Project #: EMC-2018-002 **Proposal Version#: 1** **Date:** December 7, 2018

Project Title: Spotted Owl Use of Post-fire Landscapes in Northern California

Principal Investigator(s): J. David Wiens (USGS)

Collaborators: USFWS, USFS, private landowners (TBD)

Critical Question Themes and Rules or Regulations being Tested:

- Effectiveness of Section 919.9(g) in evaluating potential impacts and avoiding take of Northern Spotted Owls.
- Effectiveness of Northern Spotted Owl rules and regulations in protecting and conserving the species. Specifically, effectiveness of 14 CCR 897, 919 [939, 959] (maintain functional wildlife habitat), and 919.2, 939.2 and 959.5 (protection of nest sites).
- The effectiveness of Section 912.9 [939.9, 959.2]and Technical Rule Addendum No. 2 in characterizing and avoiding significant adverse impacts to terrestrial wildlife species, their habitats and ecological processes.

Timeline: Mar 2019 – Jan 2022

1. Background and justification

The Northwest Forest Plan identifies timber harvests and wildfires as major threats to the federally threatened northern spotted owl (*Strix occidentalis caurina*). Additionally, the Recovery Plan for the Northern Spotted Owl identifies several Recovery Actions related to conservation in fire prone forests. Wildfires and post-fire forest management activities may change habitats in ways that can affect use and occupancy of previously-identified, high quality nesting and roosting conditions by spotted owls. Indeed, stand-replacing wildfire is the leading cause of habitat modification for spotted owls on federally administered lands in the Pacific Northwest (Davis et al. 2016). Regardless of fire severity, post-fire salvage logging has been associated with decreased survival of spotted owls (Clark et al. 2013, Rockweit et al. 2017). Despite the impacts that severe or mixed-severity fire can have on habitats managed for spotted owls, effects on demography can be highly variable and remain poorly understood. Some studies of spotted owls, for example, found that moderate and high wildfire severities negatively affected survival (Rockweit et al. 2017), while other, shorter post-fire studies have found little impacts of mixed-severity fire (see Lee 2018).

Considerable scientific uncertainty exists concerning impacts of wildfire and post-fire salvage logging operations on spotted owls. Much of this uncertainty stems from logistical challenges and considerable expense of surveying and monitoring site-occupancy dynamics of spotted owls at spatial scales required to capture broad mixtures of different burn severities and land ownerships (e.g., federal vs. private timberlands). In addition, barred owls (*S. varia*) have reached high densities within the range of the northern spotted owl and are rapidly increasing in number within the range of the California spotted owl (*S. o. occidentalis*; Lesmeister et al. 2018). Encroaching populations of barred owls pose a significant competitive threat to the viability of northern spotted owls (Wiens et al. 2014, Lesmeister et al. 2018). If not accounted for, competitive interactions with barred owls can confound results concerning habitat use and management effects on sympatric populations of spotted owls.

Recent advances in passive acoustic technology using autonomous recording units (ARU's) provide a cost-effective alternative to field-intensive call-broadcast surveys typically used to monitor spotted owls. An important benefit of using ARUs for nocturnal owl surveys is that the units can be set up at any time and left out for extended periods, which decreases field effort while increasing the quantity and consistency of data collected (Tegeler et al. 2012). Passive acoustic surveys also reduce challenges and constraints of planning surveys during optimal weather conditions and eliminates many of the safety concerns for field personnel conducting nighttime field work in remote areas. More recent assessments found that acoustic surveys with ARUs were an effective method to monitor annual changes in site-occupancy dynamics of both spotted owls and barred owls, with similar detection rates as seen in traditional call-broadcast

surveys (Wood et al. 2018). Advances in passive acoustic surveys provide a powerful approach to examine responses of spotted owls (and barred owls) to mixed-severity wildfire and post-fire management activities at broad spatial scales.

