HAMPTON LUMBER

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April 27, 2022

Via Email: boardofforestry@oregon.gov

RE: Written Public Testimony, Agenda Item #1, April Board Meeting

Dear Chair Kelly and Oregon Board of Forestry Members:

My name is Laura Wilkeson. I was raised in rural Polk County, Oregon, where I attended a school so small we played 8-man football. I grew up around farmers and loggers, who I watched year after year take thoughtful and meticulous care of the lands they harvest from. And unfortunately, I have seen firsthand what timber harvest reductions and subsequent mill closures can do to a community. Today, I serve as State Forest Policy Director for Hampton Lumber. I also represent Oregon Forest Industries Council (OFIC) State Land Committee members who operate 41 sawmills in dozens of communities and directly employ thousands of Oregonians who depend on state timber sales. I want to share our initial thoughts on the draft environmental impact statement (DEIS) for the Oregon Department of Forestry's (ODF) draft Habitat Conservation Plan (HCP).

First, we are deeply disappointed with the narrowness of the alternatives and the cursory socio-economic analysis presented in the DEIS. The three alternatives selected deviate only slightly from each other and the Proposed Action. For instance, Alternative 5 only releases 15,500 acres, a mere 2 percent of all state forest land, from the nearly 300,000 acres of habitat conservation areas. The three alternatives' harvest levels fluctuate by no more than 10 million board feet (MMBF) on average. These are not true alternatives if the prescriptions are more or less the same.

Secondly, all alternatives are being compared to a misleading No Action scenario, which reflects the extremely conservative approach to management ODF has adopted for itself. It does not reflect the realties on the ground or requirements under existing state and federal law. This presents the Board with a false decision. All of the alternatives appear to deliver better outcomes than business as usual, but only because ODF has set the bar so artificially low for itself. The disconnect between the No Action Alternative and realities on the ground are already obvious. It projects an average annual harvest of 175 MMBF– that is already a 20 percent under-estimation based on ODF's Fiscal Year 2023 plan to harvest 218 MMBF. Over the previous five years, harvests have averaged 275 MMBF.

The current Forest Management Plan (FMP) the state is managing under, structure-based management, has been a failure. The state continues to harvest far less volume than the forest grows each year, violating the obligation they have to the surrounding communities. This DEIS should at the least include an alternative that shows the harvest and habitat output of state forests under current state and federal laws, excluding the artificial restrictions imposed under the FMP.

All of the alternatives, including the Proposed Action, reflect harvest restrictions far exceeding those included in other public or private HCPs on the West Coast. This reveals a failure on the part of ODF to negotiate on behalf of all Oregonians. It is not the job of the Services to look out for the socio-economic needs and expectations of local stakeholders. That's ODF's job, and that's the Board's job. We firmly believe a less onerous HCP could be developed and still obtain an incidental take permit – this Board need only ask ODF to try again. Will it take more time? Yes. Is it worth it? Absolutely.

In the meantime, we urge ODF to take the time to do a complete socio-economic analysis of the total impacts of state forests. We are still analyzing the specifics included in the DEIS, but it doesn't appear to include complete direct or indirect economic analysis. At Hampton, we know that the stumpage value we pay when we purchase state timber sales goes much farther than the payment to ODF and the counties. Last year we purchased just over 70 MMBF from ODF. Those sales generated just under $30 million in stumpage revenue, but went on to create an additional $40 million in local benefits through wages paid to logging, hauling, roadbuilding companies and our own mill workers. That does not even include all the economic activity generated by the sale of lumber or wood residuals, which support local paper, pellet, and particle board manufacturers and agricultural operations.

Impacts of timber harvests are known to be massive and wide-reaching. Research by the Oregon Forest Resources Institute found that there are 11 jobs created in Oregon for every MMBF harvested. In Washington, they estimate 12 jobs per MMBF and in Idaho, it's 22 jobs. And yet, the DEIS assumed only three jobs are created per MMBF of harvest. An error this egregious further erodes our confidence in the quality of the analysis conducted to date. I do not believe any oversight body, especially one obligated to meet social and economic, as well as environmental goals, should be asked to make such drastic management decisions without a solid understanding of the full potential of the resources they oversee and the impacts management changes will have on key stakeholders and vulnerable communities.

The Board of Forestry is obligated to balance social, economic and environmental values when making management decisions. You cannot do that unless you have full and accurate information. This is a 70-year plan that will dramatically affect rural communities and have ripple effects across the entire state. You have the ability to change the course of the plan to produce better outcomes for at-risk species and communities alike. We urge you to take the opportunity to do so.

Respectfully,

Laura Wilkeson
State Forest Policy Director, Hampton Lumber
Chair, OFIC State Lands Committee

OREGON STATE FOREST INDIRECT ECONOMIC IMPACTS

The social and economic impacts of Oregon State Forest timber harvests extend far beyond stumpage payments. In addition to stumpage revenue, ODF harvests in FY21 (260 mmbf) generated more than **$142.4 MILLION** for logging, hauling, road building, and lumber businesses **IN LOCAL COMMUNITIES.**

Actual Economic Impact
ODF Timber Harvest (FY21)

$260.4M

DIRECT AND INDIRECT

- Stumpage (ODF & Counties)
- Logging & Hauling
- Road Construction/Maintenance/Access
- Mill Wages/Benefits
- Lumber Sales & Logistics
- Harvest Tax
- Lumber Trucking

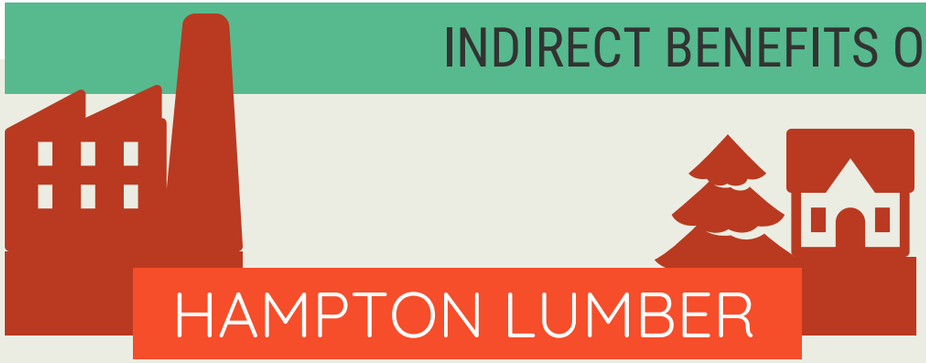
ODF
$42.8M

HARVEST TAX
$1.1M

COUNTIES
$74.1M

LOCAL RESIDENTS
$142.4M

INDIRECT BENEFITS OF ODF TIMBER PROGRAM: HAMPTON CASE STUDY



HAMPTON LUMBER

ODF TIMBER PURCHASED (FY21):
71,749 MBF

STUMPAGE VALUE: **$29.3M**

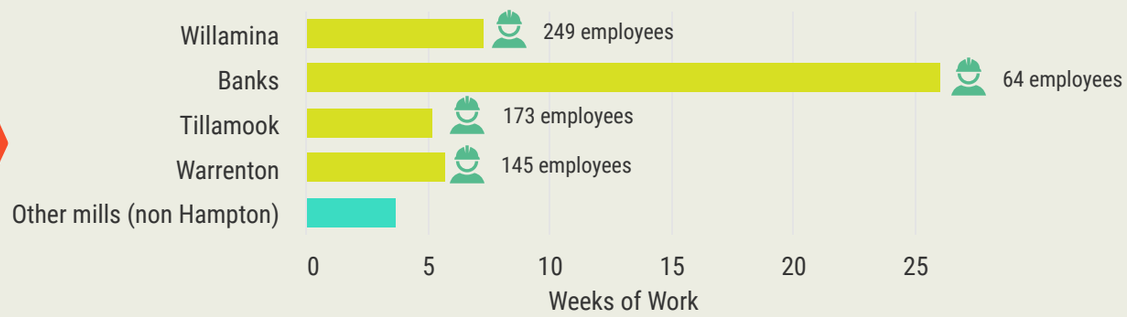
LOGGING & HAULING: $16.5M
ROAD BUILDING & MAINTENANCE: $3.5M
PAYMENTS LANDOWNERS: $110k
MILL WAGES & BENEFITS (HAMPTON ONLY): $8.8M
LUMBER TRUCKING: $2M
LUMBER SALES & LOGISTICS: $8.4M

LOCAL BENEFITS: **+$39.3M***

TOTAL BENEFITS: **$68.6M**

48 WEEKS OF SAWMILL OPERATIONS

Hampton Sawmills: ODF-related Operating Time



FINISHED PRODUCTS

293,627 METRIC TONS OF CO2 STORED IN LUMBER

7,466 HOMES FRAMED

17 RESIDUAL PURCHASERS

*DOES NOT INCLUDE HARDWOOD SAWMILL OR SECONDARY MANUFACTURING IMPACTS

It takes a village

Over 75 small, family-owned businesses worked ODF sales for Hampton Lumber in FY2021.

WHERE ARE THESE BUSINESSES LOCATED?

17 HAMPTON CONTRACTORS - LOGGING, HAULING & ROAD CONSTRUCTION

438 EMPLOYEES

- Braxling & Braxling
- JM Browning Logging
- Fallon Logging
- Smallwood Logging
- LS&D Logging
- Marshall Logging
- Olson Brothers Logging
- Stokes Construction Co.
- Warrenton Fiber Co.
- Chris Dials Contracting LLC
- D McCoy Inc.
- Marsh Creek Corp.
- Hopkes Logging
- Kottre Tree Farms
- Table Mountain Forestry LLC
- Vinson Brothers Construction
- Road Builders Inc.

61 SUBCONTRACTORS

TRUCKING

CTT Farms
Charles Bumgartner
Dale Anderson
Daniel Koch Trucking
Dean Bergeron
Dennis Lowe
Denny Calloway
Fall Creek Logging
Garrett Martindale
Gary Foglio Trucking
HG Tucker, LLC
Heith Pierce
Heritage Trucking
Ian Groshong Trucking
James Gedenberg Log Trucking, LLC
Jasen Branson Trucking
Jeff Hancock Trucking
Joe Remington
John Hunter Jr Trucking
John L Parks Trucking
Jon L Golly
KC & Sons LLC Trucking
Kiser Trucking
McCanna Trucking
Micheal Craycraft Trucking
Mike Genenberg Trucking
Pacific Timber Trucking
Pro Thin Logging
RJ Stephens Trucking
Randy Luoto Trucking
Richard Remington
Ripple Trucking
Siletz Trucking
Teevin Bros. Land & Timber
Terry Freeman
Tom Linton
Waldron Trucking
Zwald Transport Inc.

TIMBER FALLERS

Barcroft Timber
Browning Timber Falling, LLC
Cory Howell
Frank Franklin
Gary Dunn Timber Falling
Howell Cutting
Jason Dunn Timber Falling
Mark Pierce
O'Brian Timber
Orrin Cook
Rippet Timber Cutting

ROAD BUILDING & FIRE COMPLIANCE

4 Dees Log Trucking LLC
Aggregate Resources
Big Wood Contracting
Brink Fire Resources
DK Quarries
Farmington Rock
Gitchell Trucking
Jason Hagan
Keith Whitehead
Nehalem Bay Ready Mix
Porters Roadside Brushing
Robert Warren
Roger Lane Trucking
S-C Paving
Sorensen Rock & Timber
Western Rock Resources

STUMPAGE VALUE: **$29.3M** + LOCAL ACTIVITY: **$39.3M = $68.6M**

Associated Oregon Loggers, Inc.

PO Box 12339 • Salem, Oregon 97309-0339 • (503) 364-1330 • Fax (503) 364-0836

Date: April 27, 2022
To: Board of Forestry
From: Amanda Sullivan-Astor, Forest Policy Manager
Associated Oregon Loggers

Topic: Agenda Item #2 – Forestry Program for Oregon

Good morning Chair Kelly, State Forester Mukumoto and members of the Board,

Thank you for the opportunity to discuss Associated Oregon Loggers' (AOL) perspective on the Forestry Program for Oregon and its importance to creating a durable future for Oregon Department of Forestry and more broadly, the forests of Oregon. My name is Amanda Sullivan-Astor, my pronouns are she/her/hers, and I am the Forest Policy Manager at AOL.

