FY23 Project Narrative Template

# Title: Vulnerability assessment of Sugar pine, an iconic species in decline

**New Project**

# PNW Lead Scientist: Harold Zald, RMA VMaRS

# Description/Justification:

Sugar pine (*Pinus lambertiana*) provides high-value regulating, provisioning, cultural, and supporting ecosystem services across its distribution in Oregon and California. However, a host of stressors (historical logging of large old trees, fire exclusion, introduced pathogens, endemic bark beetles, and climate change) have driven widespread declines in sugar pine populations across much of its range. Despite this, there are no existing range-wide assessments of the status (current conditions), demographic trends (recruitment, growth, and mortality), or mortality vulnerability of sugar pine. This project will leverage existing FIA and vegetation mapping data (GNN, <https://lemma.forestry.oregonstate.edu/>), and associated spatial mortality vulnerability models, to quantify the status, trends, and vulnerability of this critical species across its range. Furthermore, we will develop a unique tree-ring dataset across the climate niche-space of sugar pine to independently validate vulnerability models and quantify tree growth responses to climate and other change drivers.

This project aligns with two PNWRS priorities (Priority B - science to manage for reslient landscapes and provide ecosystem services, Priority D - science to monitor and predict land stewardship and disturbance outcomes). Much of the range of sugar pine within Oregon falls west of the Cascade crest, so the impacts of fire, insects, and disease on sugar pine populations will directly relate to the Westside Fire Initiative. Sugar pine’s range also includes many fire-risk watersheds in the USFS 10-year fire plan (FS–1187b), while inventory and threat assessment of old growth sugar pine forests directly addresses Sections 2a-b of Executive Order 14072.

Understanding the status, trends, and vulnerability of sugar pine across its range is needed to inform regional policy and local decision-making regarding management activities (*e.g.,* planting, thinning, prescribed burning) to mitigate biotic and climatic stressors. The intended outcome of this work is to provide and distribute a regional synthesis of status, trends, and vulnerability that is spatially scalable down to individual firesheds. Open access to mapped products and targeted workshops will focus on disseminating translatable science to regional partners and stakeholders. The work will be conducted via a combination of statistical analysis of existing FIA and remotely sensed data, as well as field data collection and laboratory processing of tree-ring samples. The statistical modelling will occur at the CFSL, field work will be conducted throughout the range of sugar pine in Oregon and California, and tree-ring sample processing will occur at the Oregon State University Tree-ring laboratory.

# Impact, importance, and expected outcomes

Managers need assessments of sugar pine mortality to quantify factors that will reduce stress and increase vigor in support of cross-ownership, landscape-level restoration and planning activities. However, managers lack such information that is summarized across demographic components and consistent across sugar pine’s range. This work will be the first broad synthesis of sugar pine status, trends, and vulnerability across its geographic range. Further, this work will advance our general understanding of how climate change interacts with biotic and physical disturbances to drive tree population trajectories.

# Strategic Coordination

The primary research team consists of Harold Zald (PNWRS), David Bell (PNWRS), Andy Gray (PNWRS), and Daniel Perret (ORISE Postdoctoral Fellow). Additionally, this project was developed over the past year in consultation with Laura Lowrey (FHP SW Oregon Service Center), Bill Kuhn (R6 SW Oregon Regional Ecologist), Scott Kolpak (R6 SW Oregon Area Geneticist), and Marc Meyer (R5 Provincial Ecologist). In addition to NFS regional partners, we will use our existing network of past colabortors and partners to disseminate project findings and to the BLM, NPS, state agencies (ODF, Calfire), and Tribal natural resources managers. Our partners will so this work to identify areas were sugar demographic trends and mortality vulnerability suggest management actions to either mitigate risk (thinning and/or prescribed burning) or plant sugar pine to maintaining landscape persistence of the species. This project contributes to multiple long-term lines of work supporting PNW priorities. Others such as Goheen and Goheen (USFS SWOFIDSC-14-01) have examined the status of sugar pine in SW Oregon, while Goeking and Windmuller-Campione (2021, <https://doi.org/10.1016/j.foreco.2021.119438>) conducted a broad assessment of five-needle pines in the United States. Neither conducted vulnerability modelling or quantified growth climate relationships, and to our best available knowledge this project is the only one actively pursuing a detailed quantification of sugar pine status, trends, and vulnerability across its geographic range.

# Deliverables/Outcomes

1) Publications (peer-reviewed journals), including (i) guidelines for the combinations of tree size, stand density, and climates associated with greater mortality, (ii) mapping of potential high severity sugar pine decline, and (iii) tree growth-climate relationships across the climatic range of sugar pines current geographic distribution.

(2) Subbasin- or watershed-scale maps of current sugar pine density and mortality rates by size class, useful for regional manager prioritization across ownerships.

(3) 30-meter resolution maps of mortality potential, useful for identifying local sugar pine declines.

(4) Presentations to regional and national conferences, a cross-agency webinar, an ESRI Story Map written for public non-scientists, and a request to update the NIDRM (managed by FHAAST) based on findings.

(5) Downloadable maps made available on the LEMMA website (<https://lemma.forestry.oregonstate.edu/data>).

# Project Status

This is a new project, requesting one year of funding, but the project duration will be for 2 years.

Previous station investments to consider are twofold. First, this project leverages the long-standing PNWRS commitment to GNN mapping in support of the NWFP. GNN mapping is being leveraged to develop vulnerability models and maps for this project. Second, the PNWRS and WWETAC have invested almost two years of funding for the subalpine fir decline project supporting ORISE Fellow and project collaborator Daniel Perret. The data processing and statistical modelling methods Dr. Perret has developed for subalpine fir will be directly used for analysis of sugar pine.

# Diversity, Equity, and Inclusion

Given the cultural significance of large old growth trees to many west coast indigenous cultures, we believe scientific information about threats to old growth sugar pines via trends analysis and vulnerability modelling will be highly valuable to inform tribal resource management and cross-organizational planning where tribal cultural concerns are valued. At the Wildfire Crisis Strategy R6 Roundtable, it was clear that regional partners want translational science that can inform decision-making. In the process of developing our outreach activities, we will make specific effort to enable Tribal resource managers and USFS tribal liaisons.

# Urgency

1 (urgent, cannot wait). Primary urgency is one of collaborative research capacity. We currently have an excellent ORISE fellow that can seamlessly transition from his current project to this one. Dr. Perret’s skills in statistical modeling and dendrochronology will help ensure the projects success. Not receiving funding potentially creates a funding gap where Dr. Perret is no longer and ORISE fellow and undoubtably will be successful finding employment opportunities elsewhere. Recruitment of someone else with Dr. Perret’s skills and interests is highly unlikely, so the lack of funding in FY23 would make it less likely this project would have the personnel in place to be successful in the FY24 funding cycle.

# Station funding

$100,000 (100% FRRE)

Station funding to be used for an interagency agreement supporting one ORISE fellow.

# Personnel Requirements - P&T, temp/term requirements

Other station personnel include David Bell (RMA) and Andy Gray (RMA). No additional P&T or temp/term personnel are involved?

External personnel include one ORISE fellow.

No new personnel capacity is required to complete this work.

# Leverage

Station lines of work that are amplifying this project include GNN mapping, as well as a status and trends assessment of Subalpine fir in the CONUS

# Associated agreements:

21-IA-11261959058 (2000 – present)

21-IA-11261959079 (2022 – present)

21-RD-11261959-075 (time period)

19-JV-11261959-064 plus three modifications (time period)