SPLATs might affect California spotted owls in the Sierra Nevada. Thus, there is a need to estimate the effects of SPLATs on owls in a formal, experimental manner under an adaptive management framework. The previous experimental design is adequate given the presence, as noted in the original proposal, of a sufficient number of owls within the study area.

We recently completed the field portion of a study on the acute effects of canopy reduction treatments (i.e., SPLATS) on the movement patterns and habitat use of spotted owls and are now analyzing the data. This study was conducted on the Tahoe and Eldorado National Forests. Some of the owls were located on the Eldorado Study Area, but most owls were located outside of the SNAMP study site and the Eldorado Study Area. This study was based on monitoring radio-marked owls before and after applying SPLATs within owl territories. This study was a true experiment in which both treatment and control birds were randomly selected from the owl population following appropriate local control (e.g., owl territories must have contained sufficient suitable habitat to allow treatment and could not have been subject to recent or additional treatments). This study was an adaptive management experiment because of its design within the context of existing U.S. Forest Service projects and management direction such that results can be applied to future management. The results of this study will be limited to examining the short-term responses of owls to canopy reduction, which is an important aspect of measuring disturbance effects. However, chronic effects of disturbance are more important when assessing the long-term impacts of SPLATs on spotted owl populations. Chronic effects could be measured as changes in territory occupancy rates and reproduction of owls. Despite the low number of owls found on the SNAMP study area during 2007, we believe a study of chronic effects of SPLATs on owls can still be incorporated into the SNAMP design.

We do not know the reason for the low number of owls detected during the 2007 field season on the northern study site, but we can offer four potential reasons: 1) We did not receive funding in time to begin surveying during the optimal time period (April-May) for detecting owls; 2) The habitat is of relatively poor quality and will not harbor more owls than we found; 3) The overall population level was down and the area will harbor more owls after better reproductive years in the Sierra Nevada (2005 and 2006 were breeding failure years); and/or 4) The survey teams were not sufficiently skilled to detect the owls. We have rejected possibility #4 because highly experienced owl biologists supervised the less experienced technicians and also participated in the surveys. We felt the delay in starting the study (possibility #1) most likely resulted in less accurate determination of nest or roost site locations, but that our survey effort during June-August was sufficient to detect either all or most territorial owls on the study site. In any event, we note that access to the study site may be restricted during April-May after a typical Sierra Nevada winter due to the site's high elevations. Finally, the owl population may have been down following two bad years of reproduction, but territory occupancy rates on our nearby long-term demography study area suggest that this effect was not large. Thus, our assessment indicates that the area did not contain large amounts of suitable owl habitat.

Objectives

We still propose to measure chronic effects (changes in occupancy rates and reproduction of owls) as part of the SNAMP. However, we propose to increase the sample size by evaluating owl territory occupancy and reproduction on sites that are outside of the northern study area but will be experiencing SPLATS during the course of the SNAMP (see details below). In addition, pending discussion with the UC Science Team we may wish to include owl territories on the Eldorado study area that have experienced SPLAT-type (i.e., CASPO guidelines) treatments in the past. Including retrospective harvests introduces the potentially confounding effect of time, but pre- and post-treatment data are available for owl occupancy and reproduction on all territories on the Eldorado. This expanded assessment of chronic responses by owls will still satisfy our original primary objective - the need to understand the potential longer-term effects of SPLATs on owls. We reiterate that because of limited sample sizes (see methods and discussion below) and funding levels allocated to this study, our study design is contingent on continued funding of the Eldorado Population Monitoring Study. Indeed, the Eldorado Population Monitoring study will be even more critical in this revised design because some of the owl territories on our Eldorado study area may be affected by SPLAT treatments during the course of the SNAMP, and we will be collecting occupancy and reproduction data on these birds. In addition, the project leader of the Eldorado Project will serve the same role in the Adaptive Management Project. Moreover, we will rely on the Eldorado staff (Project Leader, Assistant Project leader) to provide training, monitoring, coordination, and field assistance to the SNAMP.