Forestry Program for Oregon

AOL brought forward some high-level concepts around the FPFO at the March Board Meeting and have since honed in on some of the specifics we would like to discuss with you today. We still believe that the FPFO should look to achieve environmental goals while recognizing the importance and value of a healthy, economically competitive forest products sector, but we also want to highlight the need for the Department itself to create a durable forward-looking structure that can achieve the goals of the FPFO and the 20-Year Strategic Plan because ultimately, AOL believes the emphasis on climate change that the Board is seeking within the FPFO cannot come without an equal emphasis on wildfire.

As we think about the FPFO and climate change, we must be reminded that this visionary document overlays all lands in the state. This document has the ability to build new relationships, new policies, new social license and new priorities across jurisdictions. This means that the largest landowner in Oregon, the federal government, needs to equally take ownership of the document and must carry its weight in solving these issues for the state.

As discussions about increasing forest health treatments on federal lands are occurring at different levels, the key theme I continue to hear is how vital the added capacity the state brings to the table through the Good Neighbor Authority (GNA) and the greater Federal Forest Restoration (FFR) Program is in creating resilient landscapes across the state. Resilient landscapes and working forests don't only grow vigorously and sequester large amounts of carbon, they also provide the wood necessary to build clean infrastructure and green homes. The FPFO must lean into shared stewardship with the largest land owner in the state and make commitments to utilize every authority available to be an active partner in building social license to do more on these federal lands in order to keep natural and working lands healthy and their communities flourishing. When forests are healthy, actively sequestering carbon and prepared for disturbance, it means Oregon's climate future is on the right track and the forested ecosystem is thriving. When we have healthy communities, with a robust workforce and a strong business community it means that we have created a social ecosystem that is also thriving. We can have both, we have examples of this success and we need to do more of it!

Thankfully, ODF is engaged in developing a strategy focused on landscape resilience through shared stewardship of our federal forest, the 20-year Strategic Plan, but ODF must also be developing the organizational structures that can durably and sustainably implement this work. Our federal partners are squarely focused on wildfire as the biggest threat to healthy forest and claims change in the west. We know this because they recently developed a 10-Year Strategy for Confronting the Wildfire Crisis. ODF's FPFO,

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must too be focused on wildfire as the biggest threat to climate change and forest health. We can't talk about one without talking about the other two and a large role for ODF and the Board is to lean into durable solutions while building a scalable organization that will be sustained no matter what happens to funding levels or politics. The FPFO and 20-Year Strategic Plan must maximize effectiveness of forest health treatments at a pace and scale commensurate with the risks we face.

The way this is achieved is through leveraging value from forest resiliency treatments and plowing it back into restoration work and creating additional resilient landscapes. This occurs by reducing fuel in the woods that can be used to create clean infrastructure while creating new markets from low value material to start doing things like using wood instead of petroleum to produce energy, fuel and gasoline in our state. The value we receive from these markets can then be used for grants, other restoration work, prescribed fire and more.

AOL believes an expanded FFR Program focused on landscape resiliency is critical to grow because of the social license it is able to create through collaborative efforts, the scale of forest health treatments it is able to achieve through implementing GNA and the pace of management it is able to realize by working with partners across the state. Perhaps, a durable structure at ODF could be created where all of the financial programs and operation authorities that are focused on creating landscape resiliency and implementing the 20-Year Strategic Plan are under one manager at the same level as the other two Deputy Chiefs of the Forest Resources Division.

Ultimately, AOL believes it is GNA that is truly unrivaled to any other mechanism at the departments disposal to help address the climate, wildfire and overall forest health crisis in this state without being a drain on the General Fund, but we are willing to support other programs that also make a difference.

AOL is and will always be committed to increasing the health of our forests and the health of our communities. We are a partner in developing new solutions and willing to have the discussions that lead us there.

Thank you and I am available for any questions.

Sincerely,

Amanda Sullivan-Astor
aastor@oregonloggers.org

Submitted: Mon 04/25/2022 10:22 AM

Subject: Written Testimony for April 27th Meeting Item #2

Message: Testimony to Oregon Board of Forestry from Peter Hayes, April 25, 2022 – Concerning Forestry Plan for Oregon:

I write as an Oregonian with strong interest in your process of redeveloping the Forestry Plan for Oregon to share my thanks, commendations and encouragement. Having participated as a board member when the current plan was written, I have some sense of the challenges and importance of the process.

Thank you for the important work that you're doing. I am impressed by the board's accomplishments over the past two years.

Commendations:

1 - I commend you for taking the strategic planning process seriously and for the careful and thoughtful approach you are using. I believe that the plan can move us closer to a shared vision and set of strategies.

2 - I also commend you on your clear commitment to better weaving attention to diversity, equity and inclusion into the culture of the Board and Department and on the solid progress you are making in turning good intentions into tangible actions. This work calls for change and is based on your honest and courageous acknowledgement of realities of the culture within which we operate and live: unfair treatment of some people based on unchosen traits, including gender, race, sexual orientation, class, ethnicity. As you integrate attention to DEI into your FPFO, you will take steps to help address problems that are not necessarily of your making, but for which you take responsibility for acknowledging and working to address.

The strength of the plan you are developing is grounded in the degree to which you honestly assess and acknowledge the realities of our circumstances.

Encouragement:

While your focus on DEI is essential, I feel that it is not sufficient.

I feel that there is a second, related dimension of our culture and circumstances that calls for similar honest assessment and acknowledgement. The culture of forestry in Oregon and of ODF

reflects a legacy that we've inherited, that has been shaped by the actions of many generations of those who preceded us, and one that you and I have played very small roles, if any, in creating. This cultural legacy includes much that we should be proud of and that we should work to maintain, protect and build on. At the same time, this cultural legacy includes aspects that limit our progress as we work to rise to meet current and future challenges. In many ways it is a culture that too often has been, and continues to be, extractive of the health and wealth of Oregon forests and those dimensions of the land that we all share in common - plant and animal life, water and the air and atmosphere. One of the many examples that support this observation is the story of ODF's Indicators of Sustainable Forests Program. During my service on the Board (2008 – 2012), staff presented findings on each of the indicators. Indicator E.c. which focused on the status of forest-dependent plant and animal species at risk. Soon after the staff reported that the status was "poor", the trend was "declining" and the data quality was "good", the Board and Department decided to discontinue the indicators project instead of investing attention into what the indictors were telling us and how the problems should be addressed. This history of extraction and reduced opportunities in Oregon forests is a small subset of a global economy that too often incentivizes extractive actions more than responsible stewardship.

In the same way that your DEI work aims to acknowledge and address uncomfortable realities, the effectiveness of your new Forestry Plan for Oregon depends on explicitly acknowledging and addressing this parallel reality: in too many ways, Oregon forestry has taken more from the land than it can provide without being degraded. We have been too focused on what the forests can do for us and too slow to ask what responsibilities we have to these forests and the systems that they are part of.

Having appreciatively watched your work in the past year, particularly your impressive Climate Change and Carbon Plan, I sense that you are already aware of the reality outlined above and are taking thoughtful action to change the organizational culture.

During your April 6th meeting, Chair Kelly asked a fundamentally important question of your panelists: "what steps will help the Board and Department better earn and keep the trust of Oregonians?". I sense that the question also implies the need to also earn and keep the

confidence and respect, as well as the trust, of Oregonians. I feel that the key determinant is the degree to which the Board and Department effectively and reliably do the work that we count on you to do. This includes the hard, but not impossible, work of drawing Oregonians together around an ambitious and realistic shared vision for the future of forests and forestry. Our success will be in proportion to our willingness to honestly acknowledge and address both the strengths and the unacceptable liabilities of the cultural legacies that we have inherited.

I applaud the impressive progress that you have made in beginning to do that, and strongly encourage you to expand your focus beyond the human-to-human relationships and responsibilities to also include the human-land relationships and responsibilities. Communities that are honest with themselves are more successful and functional than those that are not.

As always, thank you for your important service.

Peter Hayes
peter@hylawoods.com

April 20, 2022

Oregon Board of Forestry
2600 State Street
Salem, Oregon 97310

RE: Forestry Program for Oregon

Chair Kelly and Members of the Board of Forestry:

Thank-you for coming to Bend! I look forward to joining you for a portion of your activities next week.

I am writing once more in support of your efforts to update *Forestry Program for Oregon.* You may recall that I served as Department of Forestry staff to the Oregon Board of Forestry in the development of the 2003 and 2011 editions of the strategic plan.

In my October 7, 2021 correspondence I tried to provide some historical context to the development of these editions of the *Forestry Program for Oregon.* One additional point I would like to emphasize is the extent to which the Board of Forestry at that time sought to broaden the ownership of the goals, objectives and indicators of the *Forestry Program for Oregon.*

The 2011 Board was deliberate in developing a *Forestry Program for Oregon* with a sustainable forest management framework that would apply to <u>all</u> Oregon forests. By doing so it was hoped progress would be made to repair an otherwise fragmented administrative landscape through providing a common language for measurement and discussion. The Board also established an Oregon Roundtable on Sustainable Forests. An open invitation was provided to all interested stakeholders to participate in the Roundtable. Most significantly, the Board entered into a formal "Declaration of Cooperation" with key public agencies (Oregon Department of Forestry, OSU College of Forestry, USDA Forest Service Region 6 and Pacific Northwest Research Station, Bureau of Land Management, and Oregon Department of Environmental Quality) in support of the Roundtable. A copy of that signed Declaration is attached.

I encourage you to review the powerful language in the Declaration. I also encourage you to pursue similar levels of cooperation for the next edition of the *Forestry Program for Oregon.* But a word of caution—while the 2011 *Forestry Program for Oregon,* enjoyed passionate individual champions within each of these organizations at the time, the lack of long-term institutional support (including within the Department of Forestry) coupled with an ongoing economic recession, crippled its full implementation. Obtaining and maintaining that institutional support will be crucial for the next *Forestry Program for Oregon* to be more than an internal bureaucratic exercise.

Your Agenda Item #2 on April 27 asks you to choose whether to:

- Retain the 2011 FPFO with mild updating and editing,
- Revise the FPFO but maintain the existing structure and Montreal Protocol, or
- Abandon the FPFO and consider a new mechanism for establishing the vision and policy objectives of the Board.

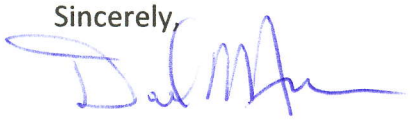
My understanding is the staff recommendation is to adopt the third option.

My recommendation is to carefully consider the ongoing value of the Montreal Process framework before abandoning it entirely. The 2003 and 2011 Boards adapted the international Montreal Process criteria and indicator framework for use in Oregon because it was believed all Oregon forest issues could be better organized and addressed the seven *Forestry Program for Oregon* goals in this integrated, holistic manner. All stakeholders could see all of their values honored and addressed within the framework. It also provided a way to define and measure "sustainable forest management" in an internationally accepted manner.

Clearly climate change adaptation and mitigation and related socio-economic issues are urgent current priorities, but I believe with minor modification these topics can be addressed within the seven existing *Forestry Program for Oregon* goals while not diminishing attention to fish and wildlife conservation, maintaining water quality, and other issues that are very important to many key Oregon forest stakeholders.

Thank-you for the opportunity to provide this information.

Sincerely,



David Morman

Bend, Oregon

Attachment: Oregon Roundtable on Sustainable Forests Declaration of Cooperation (2010)

OREGON ROUNDTABLE ON SUSTAINABLE FORESTS
DECLARATION OF COOPERATION

Preamble

The issues of forest sustainability affect all Oregonians. Wider professional and public understanding and agreement within the state on the meaning of sustainable forest management will result in:

- The conservation and enhancement of Oregon's forest land base,
- Increased public support for forest protection, investment, and management,
- Promotion of the substantial, multi-faceted benefits of Oregon's forests to its citizens and to the nation, and
- Greater alignment and coordination of government policies affecting forests.

Currently this shared understanding does not exist. There has been a high degree of values-driven enmity, antagonism, and mistrust that has dominated the discussion of forestry issues in recent decades. The public and some natural resource professionals are frustrated, fatigued, and/or disengaged by the decades of ongoing forest policy battles with no narrowing or convergence of goals. We are also challenged to recognize that forests are physical and biological systems that do not recognize political boundaries and that the necessary degree of policy coherence across various levels of governance currently does not exist.