2. Objectives and scope

We propose to use passive acoustic surveys with ARU's to monitor presence and habitat use of spotted owls in post-fire, mixed-severity burn landscapes of northern California. Because ARU's record vocalizations of both spotted owls and barred owls, detection/nondetection data from ARU's can also be used to identify post-fire use of landscapes by barred owls (a potentially confounding factor associated with use of post-fire landscapes by spotted owls).

Specific objectives of the proposed study are to:

Objective 1: determine how wildfire intensity and post-fire salvage harvesting operations under California Forest Practice Rules (i.e. 14 CR 1038 "Exemption" and 1052 "Emergency Notice" rules) affect use of post-fire landscapes by spotted owls.

Objective 2: use parallel data from passive acoustic surveys of spotted owls to monitor changes in presence of nonnative barred owls.

We propose to conduct the research in an area of mixed federal and private ownership associated with the 2018 Carr Fire in Shasta and Trinity Counties of northern California. Understanding the temporal trend in spotted owl site fidelity in this post-fire landscape will lead to more informed and defensible forest management, especially as wildfire size and total annual area burned continues to increase in California.

3. Critical questions and Relevant Forest Practice Regulations *(Please address the critical question, scientific uncertainty, geographic application, and collaboration & feasibility. See the EMC Strategic Plan Appendix F for more info)*

- **Effectiveness 14 CCR Sections 1038(b)(7)("known sites") and 1038(b)(8)(no operations in buffer zones) in evaluating potential impacts and avoiding take of northern spotted owls.** The study will provide data needed by the California Department of Forestry and Fire Protection to make determinations about the effectiveness Forest Practice Regulations in avoiding take of northern spotted owls by examining post-fire responses of spotted owls to salvage logging operations on both federal and non-federal lands. The study will also determine to what degree and under what circumstances do emergency timber operations (14 CCR 1052) have the potential to affect northern spotted owls.

- **Effectiveness of 14 CCR Sections 897, 919 [939, 959] (maintain functional wildlife habitat), and 919.2, 939.2 and 959.5 (protection of nest sites).** Our proposed study aligns directly with priority questions concerning effectiveness of northern spotted owl rules and regulations in protecting and conserving the species. The study will determine to what extent post-fire landscapes continue to be used by northern spotted owls and how post-fire salvage operations may affect that use. Given that post-fire salvage often occurs outside of the Timber Harvesting Plan and review process and spotted owl surveys are not required, the study will help determine if 919.9 and 939.9 effectively conserve and protect northern spotted owls.

- **The effectiveness of Section 912.9 [939.9, 959.2] and Technical Rule Addendum No. 2 in characterizing and avoiding significant adverse impacts to terrestrial wildlife species, their habitats and ecological processes.** The study will help inform how cumulative impacts can be evaluated in post-fire landscapes in a cost-effective manner, which is needed to develop a clearer understanding of forest ecological processes and impacts to sensitive wildlife. In addition, by monitoring invasive barred owls the proposed work provides information relevant to alternative threats affecting habitat use and site occupancy of northern spotted owls.

4. Describe Research Methods

Study area and land ownership

We propose to monitor use of post-fire conditions by spotted owls and barred owls in lands associated with the Carr Fire of northern California (Fig 1). The Carr Fire was a large (229,651 acres; 92,936 ha; 359 sq mi) wildfire that burned in Shasta and Trinity Counties in 2018. Field sites will be identified on a mixture of lands administered by the US Forest Service Lands, Bureau of Land Management, and private timber companies (Fig 1B). These lands include areas already surveyed as part of the NSO Effectiveness Monitoring Program under the Northwest Forest Plan on Federal lands and areas that have been historically surveyed for spotted owls on private timber lands. In addition to other sources, the California Natural Diversity Database records of historical spotted owl and barred owl survey detections will be used to inform our understanding of pre-fire use of the study area by both owl species.

**Specific areas associated with the Carr Fire to be surveyed are to be determined upon completion of a fire severity map in late 2018. This map is currently being created using Landsat 8 Land Surface Reflectance imagery and normalized burn ratios (NBR) in Google Earth Engine (https://earthengine.google.com).