Methods

As noted in the original proposal, there are two ways to examine the effect of SPLATS on spotted owls. The first is through radio-marking and tracking of individual owls. However, we believe that the use of radiotelemetry on owls is best suited to examining acute effects of disturbance rather than chronic effects. From our recent and past experiences, we believe that radiotelemetry monitoring of the same individuals is difficult to conduct on a long-term basis particularly where road access is limited, as it is on most national forests. Additionally, the repeated capture of owls (necessary to periodically replace radios) makes the birds exceedingly wary over time, and therefore difficult to capture. In areas where road access is good and birds can be easily found on a daily basis, recapture of birds becomes primarily a matter of probability. But in areas where access is difficult, the probability of repeated recapture goes down dramatically. Radio-telemetry monitoring of owls is also difficult with limited road access, as is the case with at least one fireshed in the adaptive management study. This decreases both the amount and the reliability of collected data. Finally, whereas we believe the reduction of transmitter size and improvement in harness design has greatly reduced the potential negative effects of transmitters on owls (and the results of current radiotelemetry research supports this contention), chronic effects of SPLATS on owls may be confounded by possible adverse effects of transmitters on owls. Therefore, we still propose to band owls and examine the long-term (chronic) effects of SPLATS on owls using banding, subsequent recapture (resighting of color bands) of individual birds, and determination of annual reproductive output. Our experience on the Eldorado study suggests that banding has no short-term or long-term negative effect on owls and is a reliable way to estimate the key parameters of interest: territory occupancy and reproduction.

Based on 2007 field season surveys, we now suspect that the number of owls present on the northern study site is insufficient to conduct a viable study of chronic effects of SPLATS on spotted owls. We propose to continue our intensive surveys on each original SNAMP fireshed, and to capture and band all owls within these firesheds. In addition, we will continue to survey adjacent areas to locate and monitor any birds whose home ranges could conceivably overlap the selected firesheds. In this revised proposal, we propose to incorporate more owl territories into the sampling design in four ways. These options are presented in order of preference, based upon ease of implementation and expected financial cost.

OPTION 1: First, we will determine if owl territories on the Eldorado Population Monitoring Study have experienced SPLAT or SPLAT-like treatments in recent years for possible inclusion in the SNAMP owl study.

OPTION 2: Second, we will continue to monitor owl territories on the Eldorado study area and can include sites that experience SPLAT treatments in the next 2 – 3 years.

OPTION 3: Third, we can attempt to determine if owl territories elsewhere on the Tahoe or Eldorado National Forests that are associated with designated Protected Activity Centers (PACs) will be receiving a SPLAT treatment in the next 2 – 3 years. If so, we can attempt to capture, band, and monitor the owls over the timeframe of the SNAMP owl study.

OPTION 4: Fourth, if we fail to find a sufficient sample size through approaches 1 – 3 above, we can attempt to find previously unknown owl territories in areas slated for SPLAT treatments and monitor them over the timeframe of the SNAMP study. Clearly, Options 3 and 4 will require much more coordination and cooperation between the U.S. Forest Service and SNAMP.

Finally, we propose to use Option 2 to determine an equal number of owl territories that can serve as controls for the SNAMP study. In effect, any owl territories on the Eldorado Study Area that do not receive SPLAT treatments during the course of the SNAMP study would be suitable to increase the control sample size. *Please refer to Appendix 1 for a more detailed summary of the pros and cons for each option.*

Estimated Cost

Options 1 and 2 do not require additional funding because they utilize existing or historic work on the Eldorado Study Area. Options 3 and 4 would incur unknown additional expenses. The amount of additional expenses will depend on several factors including the distance of added owl territories from the SNAMP and Eldorado Study Areas and the proportion of such sites that actually contain owl territories.

Recommended Course of Action

Increasing the Owl Sample Size—We favor options 1 and 2 since these approaches can be implemented without additional funds and may be sufficient to increase the owl sample size. We have already collected the data necessary to implement option 1. For option 2 we will be collecting the necessary pre-treatment data as part of the Eldorado Population Study.

In order to determine the potential increase in sample size under options 1 and 2, we recommend the following 3 actions be accomplished before March 1, 2008: 1) we present the U.S. Forest Service with a list of owl territories on the Eldorado Study Area that have experienced logging in recent years, as determined by Seamans and Gutiérrez (2007b), and ask the Forest Service to specify which logging events were similar to SPLAT treatments, 2) we ask that the Forest Service also identify any additional SPLAT-like treatments that have occurred on the Eldorado Study Area but are absent from the list, and 3) we ask the Forest Service to inform us of any SPLAT treatments that are expected to occur on the Eldorado Study Area during the course of the SNAMP study. If we then project that Options 1 and 2 are insufficient to achieve an adequate owl sample size, we could pursue options 3 and 4 during the 2008 field season. However, this would require additional money to hire an extra field crew for the 2008 field season and may be unrealistic.