To make a difference in achieving the sustainability of Oregon's forests, the focus must change to promote real collaborative discussions. There must be enhanced dialogue among forest owners and managers, local communities, those who use the forest, leaders in the forest policy sector, and leaders in government. The dialogue around Oregon's forests should be a robust engagement among diverse points of view and experiences for all forests - public and private. The people involved should reflect and honor the diversity of our society and communities. Participants must come together willing to listen and look for mutually beneficial solutions. There is a need to increase our knowledge about the linkages among the environmental, economic, and social aspects of Oregon's public and private forests and to understand how specific "on the ground" approaches affect these three aspects of sustainability.

At the request of the Oregon Board of Forestry, a group of interested individuals and organizations has developed a framework for a public dialogue around sustainable forest management called the Oregon Roundtable on Sustainable Forests (the Oregon Roundtable).

The purpose of the Oregon Roundtable on Sustainable Forests is to engage multiple stakeholders through collaborative efforts to advance understanding, assessment and reporting of forest sustainability, and to encourage forest resource management that integrates environmental, economic, and social considerations.

The Oregon Roundtable on Sustainable Forests will be part of a dynamic social process whereby Oregonians shape an evolving vision of what constitutes sustainable forest management and what it means in Oregon. Ideally, the Oregon Roundtable will produce high quality public dialogue that will result in greater understanding among Oregon individuals, communities, academia, businesses,

and government about our collective values regarding forests. It can also inform discussions on how forest management and forest policies can be encouraged and implemented to meet the expressed needs of Oregonians.

The Roundtable approach will utilize the *Forestry Program for Oregon* goals and objectives and the Oregon Indicators of Sustainable Forest Management as a common statewide framework by which to organize topics and discussions, to assess forest conditions, and to evaluate progress. Within this framework, the Roundtable can serve as a semi-independent, open forum that will select and discuss the issues that are of greatest interest or importance to Oregonians. The Oregon Roundtable also can be engaged by governing boards, universities, agencies, communities, interest groups, or others to request that it assist them with public dialogue around sustainable forests issues.

Through this Declaration of Cooperation, the Board of Forestry, partner agencies, and other organizations are expressing their commitments to actively support and participate in the Oregon Roundtable's work, and to provide opportunities for the Roundtable to submit input in their decision-making processes.

OREGON ROUNDTABLE ON SUSTAINABLE FORESTS
DECLARATION OF COOPERATION

Support and Cooperation Statements for the Oregon Roundtable on Sustainable Forests

Preface

This Declaration of Cooperation brings together the key partners and stakeholders to create and support an Oregon Roundtable on Sustainable Forests.

While not a binding legal contract, this Declaration of Cooperation is evidence to, and a statement of, the good faith and commitment of the undersigned parties. These commitments represent a public statement of intent to participate in Roundtable, to contribute assistance and support within resource limits, and to collaborate with other Roundtable participants in identifying opportunities and solutions to promote the successful implementation of its charter and work plans.

The undersigned parties agree that, if successful, the Oregon Roundtable on Sustainable Forests provides the following important opportunities:

- The Roundtable can provide meaningful input into Oregon forest policymaking.
- The Roundtable can provide an opportunity to bring citizens and organizations together who want to find common ground and environmentally, economically, and socially integrated solutions.
- The Roundtable can generate more robust engagement among diverse points of view and experiences and better reflect and honor the diversity of our society and communities.
- The Roundtable can create a dynamic social process whereby Oregonians shape an evolving, but enduring vision of what constitutes sustainable forest management and greater public support for the substantial benefits of Oregon's forests.
- The Roundtable can promote shared learning about Oregonians' environmental, economic and social values. The potential outcomes of sustainable forest management can then inform subsequent discussions on how forestry can be encouraged and implemented to meet the expressed needs of Oregonians.
- The Roundtable can explore ways to link with and learn from the efforts of local initiatives, other states, countries, and organizations that are actively pursuing sustainability of forests.
- The Roundtable can provide opportunities for pilot projects and case studies associated with forest sustainability.
- The Roundtable can encourage integrated thinking about how forests and people affect each other.

The undersigned parties agree to their stated levels of cooperation, participation, and/or support for the Oregon Roundtable on Sustainable Forest. Unless extended by mutual agreement, this Declaration of Cooperation shall terminate on December 31, 2012.

OREGON ROUNDTABLE ON SUSTAINABLE FORESTS
DECLARATION OF COOPERATION

Oregon Board of Forestry

The Oregon Board of Forestry's mission is to lead Oregon in implementing policies and programs that promote environmentally, economically, and socially integrated and sustainable management of Oregon's public and private forests.

The Oregon Board of Forestry (Board) has defined sustainable forest management as meaning forest resources across the landscape are used, developed, and protected at a rate and in a manner that enables people to meet their current environmental, economic, and social needs, and also provides that future generations can meet their own needs (based on the definition of "sustainability" in ORS 184.421). On a statewide basis, the Board believes sustainable forest management will provide:

- Healthy and diverse forest ecosystems that produce abundant timber and other forest products;
- Habitat to support healthy populations of native plants and animals;
- Productive soil, clean water, clean air, open space, and recreational opportunities; and
- Healthy communities that contribute to a healthy state economy.

To achieve its mission, the Board has established the following strategic policy goals:

Goal A: Promote a sound legal system, effective and adequately funded government, leading-edge research, and sound environmental, economic, and social policies.

Goal B: Ensure that Oregon's forests make a significant contribution towards meeting the nation's wood product needs and provide diverse social and economic outputs and benefits valued by the public in a fair, balanced, efficient, and sustainable manner.

Goal C: Protect, maintain, and enhance the productive capacity of Oregon's forests to improve the economic well-being of Oregon's communities.

Goal D: Protect, maintain, and enhance the physical and biological quality of the soil and water resources of Oregon's forests.

Goal E: Contribute to the conservation of diverse native plant and animal populations and their habitats in Oregon's forests.

Goal F: Protect, maintain, and enhance the health and resiliency of Oregon's dynamic forest ecosystems, watersheds, and airsheds.

Goal G: Enhance carbon storage and reduce carbon emissions in Oregon's forests and forest products.

The Board updates its mission statement, vision statement, value statements, and long term goals on an eight-year cycle. The Board updates its strategic objectives on a two-year cycle. Collectively, these products are known as the *Forestry Program for Oregon*. The *Forestry Program for Oregon* provides a framework for the Board to achieve sustainable forest management. This model can also

foster greater public understanding, acceptance, and support for a common vision for the future of forestry in Oregon. To successfully implement the *Forestry Program for Oregon*, the Board and the Department of Forestry need to develop and maintain strong cooperative alliances with state, federal, local government, tribal, and private partners. In addition, the sustainability framework used in the *Forestry Program for Oregon* may be exportable to other natural resource sectors.

Sustainable forest management and the seven goals are somewhat abstract and subjective concepts. Consensus on, and ownership of, indicators of sustainable forest management and other supporting statewide forest resource assessment information by policy-makers, stakeholders, and scientists is important. These data are needed to provide a means for measuring progress towards broad policy objectives and to evaluate the potential environmental, economic, and social effects of alternative policies.

The Board has endorsed, and will periodically update, a set of Oregon Indicators of Sustainable Forest Management addressing the goals of the *Forestry Program for Oregon*. The Board may also endorse desired trend statements or targets for the indicators. The Board will use sustainable forest management indicators, other assessment and accomplishment information, and stakeholder involvement as tools to provide an improvement cycle that allows it to evaluate Oregon forest resource conditions and trends and implementation of the *Forestry Program for Oregon*.

The Board will support the Oregon Roundtable on Sustainable Forests as an open forum for Oregonians to recognize the importance of forests to their environmental, economic, and social well-being. The Board recognizes the need to provide opportunities for Oregonians to participate in public discussions and provide input to decision-making on sustainable forest management. Such discussions will strive to clarify what we know about forest systems, what we value, and how public policy can integrate and balance those values. Through the Oregon Roundtable on Sustainable Forests, Oregon has an opportunity to create a long-term evolving dialogue that can lead to a body of literature, policies, improved practice, and citizen engagement that can transform sustainable forest management in the state and perhaps elsewhere.

The Board will request the assistance of the Oregon Roundtable on Sustainable Forests on discrete projects such as use of the Oregon Indicators of Sustainable Forest Management. The Oregon Roundtable could serve to fill the need for a "sounding board" for the indicators work. It would be an opportunity to develop a broader understanding of the impacts of our actions on the indicators and ultimately how to manage toward a desired blend of environmental, economic, and social targets. If this effort is successful it may lead to Roundtable participation in other Board work, such as future updates of the *Forestry Program for Oregon*.

John Blackwell, Chair

4/22/10
Date

OREGON ROUNDTABLE ON SUSTAINABLE FORESTS
DECLARATION OF COOPERATION

Oregon Department of Forestry

The mission of the Oregon Department of Forestry is to serve the people of Oregon by protecting, managing, and promoting stewardship of Oregon's forests to enhance environmental, economic, and community sustainability.

The core business functions of the Department of Forestry are to:

- Minimize loss of forest resources and values by protection from damaging agents including fire, insects, diseases, and damaging forest activities.
- Manage state-owned forest resources consistent with statutory, Board of Forestry, and State Land Board direction.
- Facilitate forest stewardship on private lands through education, assistance and regulation, with a focus on meeting landowner objectives and preventing potential adverse resource impacts.

These core business functions are based on an ongoing assessment of Oregon's forests and the analysis, development and/or influence of forest policy at the state, regional, and national level.

The Department of Forestry's strategic planning and program administration are directly linked to the Oregon Board of Forestry's mission, vision, values, goals, and objectives articulated in the *Forestry Program for Oregon.* Department of Forestry staff assists the Board to implement its strategic planning processes and its other Work Plans. In this context, the Department collects and reports data and supporting information for the Oregon Indicators of Sustainable Forest Management.

Every five years, beginning in 2010, the Department of Forestry is responsible for leading Oregonians in development of a statewide assessment of forest resources that:

- Analyzes forest conditions, trends, threats and opportunities for all Oregon forestlands – federal, tribal, state, private industrial, family and local government lands; and
- Identifies priority forest landscape areas that address national, regional and state forest management priorities.

Based on the Statewide Assessment, the Department is also responsible for leading development of a State Resource Strategy that updates program strategies for administration of federal State and Private Forestry Program initiatives in Oregon. The Department also works to promote federal forest management in the state that is consistent with Board of Forestry policies.

The Oregon Department of Forestry will actively participate in the Oregon Roundtable on Sustainable Forests and, within resource constraints, provide policy, technical, logistical, and facilitation support.

Marvin Brown, State Forester

4/22/10
Date

College of Forestry ~ Office of the Dean
Oregon State University, 150 Peavy Hall, Corvallis, Oregon 97331-5704
Phone 541-737-1585 | Fax 541-737-2906 | http://forestry.oregonstate.edu/

June 23, 2010

David Morman, Director
Forest Resources Planning Program
Oregon Dept. of Forestry
2600 State Street
Salem, Oregon 97310

RE: Oregon Roundtable on Sustainable Forests Declaration of Cooperation

The mission of the College of Forestry, as part of Oregon's Land, Sea, Sun and Space Grant University, is to educate and engage the next generation of scholars, practitioners, and users of the world's forest resources, to conduct distinctive problem-solving and fundamental research on the nature and use of forests and related resources, and to share our discoveries and knowledge with others. We aspire to be the world's premier forest resources education, research, and service institution.

Core values are essential and enduring tenets held by the faculty, staff, students, and administrators of the College of Forestry. These values express our aspirations and our fundamental reason for being:

- We value forests -- We commit to sustaining forests and the functions, products, and values they provide for current and future generations.
- We value people -- We recognize strength in diverse faculty, staff, students, and ideas. We nurture the College community through communication and mutual respect.
- We value learning -- We share a passion for learning through teaching, research, experience, and extended education.
- We value service -- We serve the people of Oregon, the nation, and the world.
- We value collaboration -- We address complex forest resource challenges through collaboration across disciplines, institutions, and perspectives.
- We value excellence -- We aspire to excellence, innovation and relevance in all that we do.

Oregon State University's College of Forestry has been educating professionals for over a century. We've earned a reputation as a world-class center of teaching and learning about forests and related resources. We offer undergraduate and graduate degrees in three departments, Forest Engineering, Resources & Management, Forest Ecosystems & Society, and Wood Science and Engineering. We also jointly offer several interdisciplinary programs. We operate about 14,000 acres of College Forests, most of it within minutes of campus. The College participates in a University online graduate certification degree program in Sustainable Natural Resources designed to enhance

leadership skills and scientific expertise to meet the global demand for effective sustainable natural resource management.