Monitoring spotted owls and barred owls with passive-acoustic surveys

The proposed study will use passive acoustic monitoring via ARUs to monitor presence and habitat use of spotted owls and barred owls in post-fire landscapes. The use of ARU's reduce the risk of disturbance and behavioral changes associated with historically used 'active' call-back surveys (Conway and Gibbs 2005) and will minimize the amount of field work required for broad-scale monitoring. ARU's will be placed at sites according to three post-fire strata: 1) burned; 2) burned with subsequent salvage logging operations, and 3) control sites with no burn or salvage logging. Post-fire strata will be identified using recent NAIP aerial imagery and GIS. We will use Wildlife Acoustics Song Meter 4s (SM4) to conduct acoustic surveys (http://www.wildlifeacoustics.com; Wildlife Acoustics 2017). SM4s are portable, weatherproof, and easily programmable with two built-in microphones, a large memory capacity, and 350-400-hour battery life. SM4 microphones record sound between 20Hz and 48 KHz at decibel levels of ~-33.5db to 122db (Wildlife Acoustics 2017).

ARU's will be placed within and outside the perimeter of the Carr Fire according to three post-fire habitat strata (burned, burned with salvage logging, unburned). We will use a randomized census-plot sampling design informed by regional maps of habitat suitability developed for spotted owls by Davis et al. (2011; Fig. 1A). Specifically, we will select 60 hexagonal grid cells (20 in each post-fire habitat strata) that approximate the size of spotted owl territories (and barred owl home ranges; Wiens et al. 2011) for two surveys during the breeding season (Mar – Aug). Each survey consists of six weeks of deployment of 3 or 4 ARU's per site, and surveys are separated by at least one month. We will deploy 60 ARUs within 20 hexagons (3 ARU's per site), and then rotate the 60 units across the remaining 40 hexagons to obtain complete coverage. For sample site selection we will use a uniform layer of 500-ha hexagons overlaid across the entire range of the northern spotted owl and used as a basis for concurrent ARU monitoring of spotted owls and barred owls in Oregon and Washington (Lesmeister et al. 2018). A randomized hexagon sampling design has also been used to facilitate barred owl surveys and experimental removals (Wiens et al. 2016), and acoustic surveys of spotted owls and barred owls in the Sierra Nevada (Wood et al. 2018). Sampled areas will included recently used spotted owl activity centers based on recent nesting and activity center data at mid- to upper-slope locations within one of the three treatments (burned, burned and salvaged, no burn or salvage). ARU's will not be located within 500 meters of another ARU to reduce overlapping efforts and potentially recording a neighboring owl. ARUs will be set to record for eight hours during diel crepuscular periods (2 hours before-and-after sunrise, 1 hour before and 3 hours after sunset), which was identified as the peak in NSO calling activity (Lesmeister et al. 2018). Recorder units will be checked every 4-6 weeks by field staff.

Several types of automated detection software are now available that employ sophisticated recognition systems and can extract detections from large acoustic data sets (Blumstein et al. 2011, Kahl et al. 2017). Sound files will be processed using convolutional neural networks developed for processing ARU data at USDA Forest Service Pacific Northwest Research Station in Corvallis, Oregon (D. Lesmeister, *personal comm*). This process also includes the use of

Kaleidoscope Software available from Wildlife Acoustic Inc. (Wildlife Acoustics Inc. 2017) to validate detections of spotted and barred owls identified by the neural network. In short, the algorithm uses spectrographs to identify sound files containing calls of spotted owls or barred owls, which are later confirmed directly by a lab technician. Thus, the proposed project will leverage new research aiming to expedite ARU sound-file processing at Oregon State University.