Our original projection that at least one of the firesheds had limited road access was correct, which required many cross-country night surveys and more survey time/unit area than would ordinarily be required for spotted owl surveys.   However, we were able to accomplish this through careful planning and hard work by the field crews and project leader. Prior work on spotted owls has also demonstrated that nearly all territorial owls on a study area can be detected given adequate survey effort (Franklin et al. 2004, Anthony et al. 2006). The specific techniques for finding, capturing, banding, and monitoring owls are well documented in the literature and will not be discussed here.

Use of Occupancy vs. Survival—We propose to estimate occupancy and not survival because of the limitations of mark-recapture with small samples and short time durations. We will estimate reproduction of owls using standard methods (Anthony et al. 2006). Recent analyses of spotted owl vital rates have relied on estimating these parameters under a model-selection framework based on Akaike's Information Criterion (AIC) values. Because sample sizes are likely to be small in this study, we may encounter numerical convergence problems when calculating AIC values. We propose instead to use a Bayesian framework, involving the calculation of Bayesian Information Criterion (BIC) values. Since BIC values are derived using Markov chain Monte Carlo simulations to estimate model parameters, we can proceed despite the expected small sample sizes. We will then compare the estimated demographic parameters (reproductive output, occupancy) among the control and treatment owl territories. To control for confounding factors, we will include other covariates in our models such as geographic location (i.e., northern SNAMP study site, Eldorado study site, elsewhere on USFS lands) and sex of bird.

In terms of the demographic parameters, we know that reproduction is highly variable and largely influenced by climate (Seamans 2005). Territory occupancy is a better measure of SPLAT effects than reproduction because occupancy is more influenced by habitat quality than weather in the Sierra Nevada (Seamans 2005). Although we had originally anticipated that survival would be one of our measured parameters, this may be problematic because of detection issues. If adult owls disperse from the northern SNAMP study area or from isolated territories incorporated into the sampling design, remain alive, and are undetected in subsequent years, then the survival rates will be biased. We know from other analyses that the size of a study area should be larger than the northern study site to avoid bias in survival estimates due to undetected emigration (Zimmerman et al. 2007). In addition, estimation of occupancy can occur with one year of sampling (to determine if a site is occupied or not), whereas three years of sampling are needed to estimate survival. Thus, we believe that estimation of occupancy will be the best source of information on examining the long-term effects of SPLATS on spotted owls (Seamans 2005).

Assessing Owl Habitat Quality—We will also test the predictions of models relating occupancy to habitat quality within owl territories (e.g., canopy cover and size class of dominant trees). Seamans (in preparation) has modeled the effects of habitat reduction in owl territories considered to contain good habitat versus those considered to contain poor habitat. Habitat quality was based on occupancy rates of owls on the Eldorado Study Area. The preliminary results suggest a greater relative impact of habitat reduction to owls located on better territories. Although one might expect that owls on better territories could better cope with habitat loss, the simulations suggest the existence of a threshold level of high-quality habitat, below which occupancy rates decrease greatly. It may be possible to use the disturbance regime of the SPLATS to predict occupancy rates of the owls with different habitat composition within their territory, where the territory is usually defined as a circle around the territory center having a radius equal to 1/2 the mean nearest neighbor distance.

In summary, this revised design will be more in the framework of a quasi-experiment than a true experiment because sites will not be selected at random, but the treatments will be similar across subjects. We believe that this revision provides the best alternative to meet the intent of the SNAMP, which is to evaluate the effect of SPLATS on key resources in the central Sierra Nevada.

We still offer the caveat in this revised proposal that the potential for success will be directly related to the sample size of birds and territories both as treatment and control sites. We believe, given our experience, that treatment sites may be more easily identified than control sites. We think it may be more difficult to find control sites (i.e., sites with no forest changing activities in the recent past), but more importantly, once potential control sites are identified, it will take increased cooperation to keep them as control (no habitat-altering management activities) for the duration of the SNAMP study.