The College is also an active partner with the Oregon Institute for Natural Resources, which is a cooperative enterprise that acts as a catalyst by bringing together decision makers and researchers and developing partnerships with state, federal, tribal and local decision makers and the talented faculty of Oregon's higher education institutions.

The College of Forestry will continue to support and promote sustainable forests at local, state, regional, national, and international scales through education, research, and technology transfer.

The College will support the Oregon Roundtable on Sustainable Forests and encourage active participation by its executives, faculty, researchers, and students. Upon request, and subject to the availability of College resources, it will support the scientific and technical development, implementation, evaluation, and integration of the Oregon indicators of sustainable forest management. Where possible, the College will strive to produce new scientific information that supplements the indicators and that informs resulting policy discussions based on indicator data.

Dr. Hal Salwasser, Dean

June 23, 2010
Date

OREGON ROUNDTABLE ON SUSTAINABLE FORESTS
DECLARATION OF COOPERATION

BUREAU OF LAND MANAGEMENT

It is the mission of the Bureau of Land Management (BLM), an agency of the Department of the Interior, to manage BLM-administered lands and resources in a manner that best serves the needs of the American people. Management is based upon the principles of multiple use and sustained yield while taking into account the long-term needs of future generations for renewable and nonrenewable resources.

The BLM manages 3.2 million acres of forests and woodlands in the state of Oregon. These lands contain a diversity of plant and animal species, recreation areas, mining claims, grazing lands, forestlands, cultural and historical resources, scenic areas, wild and scenic rivers, and wilderness. The BLM manages its forested landscapes to support sustainable rural communities and provide for healthy forests and watersheds.

The BLM manages forests under a number of different laws and initiatives, including the Healthy Forests Restoration Act, the O&C Lands Act of 1937, the Healthy Forests Initiative, and many others. The BLM also complies with all other applicable laws, including, but not limited to, the Endangered Species Act, the Clean Water Act, and the Federal Land Policy and Management Act.

The BLM currently manages its forestlands in western Oregon through Resource Management Plans prepared under the umbrella of the Northwest Forest Plan and the O&C Act. The O&C Act provides for permanent forest production in conformity with the principles of sustained yield for the purpose of protecting watersheds, regulating stream flow, contributing to the economic stability of local communities and industries, and providing recreational facilities. The BLM manages its forests and woodlands in eastern Oregon in conformity with the principles of sustained yield, offering an environmentally responsible level of forest product sales and accomplishing forest and woodland health restoration treatments.

The BLM is committed to employing several key tactics in managing its forest landscapes.

- Where forest health is an issue, use ecological health information to identify priority landscapes and to support land use planning and decision-making.
- Design treatments to minimize impacts to sensitive species and/or support Threatened and Endangered species recovery.
- Supply forest products to help sustain local communities.
- Improve public collaboration and information sharing through use of new technologies, stakeholder meetings, and forest education workshops.

The BLM will participate actively in the Oregon Roundtable on Sustainable Forests and, within resource constraints, provide biological, geographical, and technical information to support development, examination, measurement, and discussion of forest sustainability indicators and management practices.

Edward W. Shepard,
State Director, Oregon/Washington

8/9/10
Date

OREGON ROUNDTABLE ON SUSTAINABLE FORESTS
DECLARATION OF COOPERATION

Oregon Department of Environmental Quality

The mission of Oregon Department of Environmental Quality (DEQ) is to be a leader in restoring, maintaining, and enhancing the quality of Oregon's air, land, and water. Oregon DEQ is responsible for protecting and enhancing Oregon's water and air quality, for cleaning up spills and releases of hazardous materials, for managing the proper disposal of hazardous and solid wastes, and for enforcing Oregon's environmental laws. The agency's key values are:

- environmental results
- public service
- partnerships
- excellence and integrity
- teamwork
- employee growth
- diversity
- health, safety and wellness
- economic growth through quality environment

All these key values are served by healthy forests that are sustainably managed. Healthy forests are of great importance to Oregon's environment, and sustainable management of those forests is necessary to meet DEQ's water and air quality goals. Forests clean and oxygenate the air, regulate and filter precipitation, and provide habitat for aquatic and terrestrial species. The high quality water that forests can produce is necessary for downstream ecosystems and the humans that depend on them. Mismanagement or conversion of forests to other land uses can reduce or destroy the environmental benefits that they provide and pollute the water, soil, and air. Sustainable management of forests protects and enhances environmental quality, provides for human needs, and contributes in a long-term manner to Oregon's economy. As global and regional climate changes occur, it especially important to true sustainability that forests are managed in ways that increase ecological and economic resiliency.

The Department of Forestry has an ongoing relationship with DEQ as the two agencies are charged with cooperating to ensure that forest practices on state and private lands meet both water and air quality standards. Cooperation is especially important for the implementation of the Nonpoint Source Control and Coastal Nonpoint Pollution Control plans, Total Maximum Daily Loads, Drinking Water Protection priorities, and Smoke Management plans. The Roundtable presents a forum and opportunity to continue and build upon our relationship and better enable both agencies to meet their missions in a cooperative way. Cooperation is especially necessary to meet water quality objectives and to protect forests and the ecosystem services they provide from development or conversion to other land uses. It is DEQ's intention to participate in the Roundtable to facilitate this necessary cooperation.

OREGON ROUNDTABLE ON SUSTAINABLE FORESTS
DECLARATION OF COOPERATION

The Oregon Department of Environmental Quality will participate in the Oregon Roundtable on Sustainable Forests, contribute policy, technical, and scientific support to the extent that resources allow, and utilize the insights of the Roundtable to the maximum extent possible in decision making processes.

Dick Pedersen, Director

8-27-2010
Date

OREGON ROUNDTABLE ON SUSTAINABLE FORESTS
DECLARATION OF COOPERATION

USDA Forest Service

The work of the Oregon Roundtable supports the vision of Secretary of Agriculture Tom Vilsack for the Forest Service. He has described the many challenges America faces in forest conservation and management: climate change, globalization, the threat of development to forests, society's need for both the products and the services forests provide, and the potential conflict between use and protection. To address these challenges, the Secretary envisioned an "all-lands approach" reaching beyond public lands to operate at a landscape scale.

Forest Service Chief Tom Tidwell has encouraged the Forest Service to respond with Landscape Scale Conservation strategies which take a comprehensive approach to land management that frames problems and solutions at the level of watersheds, eco-regions, or broad geographic areas. Such large areas often encompass multiple ownerships and jurisdictions. A landscape Conservation Strategy might therefore include federal and state land management agencies as well as private landowners. Goals and actions are coordinated among stakeholders who share decisions, risks, and resources. Rather than addressing individual issues through a piecemeal approach on a fragmented landscape, problems are viewed comprehensively from a broader perspective and addressed at the most appropriate and effective scale.

We know we cannot and should not do our work alone; we value partnerships, collaboration, and working across all lands in all ways. We also recognize the importance of supporting each other.

The work we do makes valuable contributions to the communities of the Pacific Northwest. We know that certain goals will require greater energy and attention to ensure success. Listed below are our emphasis areas for 2010 and are an expression of how we will contribute to the Department and Agency priorities and our contribution to helping our partners meet their goals. Our emphasis areas are a commitment to each other and the public we serve. They are a bridge from our current innovative work and creative partnerships to a more contemporary suite of actions. They reflect a changing landscape--political, environmental, social—and recalibrate actions needed to be responsive and effective. They are areas where we have an opportunity to work with partners.

The Pacific Northwest Region's 2010 emphasis areas are:

1. Valuing place - Organize Regional actions to value the connection of people to the beauty and benefits of National Forest places as much as we value individual resources and services.

2. Improved working environment for employees - Determine what we can do to be a place where people are excited and energized to come to work.

3. Finish what we started: ARRA implementation - Fulfill all of our ARRA obligations.

4. Engaging Youth and Communities - Find more ways to connect youth to their National Forests through education, employment and enjoyment.

OREGON ROUNDTABLE ON SUSTAINABLE FORESTS
DECLARATION OF COOPERATION

5. Landscape Conservation in a Changing Climate –
   - Develop a Regional Landscape Conservation Strategy that is responsive to the challenges of climate change and provides a framework for the development of conservation action plans for priority landscapes.
   - Develop meaningful ways to focus on the role of National Forests in providing water and water-related ecosystem services.
   - Work with partners to facilitate and implement an integrated approach to landscape restoration across all lands, using the full suite of our authorities

The USDA Forest Service looks forward to active participation in the Oregon Roundtable on Sustainable Forests to accomplish a better understanding of sustainable forests in Oregon and accomplishing our mission to improve the health and use of the Nation's forests. We will support and use the Oregon Roundtable to provide meaningful input into Oregon forest policymaking from an "All lands" approach.

Mary Wagner, Regional Forester
Pacific Northwest Region

9/23/10
Date

SEPTEMBER 22, 2010

USDA United States Department of Agriculture | Forest Service | Pacific Northwest Research Station | P.O. Box 3890 Portland, OR 97208-3890 Phone (503) 808-2592 Fax (503) 808-2130

File Code: 4000
Date: September 29, 2010

John Blackwell
Chair
Oregon Board of Forestry
2600 State Street
Salem, OR 97310

Dear Mr. Blackwell,

The mission of the Pacific Northwest Research Station is to generate and communicate scientific knowledge that helps people understand and make informed choices about people, natural resources, and the environment.

The Pacific Northwest Research Station redeems this responsibility by increasing the availability and utility of science information and products, engaging in strategic partnerships to more effectively accomplish mutual objectives, and developing and conducting high-quality research that is responsive to current and future resource priorities and that supports the Forest Service in achieving its mission.

The strategic research priorities of the PNW Station are:

Climate change resilience

- Assess and predict the effect of climate change on water resources and salmon; develop measures and tools to mitigate the effect of climate change on water resources and native fish.
- Develop climate change adaptation strategies for forested landscapes in the Pacific Northwest for land managers to reduce impacts of changing climate on key ecosystem functions and services.
- Assess social and economic impacts of climate change in the Pacific Northwest.
- Develop models and tools to better manage and mitigate carbon.

Community sustainability

- Assess social and economic status and trends of communities in the Pacific Northwest.
- Provide information and methods to understand and predict land use change and effects.
- Provide information and tools to contribute to rural economic sustainability.
- Provide information and tools for green community development.

- Provide information and tools to evaluate and develop bio-energy alternatives (forest genetics, silviculture strategies, production standards, policy evaluation, and economic feasibility assessments).

Watershed health and sustainability

- Provide information and methods to establish and maintain desired watershed conditions in Alaska, Oregon, and Washington.
- Assess and predict the effect of climate change on water resources.
- Develop and deliver science-based aquatic-riparian conservation strategies for land managers in Alaska, Oregon, and Washington.

Landscape assessment, modeling, and management

- Provide landscape assessment techniques and tools.
- Provide multiple threat risk assessment to landscapes.
- Provide post-fire landscape restoration strategies.
- Provide knowledge and tools to reduce risk to priority landscape ecosystem services.

Fire management

- Develop a fire danger model and decision-support system for regional and national application in planning landscape-scale fuels reduction programs.
- Synthesize knowledge on relationships among bark beetle outbreaks, wildfire, and wildfire risk in the Interior West.
- Develop dry-forest fuels reduction strategies for the interior Pacific Northwest that integrate fire management with ecological objective, including the conservation of species.
- Develop and deliver management strategies to restore ecosystem resiliency to landscapes after fire.
- Provide strategies to fire and community planners to implement practices to reduce risk to communities.

Delivering science and technology

- Develop enhanced Web and social media capability.
- Assist practitioners in selecting the most appropriate science.
- Conduct a 3-year pilot to explore the use of techniques in extension and adult education to disseminate research findings on fire and fuels management.
- Establish regional demonstration projects of landscape-scale analytical tools and protocols.

- Create awareness and understanding within the general public of existing climate change science and its implication for forest management.

In his vision for the Forest Service, Secretary of Agriculture Tom Vilsack described the many challenges America faces in forest conservation and management: climate change, globalization, the threat of development to forests, society's need for both the products and the services forests provide, and the potential conflict between use and protection. To address these challenges, the Secretary envisioned an "all-lands" approach that reaches beyond public lands to operate at a landscape scale.