Analysis of effectiveness of Forest Practice Regulations in conserving spotted owls in post-fire landscapes

Detection/non-detection data of spotted owls from ARU's will be summarized for each sample site (i.e. 500-ha hexagon) to evaluate spatial changes in use of burned (with and without salvage logging) and unburned sites associated with the Carr Fire. Thus, the study design provides a direct test of the research hypothesis that sites with greater disturbance (i.e. those with recent fire and salavage logging) will have annual reductions in use relative to sites without management activity or wildfire. We will use single-species, multi-season occupancy models (McKenzie et al. 2017) to estimate occupancy and detection probabilities during acoustic surveys. Occupancy modeling is a statistical method for modeling the patterns and dynamics of species occurrence while accounting for potential biases associated with imperfectly detecting a species during sampling. The analysis will use site-specific covariates (e.g., measure of burn intensity, forest structural conditions) to account for relevant sources of spatial and temporal variation in use of sites by spotted owls and barred owls. Occupancy analyses will explicitly account for factors that affect the probability of detecting spotted owls or barred owls during acoustic surveys (e.g., background noise created by nearby streams, rainfall, or variable topographic conditions).

5. Describe Project Deliverables

- Project updates on progress and preliminary findings to study partners and collaborators (every 6 months)
- Interim annual reports (2019, 2020) summarizing project activities and accomplishments
- Maps and GIS data of site-occupancy, results of acoustic surveys, and predicted spatial distribution of northern spotted owls and barred owls across the study area (size and specific location of sampled area TBD).
- Annual report submitted as draft manuscript suitable for publication in peer-reviewed journal (2022)

6. Anticipated Project Timeline

Time period	Task Completed
Mar 2019 – Jan 2022	Project updates to study partners and collaborators, every 6 months.
Mar 2019 – Aug 2020	Complete passive acoustic surveys of spotted owls and barred owls at 60 sites (500-ha hexagons) to be located within and outside the periphery of the 2018 Carr Fire.
Aug 2019 – Nov 2021	Data entry and analysis; submit interim annual reports to project collaborators (Nov 2019, 2020)
Jan 2022	Submit annual report as draft manuscript suitable for publication in peer-reviewed journal

7. Requested Funding: $ 274,665

8. Principal Investigator(s) and Collaborator(s) *(Include a contact person with email address, phone number, and mailing address)*

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Attach figures, tables, or photos as needed.