Literature Cited

Anthony, R.G., E.D. Forsman, A.B. Franklin, D.R. Anderson, K.P. Burnham, G.C. White, C.J. Schwarz, J. Nichols, J.E. Hines, G.S. Olson, S.H. Ackers, S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, K.M. Dugger, K.E. Fehring, T.L. Fleming, R.P. Gerhardt, S.A. Gremel, R.J. Gutiérrez, P.J. Happe, D.R. Herter, J.M. Higley, R.B. Horn, L.L. Irwin, P.J. Loschl, J.A. Reid, and S.G. Sovern. Status and trends in demography of Northern Spotted Owls, 1985-2003. Wildlife Monographs 163.

Franklin, A. B., R. J. Gutiérrez, J. D. Nichols, M. E. Seamans, G. C. White, G. S. Zimmerman, J. E. Hines, T. E. Munton, W. S. LaHaye, J. A. Blakesley, G. N. Steger, B. R. Noon, D. W. H. Shaw, J. J. Keane, T. R. McDonald, and S. Britting. 2004. Population dynamics of California spotted owls: a meta-analysis. Ornithological Monographs 54.

Seamans, M. E. 2005. Temporal and Spatial Variability in California Spotted Owl Demographic Rates as Related to Weather, Habitat, and Habitat Modification. Doctoral Dissertation, University of Minnesota, St. Paul, MN.

Seamans, M. E., and R. J. Gutiérrez. 2007a. Sources of variability in spotted owl population growth rate: testing predictions using long-term mark-recapture data. Oecologia 152:57-70.

Seamans, M.E., and R.J. Gutiérrez. 2007b. Habitat selection in a changing environment; the relationship between habitat alteration and spotted owl territory occupancy and breeding dispersal. Condor 109:566-576.

Zimmerman, G. S., R. J. Gutiérrez, and W. S. LaHaye. 2007. Finite study areas and vital rates: sampling effects on estimates of spotted owl survival and population trends. Journal of Applied Ecology 44:963-971.

Time Schedule

2007 1 April – 30 August. Survey, trapping, and banding of owls. Complete at least 3 surveys of entire study area. This segment of the project has been completed.
1 September 2007 – 30 March 2008. Enter data, evaluate survey and banding success, make recommendations for future of study given results, and complete annual report. Engage in public outreach as required by Adaptive Management Team.

2008 1 January – 31 March. Determine sites to serve as treatment and control sites.

2008 1 April – 30 August. Survey, trapping and banding of new owls, and resighting of color bands of owls captured in 2007. Complete at least 3 surveys of entire study area.
1 September – 30 March. Enter data, evaluate survey and banding success, make recommendations for future of study given results, and complete annual report. Engage in public outreach as required by Adaptive Management Team.

2009 1 April – 30 August. Survey, trapping and banding of new owls, and resighting of color bands of owls captured in previous years. Complete at least 3 surveys of entire study area.
1 September – 30 March. Enter data, evaluate survey and banding success, make recommendations for future of study given results, and complete annual report. Engage in public outreach as required by Adaptive Management Team.

2010 1 April – 30 August. Survey, trapping and banding of new owls, and resighting of color bands of owls captured in previous years. Complete at least 3 surveys of entire study area.
1 September – 30 March. Enter data, evaluate survey and banding success, make recommendations for future of study given results, and complete annual report. Engage in public outreach as required by Adaptive Management Team.

2011 1 April – 30 August. Survey, trapping and banding of new owls, and resighting of color bands of owls captured in previous years. Complete at least 3 surveys of entire study area.
1 September – 30 March. Enter data, evaluate survey and banding success, make recommendations for future of study given results, and complete final report. Engage in public outreach as required by Adaptive Management Team.

Appendix 1: Detailed Summary of Proposed Methods to Increase SNAMP Owl Sample Size

We have identified four methods to increase the SNAMP owl sample size. In this summary we have summarized each method and its strengths/weaknesses below. The methods are listed in order of the owl research team's preference.

OPTION 1—Determine if owl territories on the Eldorado Population Monitoring Study Area have experienced SPLAT or SPLAT-like treatments, and then use these territories as possible samples for inclusion in the SNAMP owl study.

Strengths

- No additional field effort is required (i.e., the data has already been collected). *As a result, this method will incur no additional fiscal costs for the owl portion of the SNAMP.*
- We have extensive pre- and post-treatment data on occupancy, survival, and reproduction of owls on these sites.