Forest Service Chief Tom Tidwell has encouraged the Forest Service to respond with Landscape Scale Conservation plans, which take a comprehensive approach to land management that frames problems and solutions at the level of watersheds, eco-regions, or broad geographic areas. Such large areas often encompass multiple ownerships and jurisdictions. A landscape management plan might therefore include federal and state land management agencies as well as private landowners. Rather than addressing individual issues through a piecemeal approach on a fragmented landscape, problems are viewed comprehensively from a broader perspective and addressed at the most appropriate and effective scale.

The purpose of the Oregon Roundtable is to engage multiple stakeholders through collaborative efforts to advance understanding, assessment and reporting of forest sustainability indicators, and to encourage forest resource management that integrates economic, environmental, and social considerations. This is an opportunity to increase our collective knowledge about the linkages among the environmental, economic, and social aspects of Oregon's public and private forests and to understand how specific "on the ground" approaches affect forest sustainability.

The Pacific Northwest Research Station supports the establishment of the Oregon Roundtable. We look forward to active participation in using this forum to accomplish a better understanding of sustainable forests in Oregon and accomplishing our mission to develop and deliver

Sincerely,

/s/ Cynthia D. West (for)
BOV B. EAV
Station Director

cc: pdl pnw smt
Becky Gravenmier

April 27, 2022, Board of Forestry Testimony

Chair Kelly, members of the Board of Forestry, State Forester Mukumoto, Staff: I am David Yamamoto, Tillamook County Commissioner and Chair of the Forest Trust Land Advisory Committee (FTLAC). I am writing representing FTLAC in order to fulfill our statutory responsibility to advise the BOF and the State Forester on matters which affect management of the State Forest Trust Lands (ORS 526.156).

While the BOF agenda this month does not contain any material concerning the HCP, I hope you are all thinking as intently as I am about what the HCP means for the State Forest Lands and especially the Trust Counties and special districts. As I have expressed to you previously, the decision in front of this board is significant. The draft HCP proposes a 70-year contract with the Federal Services. It will set in place a management plan which will limit the ability of future Boards of Forestry and future State Foresters to manage State Forest Lands for the Counties and for Oregonians.

I have had an opportunity to review the lengthy 1850-page draft environmental impact statement (DEIS) for the HCP and I do not believe the DEIS contains all of the information you need to understand the consequences of the HCP to our communities.

Specifically, the DEIS provides analysis between only a no action alternative and a narrow range of action alternatives. The DEIS does not provide key information you should know before making a decision to accept an HCP.

First, the DEIS does not show how threatened and endangered species populations would change under the HCP. The HCP would set aside a substantial portion of that State Forest Lands, but for how many northern spotted owls? How many marbled murrelets?

The DEIS does not inform you of the biological potential of the State Forest Lands. The State Forest Lands have long been managed for objectives other than just timber. As a result, we now no longer fully understand what these lands could produce or how harvest levels under the current management plan or under an HCP would differ from the biological potential.

The DEIS does not inform you of the expected take of threatened and endangered species under the HCP or the amount of mitigation provided. The Federal Services state in the HCP Handbook that, “the applicant will, to the maximum extent practicable, monitor, minimize and mitigate the impacts” of take. Neither the HCP nor DEIS provide quantification of either expected take or mitigation. Both provide only summaries of acres of habitat, but neither consider how changes in quantity, quality, and configuration of habitat results in take or mitigation.

Finally, the HCP and DEIS do not explain why the assumptions in the business cases analysis have proven so inaccurate. This business case analysis, presented to the BOF in 2018, was instrumental in providing data that informed the board with sufficient information to direct ODF to continue pressing on with the HCP. The business case analysis showed increasing harvest over time. The proposed HCP now shows declining harvest. Additionally, the business case analysis expected a far higher harvest level from the current forest management plan than does the DEIS (Figure 1). The forest management plan in the

business case analysis showed harvest levels far more consistent with recent harvest levels than the forest management plan in the DEIS. What has changed in the short 4-year interim?

The BOF should request from ODF the answers to the following questions:

1) How would threatened and endangered species populations change under the HCP?
2) What is the biological potential for timber production of the State Forest Lands?
3) How much take of covered species is expected under the HCP and how much mitigation will be provided?
4) Why have the assumptions in the business case analysis proven inaccurate?

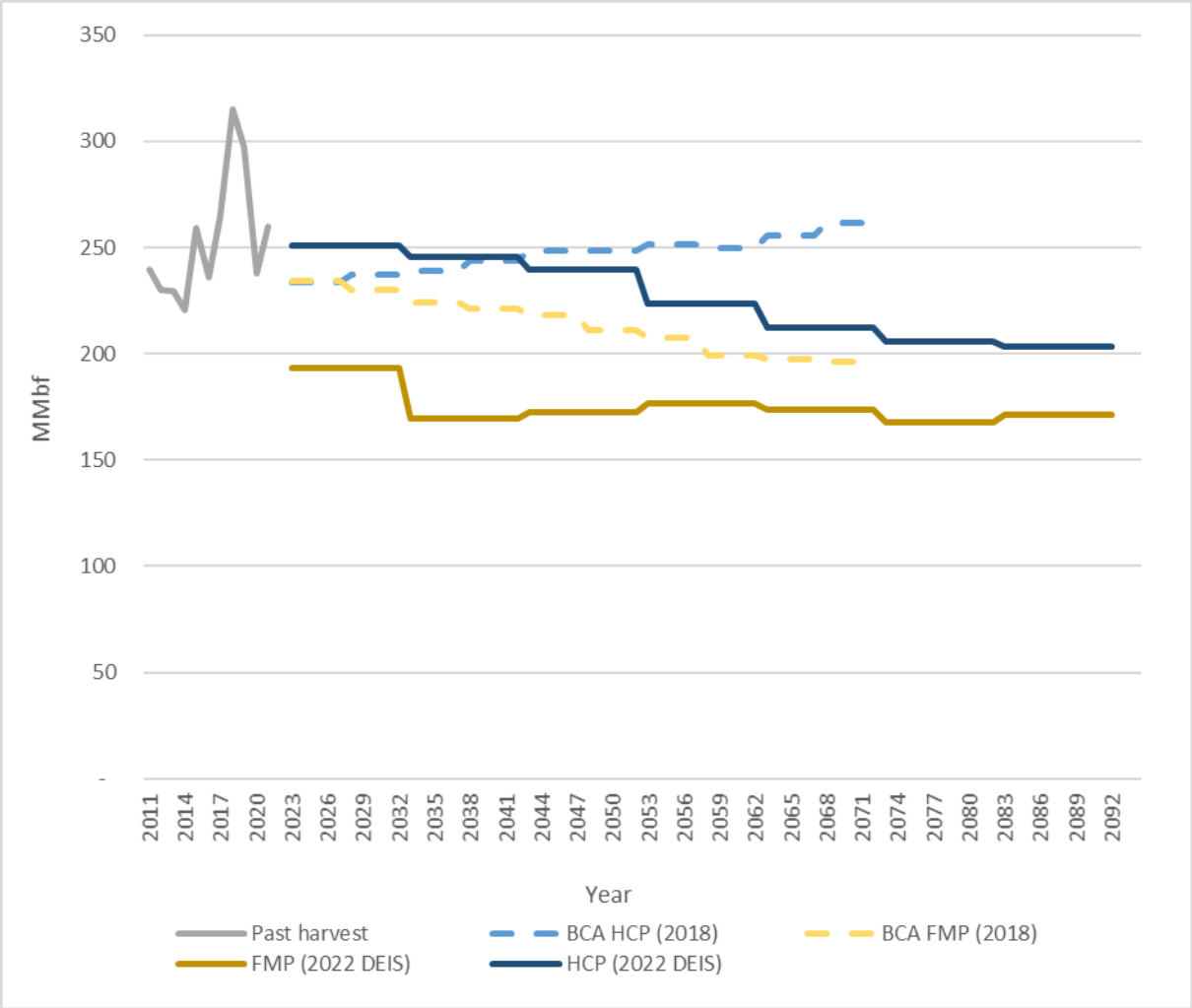


Figure 1. Past harvest levels and harvest level projections for the proposed HCP and the current FMP as modeled for the 2022 DEIS and in the Business Case Analysis (BCA).

The board should request ODF to provide information supporting the assumptions behind the DEIS. It is critical that you and FTLAC fully understand these assumptions. For example, the DEIS assumes that the current forest management plan will result in significant acreages becoming unavailable for harvest due to occupancy by listed species. For example, the DEIS assumes 123,000 additional acres will be set aside for northern spotted owls, even as all reports show declining populations in the face competition from barred owls. To me, the assumptions in the DEIS about the forest management plan present an unreasonable scenario as current science shows that without barred owl control, the northern spotted owl is on a trend towards extinction.[1] Attached is a paper reviewing range-wide northern spotted owl population trends. The authors state, "without removal or reduction of barred owl populations, the more realistic scenario is probably that NSOs will become extirpated from portions of their range and possibly linger on as small populations in other areas until those populations are eliminated because of catastrophic events, resulting in the extinction of this subspecies." The authors do not state that more large reserves will recover the spotted owl.

Further, the DEIS assumes continued management under the current forest management plan for 70 years. However, 70 years of management under the current forest management plan does not represent the future of these lands. ORS 629-035-0030 (1) requires that the board review the forest management plan every 10 years. That same rule requires the State Forester to develop forest management plans, just as State Forester Mukumoto is doing now. Change in forest management is inevitable. The DEIS no action alternative does not consider this, but the BOF must.

Members of the Board of Forestry, few people have the opportunity to make decisions affecting a multi-billion-dollar public asset and communities across the state. You have that opportunity by sitting on this board. As chair of FTLAC, I urge you to think deeply about the decision in front of you, to ask questions, to demand answers, to understand the full costs and benefits of the HCP, and not to settle with the limited information so far provided to you.