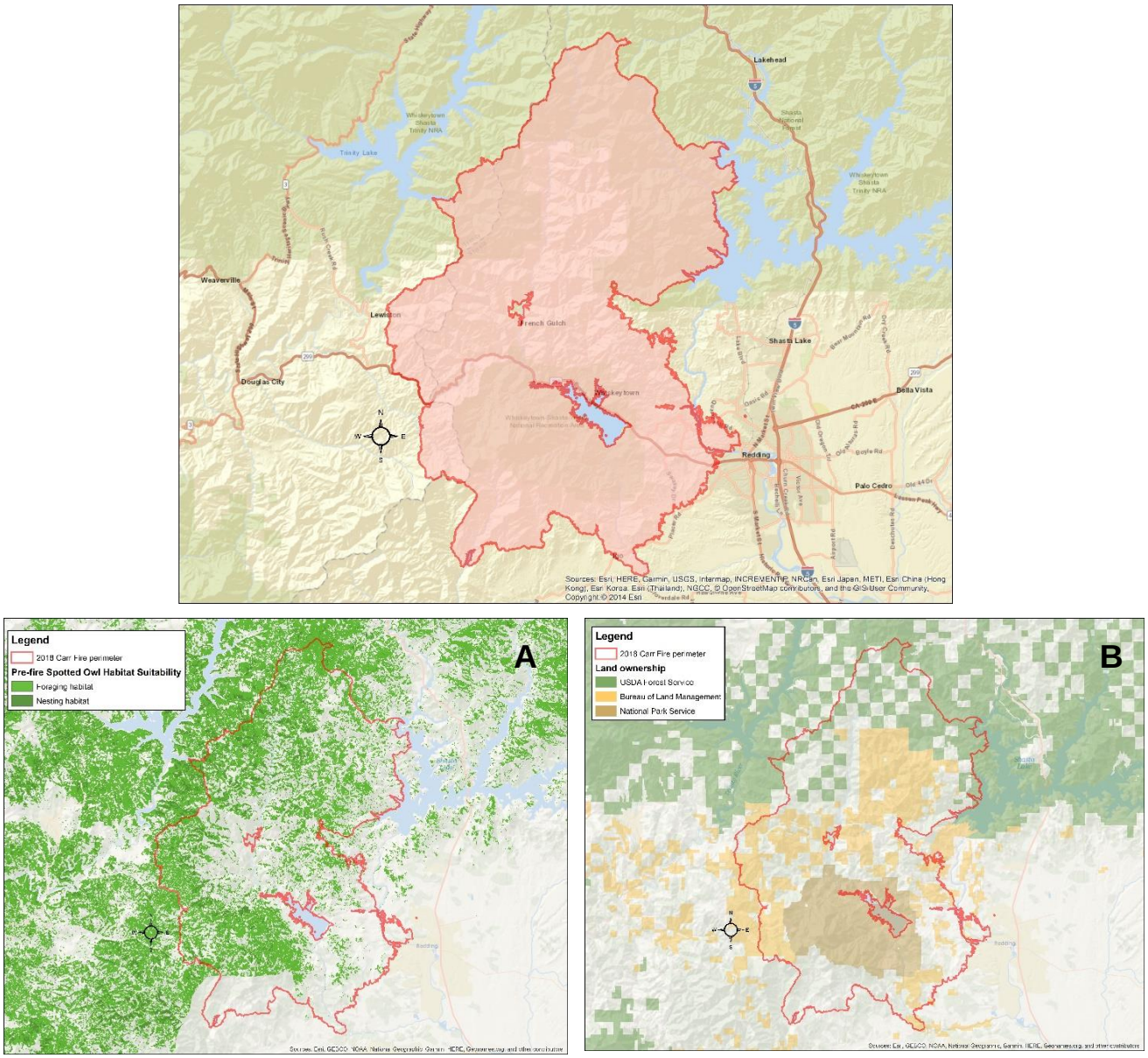

Figure 1. Proposed study area associated with the Carr Fire, which burned a total of 229,651 acres; (92,936 ha; 359 sq mi) in Shasta and Trinity Counties of northern California in 2018. Also shown is the regional distribution of: **A**) old-forest conditions used for nesting and foraging by northern spotted owls, and **B**) land ownership.

This budget template is provided as an example. Feel free to modify it to fit your project.

Category	Description	Year 1	Year 2	TOTAL
Personnel	PI (partial salary)	$15,568	$15,568	**$31,136**
	ARU Field/Lab Technicians (2 @ GS5, 7-mo/yr)	$35,282	$35,282	**$70,564**
Staff Benefits	PI (partial salary)	$3,660	$3,660	**$7,320**
	ARU Field/Lab Technicians (2 @ GS5, 7-mo/yr)	$8,112	$8,112	**$16,224**
Subcontract	Oregon State University (use of neural network lab)	$5,500	$5,500	**$11,000**
Equipment	ARUs (60 @ $825 ea)	$49,500		**$49,500**
	SD Cards (60 @ &97 ea)	$5,820		**$5,820**
	Kaleidoscope Software (annual subscription)	$399	$399	**$798**
	Batteries and charger (60 @ $76 ea + $110)	$4,670		**$4,670**
	Repairs and maintenance	$500	$500	**$1,000**
	Field Vehicle (GSA; 6 mo @ $350/mo)	$2,100	$2,100	**$4,200**
Travel	PI Travel	$2,000	$2,000	**$4,000**
	Field Tech Travel	$3,000	$3,000	**$6,000**
Project subtotal		$136,111	$76,121	**$212,232**
Indirect Cost	USGS Indirect (*47.533%*)	*$64,698*	*$36,183*	*$100,880*
Other				
Matching or In-kind Contributions	PI Salary and Benefits (USGS In-kind)	$19,228	$19,228	**$38,456**
EMC Funding Requested		**$181,580**	**$93,075**	**$274,655**

9. Literature Cited

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