Weaknesses

- Because the treatments have already occurred, a confounding effect of time will be present. This is particularly critical for reproductive output, which has a large amount of annual variation due to climatic influences. The time effect will have far less importance for territory occupancy, which has lower annual variation than reproductive output. In addition, occupancy is conditional only on a bird having been present at a site prior to the treatment.
- Treatments (i.e., past fuels reduction projects on the Eldorado Study Area) may not be identical to treatments on SNAMP firesheds.

Important note: We caution that a confounding effect due to differences in time of treatment is a general concern for all aspects of the SNAMP. If SPLAT treatments for the SNAMP are applied sequentially over the course of several years (e.g., due to constraints encountered by the Forest Service during project implementation), we are concerned that treatment effects on a response variable could be confounded by time effects if significant annual variation exists in the response variable.

OPTION 2—Continue to monitor owl territories on the Eldorado Study Area and include in the SNAMP owl study any sites that receive SPLAT treatments within the same timeframe that treatments occur on the SNAMP study sites.

Strengths

- No additional field effort (i.e., no additional cost) is required beyond our ongoing effort on the Eldorado Study Area. *As a result, this method will incur no additional fiscal costs for the owl portion of the SNAMP.*
- There are no (or reduced) confounding effects due to time of treatment.

Weaknesses

- An insufficient number of SPLAT treatments may occur on the Eldorado Study Area during the timeframe of the SNAMP study.

OPTION 3—Determine if there are additional sites (i.e., outside of the SNAMP or Eldorado Study Area) on the Tahoe or Eldorado National Forests that: 1) are scheduled to receive SPLAT treatments during the same timeframe that treatments occur on the SNAMP, and 2) are near designated owl Protected Activity Centers (PACs). If so, survey and monitor these sites for possible inclusion in the SNAMP owl study.

Strengths

- There are no (or reduced) confounding effects due to time of treatment.

Weaknesses

- This approach will be logistically difficult because pre-treatment data (surveys, capture, banding, and monitoring of owls) will need to be collected. The Forest Service will need to provide the owl research team with sufficient notice of any planned SPLAT treatments.
- This approach has risk because planned SPLAT treatments may be delayed or prevented by logistic constraints or legal challenges. We may also fail to find an occupied owl territory within or near the treatment sites (despite the presence of a designated owl PAC in the area).
- *This method will incur additional (but unknown) costs for the owl portion of the SNAMP.* The amount of the additional cost will depend on several factors: 1) how far these sites are located from the SNAMP and Eldorado Study Areas, 2) the proportion of such sites that actually contain owl territories, and 3) the proportion of such sites in which the SPLAT treatments occur in a timely fashion, if at all (see note above).

OPTION 4—If we fail to find a sufficient sample size through approaches 1 – 3 above, determine if there are additional sites on the Tahoe or Eldorado National Forests that: 1) are scheduled to receive SPLAT treatments during the same timeframe that treatments occur on the SNAMP, and 2) are *not* near designated owl

Protected Activity Centers (PACs). If so, survey and monitor these sites for possible inclusion in the SNAMP owl study.

Strengths

- There are no (or reduced) confounding effects due to time of treatment.

Weaknesses

- This approach will be logistically difficult because pre-treatment data will need to be collected (initial owl surveys, capture, banding, monitoring), so the Forest Service will need to provide the owl research team with sufficient notice of any planned SPLAT treatments.
- This approach will be even riskier than the previous method. In addition to the risk of logistic constraints and/or legal challenges, we expect a lower probability of finding occupied owl territories at these sites (as compared to sites near owl PACs).
- *This method will incur additional (but unknown) costs for the owl portion of the SNAMP*. The amount of the additional cost will depend on several factors: 1) how far these sites are located from the SNAMP and Eldorado Study Areas, 2) the proportion of such sites that actually contain owl territories, and 3) the proportion of such sites in which the SPLAT treatments occur in a timely fashion, if at all.