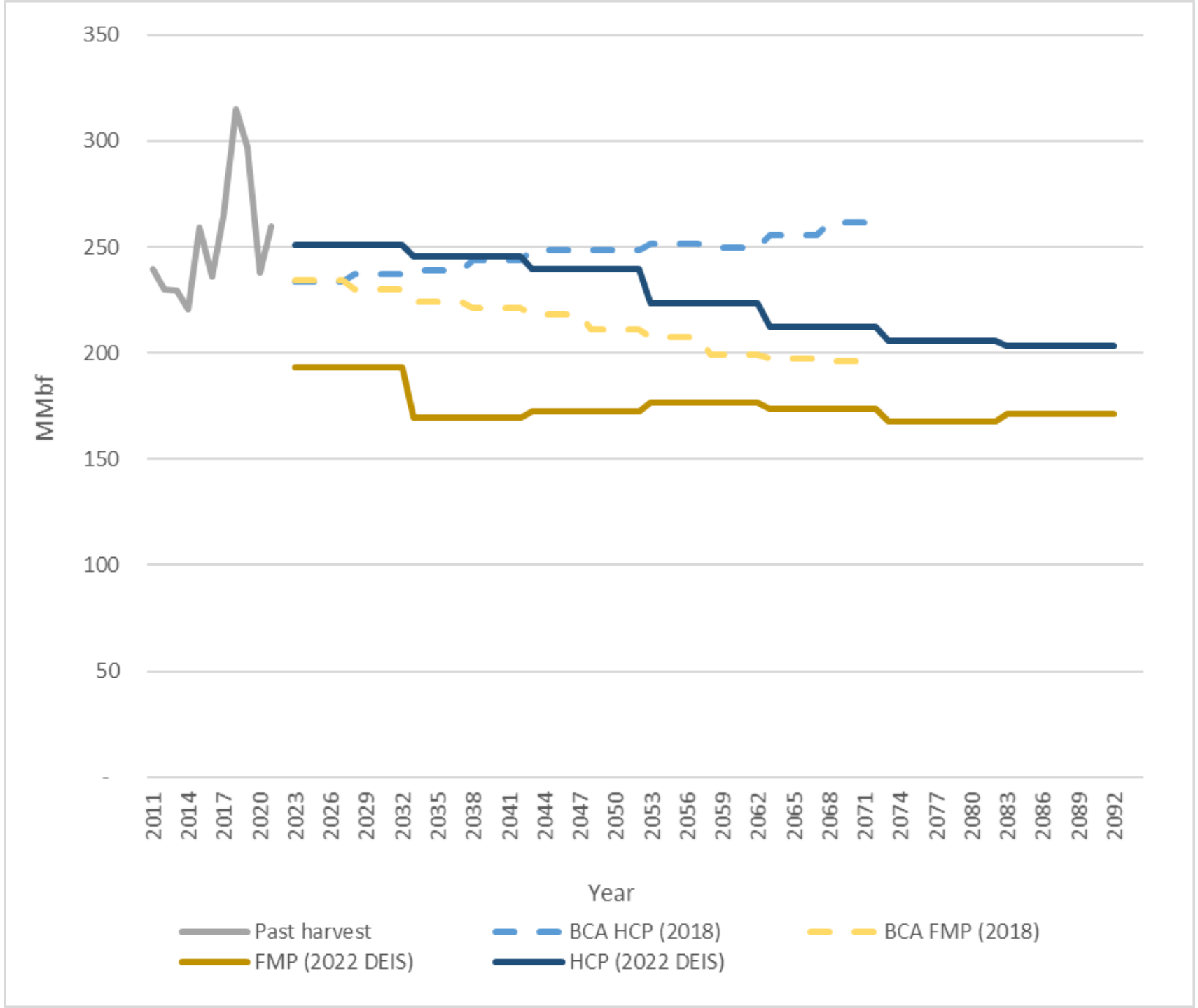
Respectfully submitted,

David Yamamoto

---

[1] Franklin, Alan B., Katie M. Dugger, Damon B. Lesmeister, Raymond J. Davis, J. David Wiens, Gary C. White, James D. Nichols, James E. Hines, Charles B. Yackulic, Carl J. Schwarz, Steven H. Ackers, L. Steven Andrews, Larissa L. Bailey, Robin Bown, Jesse Burgher, Kenneth P. Burnham, Peter C. Carlson, Tara Chestnut, Mary M. Conner, Krista E. Dilione, Eric D. Forsman, Elizabeth M. Glenn, Scott A. Gremel, Keith A. Hamm, Dale R. Herter, J. Mark Higley, Rob B. Horn, Julianna M. Jenkins, William L. Kendall, David W. Lamphear, Christopher McCafferty, Trent L. McDonald, Janice A. Reid, Jeremy T. Rockweit, David C. Simon, Stan G. Sovern, James K. Swingle, Heather Wise. 2021. Range-wide declines of northern spotted owl populations in the Pacific Northwest: A meta-analysis. Biological Conservation 259. https://doi.org/10.1016/j.biocon.2021.109168

Past harvest levels and harvest level projections for the proposed HCP and the current FMP as modeled for the 2022 DEIS and the Business Case Analysis (BCA).



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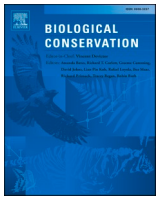

Review

Range-wide declines of northern spotted owl populations in the Pacific Northwest: A meta-analysis

Alan B. Franklin [a,*], Katie M. Dugger [b], Damon B. Lesmeister [c], Raymond J. Davis [d], J. David Wiens [e], Gary C. White [f], James D. Nichols [g], James E. Hines [h], Charles B. Yackulic [i], Carl J. Schwarz [j], Steven H. Ackers [k,1], L. Steven Andrews [k], Larissa L. Bailey [f], Robin Bown [l], Jesse Burgher [c], Kenneth P. Burnham [f], Peter C. Carlson [f], Tara Chestnut [m], Mary M. Conner [n], Krista E. Dilione [e], Eric D. Forsman [c], Elizabeth M. Glenn [o], Scott A. Gremel [p], Keith A. Hamm [q], Dale R. Herter [r], J. Mark Higley [s], Rob B. Horn [t], Julianna M. Jenkins [c], William L. Kendall [u], David W. Lamphear [q], Christopher McCafferty [c], Trent L. McDonald [v], Janice A. Reid [c], Jeremy T. Rockweit [k], David C. Simon [e], Stan G. Sovern [c,k], James K. Swingle [c], Heather Wise [t]

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[m] U. S. Department of the Interior, National Park Service, Mount Rainier National Park, 55210 238th Ave E, Ashford, WA 98304, USA
[n] Department of Wildland Resources, Utah State University, Logan, UT 84322, USA
[o] U. S. Geological Survey, Northwest Climate Adaptation Science Center, 777 NW 9th Street, Corvallis, OR 97330, USA
[p] U. S. Department of the Interior, National Park Service, Olympic National Park, 3002 Mt Angeles Road, Port Angeles, WA 98362, USA
[q] Green Diamond Resource Company, California Timberlands Division, P.O. Box 68, Korbel, CA 95550, USA
[r] Raedeke Associates, 2111 N Northgate Way #219, Seattle, WA 98133, USA
[s] Hoopa Tribal Council, Forestry Division, P.O. Box 368, Hoopa, CA 95546, USA
[t] U. S. Department of Interior, Bureau of Land Management, 777 NW Garden Valley Boulevard, Roseburg, OR 97471, USA
[u] U. S. Geological Survey, Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Fort Collins, CO 80523, USA
[v] Western Ecosystem Technology (WEST), Inc., 415 West 17th Street, Suite 200, Cheyenne, WY 82001, USA

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Territory occupancy

ABSTRACT

The northern spotted owl (*Strix occidentalis caurina*) inhabits older coniferous forests in the Pacific Northwest and has been at the center of forest management issues in this region. The immediate threats to this federally listed species include habitat loss and competition with barred owls (*Strix varia*), which invaded from eastern North America. We conducted a prospective meta-analysis to assess population trends and factors affecting those trends in northern spotted owls using 26 years of survey and capture-recapture data from 11 study areas across the owls' geographic range to analyze demographic traits, rates of population change, and occupancy parameters for spotted owl territories. We found that northern spotted owl populations experienced significant declines of 6–9% annually on 6 study areas and 2–5% annually on 5 other study areas. Annual declines translated to ≤35% of the populations remaining on 7 study areas since 1995. Barred owl presence on spotted owl territories was the

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primary factor negatively affecting apparent survival, recruitment, and ultimately, rates of population change. Analysis of spotted and barred owl detections in an occupancy framework corroborated the capture-recapture analyses with barred owl presence increasing territorial extinction and decreasing territorial colonization of spotted owls. While landscape habitat components reduced the effect of barred owls on these rates of decline, they did not reverse the negative trend. Our analyses indicated that northern spotted owl populations potentially face extirpation if the negative effects of barred owls are not ameliorated while maintaining northern spotted owl habitat across their range.

1. Introduction

The northern spotted owl (*Strix occidentalis caurina*; NSO) inhabits coniferous forests in the Pacific Northwest of the U.S., extending from British Columbia through Washington and Oregon and into northern California (Gutiérrez et al., 1995). This subspecies has been at the nexus of forest management issues in the Pacific Northwest since the 1970s because of its strong association with older forests coupled with relatively large home ranges. In 1990, the NSO was listed as threatened under the Endangered Species Act (U. S. Fish and Wildlife Service, 1990) and protection of older forests for NSO and other old-forest obligates reduced timber harvest (Dixon and Juelson, 1987). Multiple management strategies and plans were developed by federal agencies on whose lands the bulk of NSO populations were found. Most of these management plans were litigated, especially after the owl was federally listed (Marcot and Thomas, 1997). In 1994, the Northwest Forest Plan (NWFP) was adopted, which attempted to balance maintenance of forests for NSO populations with economically viable timber harvest on federal lands throughout the owls' range; current forest management continues under this plan (U. S. Department of Agriculture and U. S. Department of the Interior, 1994).

One component of the NWFP required long-term monitoring of NSO populations (Lint et al., 1999). This monitoring scheme utilized eight existing NSO demographic studies that were established as early as 1985. Additional demographic studies were also initiated outside the NWFP population monitoring framework and, at one point, there were 15 demographic studies distributed across the range of the NSO (Franklin et al., 1999). These studies were alike in that all utilized similar field methods to estimate demographic parameters using primarily capture-recapture estimators (Franklin et al., 1996).

Collectively, the demographic studies of the NSO were considered as meta-replicates, where the study area was the unit of replication (Johnson, 2002, 2006). This allowed for a prospective meta-analysis (Seidler et al., 2019) of NSO demographic studies, where study area selection, hypotheses, and analyses were specified before the meta-analysis was conducted (e.g., Anthony et al., 2006). Although rare, prospective meta-analyses are useful for addressing high-priority research questions in situations where new studies are expected to emerge (Seidler et al., 2019).

We provide here the results from the seventh meta-analysis on population trends in NSOs (Table 1). This meta-analysis continued the tradition of earlier meta-analyses in addressing two key questions of concern to forest and wildlife managers: *What are the range-wide population trends in NSO populations?* and *Are management activities or other factors affecting these trends?* We addressed the first broad question by examining a number of more specific questions, including: *What are the trends in life history traits, such as fecundity, survival, and recruitment?* and *What are the annual rates of population change?* To address the second broad question, hypotheses about range-wide factors, such as habitat, climate, and invasive species, are addressed in the meta-analysis, especially those factors previously identified as threats to population recovery (e.g., Dugger et al., 2016; Forsman et al., 2011). Threats to NSO populations have changed since the first several meta-analyses (Table 1) with habitat loss and fragmentation considered the primary threats in the 1980s and 1990s (U. S. Fish and Wildlife Service, 1990). Since the adoption of the NWFP, timber harvesting declined on federal lands, which slowed the threat of alteration and removal of suitable forest for NSO on federal lands. Concurrently, barred owls (*Strix varia*; BO) from the eastern U. S. began expanding their distribution and increasing in numbers throughout the Pacific Northwest (Kelly et al., 2003; Long and Wolfe, 2019). In the last two decades, BOs have been considered a primary threat to NSO populations (U. S. Fish and Wildlife Service, 2011, 2020), through both interference and exploitative competition (Lesmeister et al., 2018; Van Lanen et al., 2011; Wiens et al., 2014). Relative to NSO, congeneric BOs are larger, use smaller home ranges, and have a broader (generalist) diet that includes numerous small mammalian prey important to NSO (Gutiérrez et al., 2007; Hamer et al., 2001; Wiens et al., 2014). BOs are also behaviorally dominant to NSO during territorial confrontations (Van Lanen et al., 2011), and where the two species co-occur they exhibit a high degree of overlap in patterns of habitat selection at nesting sites and foraging areas (Long and Wolfe, 2019; Wiens et al., 2014). This combination of exploitation and interference competition, coupled with rapidly increasing numbers of BOs in older forests throughout the Pacific Northwest, has exacerbated NSO population declines historically triggered by habitat loss.

In the last meta-analysis, BOs were identified as a primary influence negatively affecting life history traits, territory occupancy rates, and, ultimately, rates of population change in NSOs (Dugger et al., 2016). Recently, the U.S. Fish and Wildlife Service determined that the NSO was warranted for uplisting to endangered, but this re-classification was precluded by other higher priority listings (U. S. Fish and Wildlife Service, 2020). This, coupled with the recent elimination of 14,050 km^2 of critical habitat for the NSO (U. S. Fish and Wildlife Service, 2021), makes it imperative to understand current population trends and the factors affecting those trends for this species.

The meta-analysis presented here follows the same general guidelines as preceding meta-analyses on NSO populations to objectively evaluate trends in population parameters and competing hypotheses representing different effects that can influence those trends (Anderson et al., 1999). We used rigorous analytical methods, such as random effects, and approaches that accounted for imperfect detectability, such as capture-recapture and occupancy modeling. In keeping with previous meta-analyses, we also incorporated recent innovations in statistical analyses to provide a rigorous analytical approach.

Table 1
History of meta-analyses to estimate range-wide population trends in northern spotted owls.

Year	No. of study areas	No. of participants[a]	Source
1991	5	12	Anderson and Burnham (1992)
1993	14	47	Forsman et al. (1996b)
1998	15	44	Franklin et al. (1999)
2004	14	44	Anthony et al. (2006)
2009	11	43	Forsman et al. (2011)
2014	11	38	Dugger et al. (2016)
2020	11	40	Current study

[a] Number of participants at the analytical workshops.