Appendix 2: Biographical Sketch for the Principle Investigator

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PROFESSIONAL PREPARATION

Colorado State University	Wildlife Biology	B.S., 1971
University of New Mexico	Biology	M.S., 1973
University of California, Berkeley	Zoology	Ph.D., 1977

POSITIONS AND ACADEMIC APPOINTMENTS

Professor and Gordon Gullion Endowed Chair in Forest Wildlife Research (2001-Present), *Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St. Paul, MN.*

Assistant to Professor (1979-2000), *Department of Wildlife, Humboldt State University, Arcata, CA.*

Assistant Professor, (1977-1979), *Department of Natural Resources, Cornell University, Ithaca, NY.*

PUBLICATIONS (115 TOTAL PEER REVIEWED PAPERS; 8 EDITORSHIPS; 1 BOOK)

Recent Papers Closely Related to the Project:

Anthony, R.G., E.D. Forsman, A.B. Franklin, D.R. Anderson, K.P. Burnham, G.C. White, C.J. Schwarz, J. Nichols, J.E. Hines, G.S. Olson, S.H. Ackers, S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, K.M. Dugger, K.E. Fehring, T.L. Fleming, R.P. Gerhardt, S.A. Gremel, R.J. Gutiérrez, P.J. Happe, D.R. Herter, J.M. Higley, R.B. Horn, L.L. Irwin, P.J. Loschl, J.A. Reid, and S.G. Sovern. 2006. Status and trends in demography of Northern Spotted Owls, 1985-2003. Wildlife Monographs 163.

Barrowclough, G. F., J. G. Groth, L. A. Mertz, and R. J. Gutiérrez. 2006 Genetic structure of Mexican spotted owl (*Stix occidentalis lucida*) populations. Auk 123:1090-1102.

Buchanan, J.B., R.J. Gutiérrez, R.G. Anthony, T. Cullinan, L.V. Diller, E.D. Forsman, and A.B. Franklin. 2007. A synopsis of suggested approaches to address potential competitive interactions between Barred Owls (*Strix varia*) and Spotted Owls (*S. occidentalis*). Biological Invasions 9:679-691.

Crozier, M. E. Seamans, R. J. Gutiérrez, P. J. Loschl, R. B. Horn, S. G. Sovern, and E. D. Forsman. 2006. Does the Presence of Barred Owls Suppress the Calling Behavior of Spotted Owls? Condor 108:760-769.

Franklin, A. B., R. J. Gutiérrez, J. D. Nichols, M. E. Seamans, G.C. White, G. S. Zimmerman, J. E. Hines, T. E. Munton, W. S. LaHaye, J. A. Blakesley, G. N.

Steger, B. R. Noon, D. W. H. Shaw, J. J. Keane, T. L. McDonald, and S. Britting. 2004. Population dynamics of the California spotted owl (Strix occidentalis occidentalis): a meta-analysis. *Ornithological Monographs* 54:1-55.

Gutiérrez, R. J., M. Cody, S. Courtney, and Alan B. Franklin. 2007. The invasion of barred owls and its potential effect on the spotted owl: a conservation conumdrum. Biological Invasions 9:181-196.

Nichols, J. D., J. E. Hines, D. I. Mackenzie, M. E. Seamans, and R. J. Gutiérrez. 2007. Occupancy Estimation and Modeling with Multiple States and State Uncertainty. Ecology 88:1395-1400.

Seamans, M. E., and R. J. Gutiérrez. 2006. Spatial Dispersion of Spotted Owl Sites and the role of Conspecific Attraction on Settlement Patterns**.** Ecology, Ethology, and Evolution 18:99-111.

Seamans, M. E., and R. J. Gutiérrez. 2007. Sources of variability in spotted owl population growth rate: testing predictions using long-term mark-recapture data. Oecologia 152:57-70.

Seamans, M.E., and R.J. Gutiérrez. 2007. Habitat selection in a changing environment; the relationship between habitat alteration and spotted owl territory occupancy and breeding dispersal. Condor 109:566-576.

Zimmerman, G. S., R. J. Gutiérrez, and W. S. LaHaye. 2007. Finite study areas and vital rates: sampling effects on estimates of spotted owl survival and population trends. Journal of Applied Ecology 44:963-971.

Other Recent Significant Publications:

Barrowclough, G. F., R. J. Gutiérrez, and J. G. Groth. 1999. Phylogeography of spotted owl (Strix occidentalis) populations based on mitochondrial DNA sequences: gene flow, genetic structure, and a novel biogeographic pattern. *Evolution* 53:919-931.

Gutiérrez, R. J., and S. Harrison. 1996. Applying metapopulation theory to spotted owl management: a history and critique. Pp. 167-185. In McCullough, D. (ed.). *Metapopulations and Wildlife Conservation*. Island Press, Covelo, CA.

Gutiérrez, R. J., G. F. Barrowclough, and J. G. Groth. 2000. A classification of the grouse (Aves: Tetraoninae) based on 5 complete mitochondrial DNA gene sequences. *Wildlife Biology* 6:205-211.

Gutiérrez, R. J., G. S. Zimmerman, and G. W. Gullion. 2003. Daily breeding season survival rates of ruffed grouse. *Wildlife Biology* 9:351-356.

Tempel, D. J., and R. J. Gutiérrez. 2004. Estimating Fecal Corticosterone Levels in California Spotted Owls: Implications for Assessing Chronic Stress. *Conservation Biology* 18:1-11.

SYNERGISTIC ACTIVITIES

Workshops Organized to Integrate and Transfer Knowledge (1998-2001): Workshop on Analysis of Demographic Rates of California Spotted Owls (Colorado State University) and Northern Spotted Owls (Colorado State University; Oregon State University); Co-developed short course on “Applying remote sensing techniques to Wildlife Habitat analysis” (Humboldt State University).

Participation in Review Teams Applying Science to Conservation Problems: (1) Member, Scientific Review Panel for 5-year Review of Federal Listing Status of the Northern Spotted Owl (2003 - present), *Sustainable Ecosystem Institute, Portland, Oregon*; (2) Member, Federal Advisory Team to review U.S. Forest Service Sierra Nevada Forest Management Strategy (1997), *Congressional Appointment through USDA Forest Service [Received Conservation Award 1997]*; (3) Member, California Spotted Owl Technical Assessment Team (1990-1992). *U. S. Forest Service, Sacramento, California [Received 3 Conservation Awards {1992, 1992, 1994} and 1 Publication Award {2001}]*; (4) Member, Northern Spotted Owl Recovery Team (1990 – 1992), *U. S. Fish and Wildlife Service, Portland, Oregon [Received Citation for Exceptional Service in 1992 from the Secretary of the Interior]*.

Contributions to Minority Participation in Science and University Education: (1) NIH Minority Representative from U.C. Berkeley to a national workshop on minority participation in Science (1975); (2) Development of biology teaching module in the College Enrichment Program for underrepresented students preparing for University life (1972; University of New Mexico); (3) Co-Director, CORE Student Affirmative Action Program to enhance minority participation in University education, particularly science (1981; Humboldt State University).

Service to the Professional Scientific Organizations: (1) Humboldt Chapter of The Wildlife Society representative to the Western Section of the Wildlife Society (1981); (2) The Wildlife Society's Representative to The Nature Conservancy (1990-1998); (3) Associate Editor, *Wildlife Biology*; (4) Ad Hoc Associate Editor, Wildlife Monographs, Conservation Biology, (5) Rush Scholarship Committee, the Wildlife Society (2004-present).

COLLABORATORS & OTHER AFFILIATIONS

Collaborators During past 48 Months: David R. Anderson (Colorado State University), Beatrice E. Arroyo (Spain), George F. Barrowclough (American Museum of Natural History), William M. Block (Rocky Mountain Research Station), Alan Franklin (USDA, APHIS), Jeffery G. Groth (American Museum of Natural History), Joshua J. Milspaugh (University of Missouri), Darryl Mackenzie (New Zealand), James D. Nichols (Patuxent Wildlife Research Center), Steven M. Redpath (Institute of Ecology and Hydrology, Banchory, Scotland), Brian Reilly (Tashwane University, South Africa), Peter Stine (PSW), Gary C. White (Colorado State University).

Graduate and Postdoctoral Advisors: A. Starker Leopold (Ph.D.; University of California, Berkeley), J. David Ligon (M.S.; University of New Mexico).

Graduate Students Advised (University of Minnesota 9) : Lorelle Berkeley, PhD., Andrea Chatfield, M.S. (2005), Jeremy Rockweit, M. S., Mark Seamans, PhD. (2005), Jonathan Slaght, PhD., Douglas Tempel, M.S. (2002), Douglas Tempel, PhD., Perry Williams, M.S., Guthrie Zimmerman, PhD. (2006)
(*Humboldt State University* 32) – Individuals not listed, but all M.S. [no PhD program at Humboldt State]

Undergraduate Research and Theses Advised (40+): not listed, 5 at University of Minnesota and remainder at Humboldt State University