2. Methods

2.1. Study areas

We used 11 study areas where demographic data were collected on

NSOs (3 in Washington, 5 in Oregon, and 3 in California) through 2018 (Table 2, Fig. 1). Although the duration of these studies ranged from 27 to 34 years, we used 1993 as the starting year for all the study areas because it provided a common time period for analyses and allowed for comparisons among study areas that began in different years (Fig. 2; 26 years: 1993–2018). Eight of the 11 study areas (OLY, CLE, COA, HJA, TYE, KLA, CAS, NWC) were part of the NWFP Effectiveness Monitoring Program (Lint et al., 1999). Of these eight study areas, the OLY, HJA, CAS, and NWC study areas were primarily on federal public lands while the CLE, COA, TYE, and KLA study areas were on a mixture of federal and private lands. The 3 study areas not included in the NWFP Monitoring Program were on lands owned by Green Diamond Resource Company (GDR) and the Hoopa Tribe Reservation (HUP), both in California. Also, the RAI study area in Washington included lands managed by Weyerhaeuser Company, the National Park Service, the U.S. Forest Service, and Hancock Forest Management. The study areas were large (356–3922 km^2; Table 2) and were distributed across the range of the NSO, which encompassed different climatic, topographic, vegetative, and elevation regimes (Fig. 1, Table 2; see Anthony et al. (2006) for study area details). Since the last meta-analysis (Dugger et al., 2016), the CAS study area was reduced from 3377 to 2372 km^2 because areas surveyed for spotted owls by the Bureau of Land Management (BLM) and National Park Service (NPS) were reduced or discontinued after 2013 and subsequently eliminated from the CAS data. Thus, the CAS data were reduced in spatial and temporal scope during this current meta-analysis. In addition, Green Diamond Resource Company discontinued monitoring spotted owls on 100 km^2 of the GDR study area since the last meta-analysis, which eliminated about 30 NSO territories that were included in the previous meta-analysis. For the analyses described below, we included the data associated with those owls and territories until monitoring was discontinued.

The 11 study areas in our analysis were not selected randomly (see Anthony et al., 2006; Dugger et al., 2016; Forsman et al., 2011; Franklin et al., 1996), but this collection of study areas sampled most of the geographic provinces within the range of the NSO (Fig. 1, Table 2). Combined, these study areas covered about 8% (18,683 km^2/230,690 km^2) of the range of the NSO, and the percentages of suitable NSO habitat on the study areas were similar to those of the surrounding landscape of federal lands (Appendix F in Anthony et al., 2006). These three lines of evidence suggest that habitat conditions within the study areas on federal lands were representative of forest and general conditions on federal lands within the geographic range of the owl. The GDR and HUP were on non-federal lands, where forests were actively managed while maintaining protections for NSOs and their forested habitat.

Since the last meta-analysis (Dugger et al., 2016), active BO removals occurred on portions of the CLE, COA, and HUP study areas as part of a removal experiment estimating the effects of BOs on NSO populations (U. S. Fish and Wildlife Service, 2013; Wiens et al., 2019, 2020). BO removals occurred on the GDR study area from 2009–2014. Data from areas where BOs were removed were censored from our meta-analysis beginning in the year of first removal and including all subsequent years, regardless of whether removals were later discontinued (e.g., GDR; Fig. 2). BOs were removed over the entire HUP study area starting in late 2013, so NSO demographic data collected from 2014–2018 were not included in our analyses (Fig. 2). Both CLE and COA were split into control and removal areas starting in 2016 (Fig. 2). While both control and removal areas were surveyed for BOs and NSOs in 2016–2018, only the control portions of these study areas were included in the meta-analysis, with a study area contraction starting the first field season after removals began. The area of the GDR involved in a BO removal experiment from 2009–2014 (Diller et al., 2016) was excluded from analyses after 2009 to remove any possible carryover effects from BO removals (Fig. 2). We excluded areas with BO removal from our meta-analysis because 1) our goal was to examine population trends in NSO for the NWFP monitoring program without experimental manipulations, and 2) analyses specific to the effects of BO removal on NSO populations are presented elsewhere (Wiens et al., 2021).

Within each study area, NSO territories were delineated using Thiessen polygons, which were defined as "*a landscape patch that represented the cumulative area of use by an owl, or pair of owls, during the study period*" (Dugger et al., 2016). Thiessen polygons were delineated around each territory using the total number of annual locations of owls collected across all years, which were prioritized based on nests, fledged young, roosts, and, rarely, nocturnal detections (see Field methods section). Thus, Thiessen polygons were static for the study period of 1993–2018 (i.e., did not change from year to year). Within each study area, Thiessen polygons were used to define range-wide covariates at the territory scale, summarize data for territory occupancy-based analyses, and merged to form boundaries for the development of covariates at the study area scale (Fig. 3).

2.2. Meta-analysis format

We followed the philosophy and protocols of previous meta-analyses of NSO demographic data (Anderson and Burnham, 1992; Anthony et al., 2006; Dugger et al., 2016; Forsman et al., 2011; Forsman et al., 1996b; Franklin et al., 1999). Although we followed the protocol established by Anderson et al. (1999), the structure of the meta-analysis described here differed from the previous efforts in that the analysis was not completed in a 7–10 day in-person workshop because the complexity of the data and analyses had grown beyond what could be completed

Table 2
Characteristics of 11 study areas used to study demography of northern spotted owls from 1993 through 2018 in Washington, Oregon and California, USA.

Study area	Acronym	Area (km^2)	Number banded S2 and adult owls	Landowner	Ecological region	Mean annual precipitation (cm)
Washington						
Cle Elum	CLE	1784	218	Mixed	WA mixed conifer	136
Rainier	RAI	2167	194	Mixed	WA Douglas-fir	215
Olympic	OLY	2230	377	Federal	WA Douglas-fir	282
Oregon						
Coast Ranges	COA	3922	580	Mixed	OR coastal Douglas-fir	212
H.J. Andrews	HJA	1604	690	Federal	OR Cascades Douglas-fir	201
Tyee	TYE	1026	426	Mixed	OR coastal Douglas-fir	126
Klamath	KLA	1422	630	Mixed	OR-CA mixed conifer	116
South Cascades	CAS	2372[a]	555	Federal	OR Cascades Douglas-fir	119
California						
NW California	NWC	460	459	Federal	OR-CA mixed conifer	154
Hoopa	HUP	356	234	Tribal	OR-CA mixed conifer	176
Green Diamond Resources	GDR	1340	803	Private	CA coast	187
Totals		18,683	5166			

[a] Study area size was 3377 km^2 in 2014 meta-analysis.

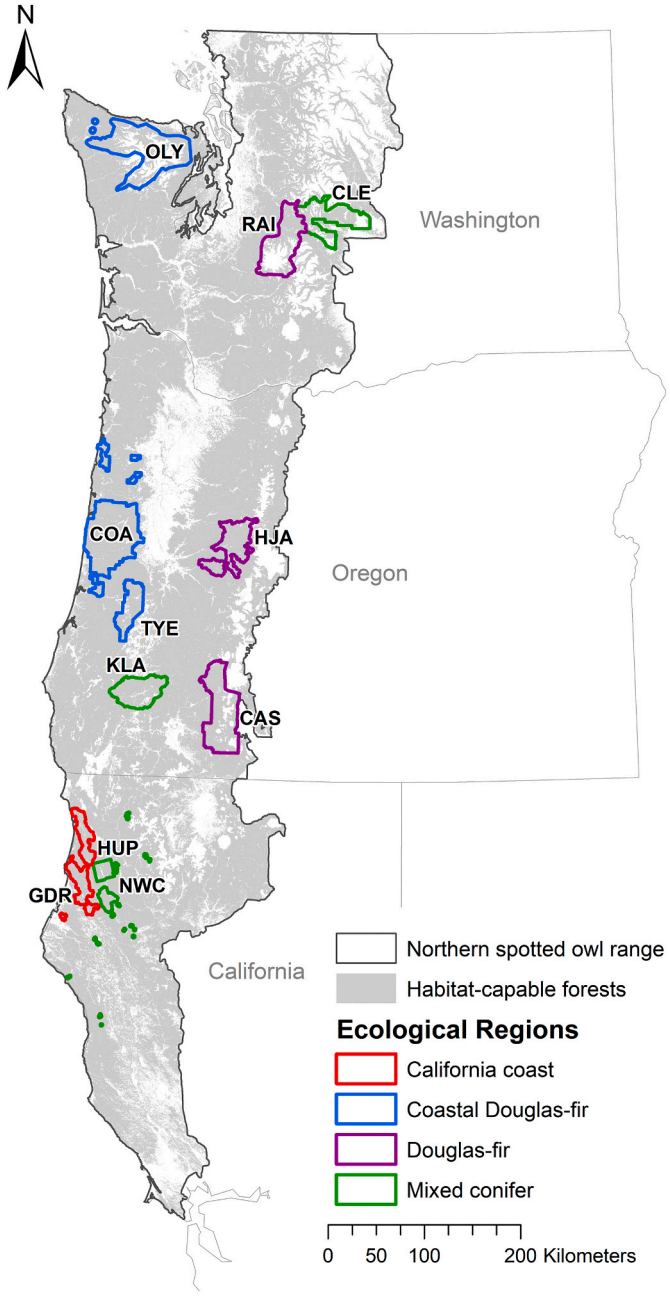

Fig. 1. Location of 11 study areas used in the northern spotted owl demographic meta-analysis.

within the short time frame of previous workshops. Rather, we structured this meta-analysis with an introductory workshop where all participants gathered to decide on the research questions of interest and how data would be analyzed. A written protocol describing each analysis was developed (Appendix A), and participants separated into working groups that subsequently analyzed data remotely. Several months later, we held a series of webinars where participants reviewed and commented on results from the working groups, ultimately resulting in the final synthesis of results (see Fig. 1 in Appendix A Supplementary Materials). Data combined across all study areas in a meta-analysis framework provided more power to evaluate trends and identify important associations between environmental factors and NSO demographics.

We analyzed fecundity from reproductive survey data, and apparent survival, recruitment rates, and rates of population change from capture-recapture data. We also analyzed detection/non-detection data for both NSOs and BOs using two-species occupancy models to estimate occupancy, local extinction rates, and colonization rates of NSO territories for both species. We used a random effects approach for all analyses except the occupancy analysis and used an information-theoretic approach for model selection and inference.

2.3. Field methods

Field methods were similar across all study areas and have been described in detail elsewhere (Appendix B in Dugger et al., 2016; Franklin et al., 1996; Reid et al., 1999). Study areas were surveyed for NSOs each year to locate territorial individuals, which were initially captured and banded with a uniquely numbered USGS aluminum band and a unique color-band combination (Forsman et al., 1996a). Banded owls were subsequently identified as individuals by re-sighting color-band combinations. Each year, reproductive output of individuals was determined using established methods (Franklin et al., 1996) where the number of fledged young (including 0 young) was estimated. The surveys of study areas were designed to estimate whether individuals were present and, if so, their unique identity and how many young they fledged. NSOs are strongly territorial, have high site fidelity, and are detectable even when they are not breeding (Franklin et al., 1996; Reid et al., 1999). Thus, we assumed that the birds sampled during an entire breeding season were not biased towards those that reproduced, and that the sample of owls used in our analyses was representative of the territorial population on the study areas. Owls that were visually detected were assigned to 1 of 3 discrete age classes based on their plumage characteristics when first captured as a territorial bird (S1 = 1-year old, S2 = 2-year old, Adults $\geq$ 3 years old) (Forsman, 1981; Franklin et al., 1996; Moen et al., 1991).

2.4. Development of range-wide covariates

We developed range-wide covariates to incorporate in the meta-analysis that reflected extrinsic factors previously associated with NSO demographics. These covariates included ecological region, reproductive effort, BO presence, climate descriptors, habitat components, and disturbance to habitat components (Table 3, Appendix B). We generated estimates of annual reproductive effort (R) from the analysis of fecundity (see below), which was used solely in the subsequent analysis of rates of population change. BO, climate, and habitat covariates are described in more detail in Appendix B and summarized in Table 3.

2.5. Analytical approach

Our meta-analysis differed from the previous meta-analyses in that we did not conduct analyses on individual study areas. Instead, study areas were treated as one level of sampling unit, with estimates and evaluation of covariate effects conducted in meta-analyses with data from all study areas combined.

We used random effects in two different analyses. First, to assess annual process variation, the method-of-moments random effects approach (Burnham, 2019; Burnham and White, 2002; Appendix F in Dugger et al., 2016; Forsman et al., 2011; Franklin et al., 2002) was used to examine trends in annual survival, fecundity, recruitment, and rates of population change of NSOs and associations between these vital rates and the covariates described above. In this random effects approach, process variation (σ^2) is treated as the conceptual unexplained ("random") variation in the true, unknown, set of parameters, such as annual survival, which is considered a random variable rather than a fixed constant. The random effects approach correctly uses the maximum-likelihood estimates for inference on structural parameters in population-level models while also being robust to over-dispersion (Appendix F in Dugger et al., 2016). The random effects here were the annual estimates of parameters within study areas. A second random

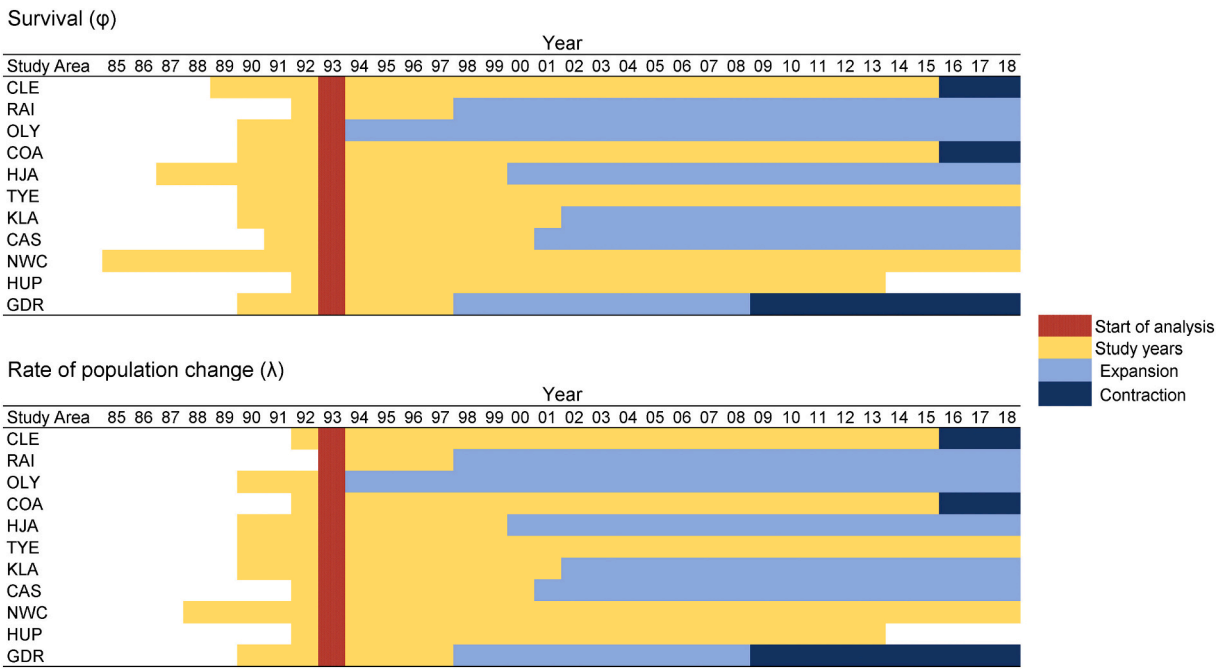

Fig. 2. Timelines for analyses of northern spotted owl demographic parameters on 11 study areas showing expansions (blue) and contractions (black). Brown line indicates common start year across all study areas for all analyses. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

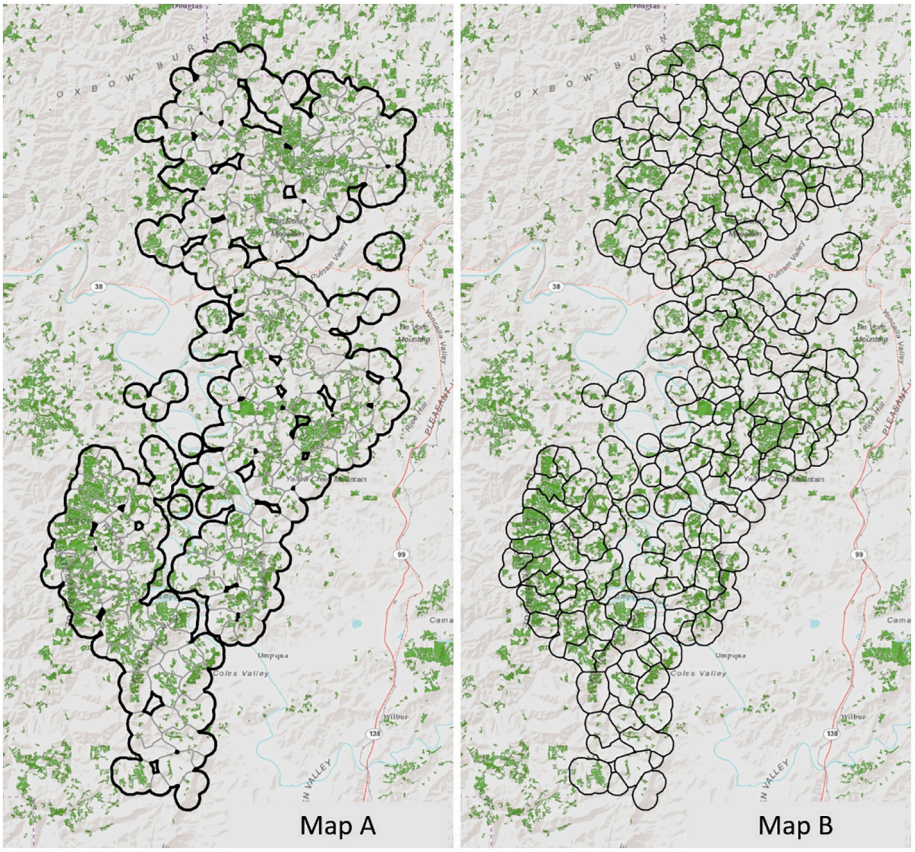

Fig. 3. Examples of study area (Map A) and territory (Thiessen polygon) scales (Map B) used to calculate covariates. Study area scales in Map A were generated from the fusion of Thiessen polygons in Map B. For fecundity, survival, and rates of population analyses, study-area scales (Map A) were used to generate covariates while for the occupancy analyses, territory scales (Map B) were used to generate territory-specific covariates.

Table 3
Definitions of covariates used in meta-analyses of northern spotted owl (NSO) demographic data from 1993–2018.

Covariate	Acronym	Description
Spatial		
Study area	AREA	Individual study area (see acronyms in Table 2)
Ecological region	ECO	Ecological region categories which incorporated geographic location (state) and major forest type, to which each study area was assigned: • WA Douglas Fir (RAI, OLY) • WA Mixed-Conifer (CLE) • OR Coastal Douglas Fir (COA, TYE) • OR Cascade Douglas Fir (HJA, CAS) • OR/CA Mixed-Conifer (KLA, NWC, HUP) • CA Coast (GDR)
Temporal		
Year	YEAR	Year when surveys and sampling occurred
Linear time trends	T	Year as a continuous linear variable, such as 1 = 1993, 2 = 1994, etc.
Quadratic time trends	TT	Year as continuous quadratic variable with T and T^2.
Even-odd year trend	EO	Year as a categorical variable to indicate oscillating time trends, where 1993 = 1 (Odd), 1994 = 0 (Even), 1995 = 1 (Odd), etc.
Spline time trends	SPLINE	A 7-df cubic spline time model with four interior nodes spaced 5 years apart.
Autoregression trend	AR1	Autoregression covariance structure on residuals of year, with a lag of 1 year.
Climate		
Pacific decadal oscillation	PDO	Mean of monthly values over the year (June–June) for sea level pressure at Tahiti minus sea level pressure at Darwin, Australia divided by SD of that quantity (http://research.jisao.washington.edu/pdo/pdo.latest).
Southern oscillation index	SOI	Mean of monthly values over the year (June–June) for the spatial average of monthly sea surface temperatures of the Pacific Ocean north of 20° N (https://www.cpc.ncep.noaa.gov/data/indices/soi).
Winter minimum temperature	WMT	Annual mean minimum monthly temperature (°C), as a spatial average of all values within the boundaries of each study area, from PRISM data (https://prism.oregonstate.edu/explorer/) for the months November–February.
Winter precipitation	WP	Annual total precipitation (cm), as a spatial average of all values within the boundaries of each study area, from PRISM data (https://prism.oregonstate.edu/explorer/) for the months November–February.
Miscellaneous		
Barred owl	BO	Annual estimate that a spotted owl territory (defined by Thiessen polygons) is occupied by ≥1 barred owls as estimated from a single species occupancy model.
Reproductive effort	R	Annual mean number of young fledged per female (NYF) generated from the fecundity analysis.
Sex	SEX	Sex of individual owls
Northern spotted owl habitat components[a]		
Suitable habitat without recruitment (proportion)	HABp	Annual proportion of the forest cover type used by NSOs for nesting and roosting in each study area each year, which included only losses and did not include recruitment of the forest cover type. This is the same covariate as used in Dugger et al. (2016). Used in the study area analyses.
Suitable habitat without recruitment (amount)	HABa	Annual amount (ha) of the forest cover type used by NSOs for nesting and roosting in each spotted owl territory each year, which included only losses and did not include recruitment of the forest cover type. This is the same covariate as used in Dugger et al. (2016). Used in the territory within study area analyses.
Relative habitat suitability (index)	RHS	Annual index representing a structural/composition gradient of forest cover. Index ranges from 0–1, with lower values having forest cover dissimilar to what NSOs use to nest and roost in, while higher values have higher degree of similarity to nesting/roosting cover type (Davis et al., 2016). Calculated as a mean value for study area or territory and includes recruitment of cover types used by NSOs for nesting and roosting
Edge (proportion)	EDGEp	Annual proportion of nesting/roosting cover type that occurs along 30 m wide edges of nesting/roosting cover patches or is contiguous with a patch and interfused with other cover types. Used in the analyses specific to study areas.
Edge (amount)	EDGEa	Annual amount (ha) of nesting/roosting cover type that occurs along 30 m wide edges of nesting/roosting cover patches or is contiguous with a patch and interfused with other cover types. Used in the territory-specific analyses.
Moderate-high disturbance (proportion)	DISThi-p	Annual proportion of moderate to high severity forest disturbance in each study area during the 3-yr interval prior to each survey year.
Moderate-high disturbance (amount)	DISThi-a	Annual amount (ha) of moderate to high severity forest disturbance in each spotted owl territory during the 3-yr interval prior to each survey year.
Low disturbance (proportion)	DISTlo-p	Annual proportion of low severity forest disturbance in each study area during the 3-yr interval prior to each survey year.
Low disturbance (amount)	DISTlo-a	Annual amount (ha) of low severity forest disturbance in each spotted owl territory during the 3-yr interval prior to each survey year.
Barred owl habitat components		
Elevation of NSO territory	ELEV	Mean elevation of forest capable pixels within NSO Thiessen polygons.
Topographic position index of NSO territory	TPI	Mean topographic position index of NSO Thiessen polygons based on the relationship between the elevation of the center pixel and mean elevation of the surrounding pixels for varying radii. Positive numbers indicate higher slope positions and ridge tops, negative index numbers indicate lower slope positions and valley bottoms.

[a] All habitat component covariates are calculated within forest capable lands.

effects analysis was a mixed model approach to construct models of individual heterogeneity of detection probabilities (p) (Gimenez and Choquet, 2010). Variance across individuals in p was estimated as σ_p.

We used an information-theoretic approach (Burnham and Anderson, 2002) and Akaike's information criterion corrected for small sample sizes (AIC_c) to determine the best model(s) from a priori model sets generated for each analysis. We generally selected the model with the lowest AIC or AIC_c values and highest Akaike weights as our best model, but other models with similar Akaike weights were considered competitive (Burnham and Anderson 2002). When evaluating models, we also examined $-2\ln L$ or deviance values to ensure that ΔAIC_c values were not solely the result of adding an additional, uninformative covariate (Arnold, 2010). We evaluated the strength of evidence for specific effects in competing models based on the degree to which 95% confidence intervals (95% CIs) for slope coefficients (β's) overlapped zero (Forsman et al., 2011). Covariates that occurred in competitive models with 95% CIs that did not overlap zero were considered to provide the strongest evidence of an effect. Covariates in competitive models with 95% CIs that overlapped zero with <10% of the interval ("slightly" overlapping) were considered to have less evidence of an effect compared to covariates with CIs that did not overlap zero. Covariates with confidence limits with >10% of the interval above or below zero ("widely" overlapping) were considered to have little support for the importance of the effect.

2.6. Analysis of fecundity

We analyzed only data for adult (≥3-years old) NSOs because fecundity estimated for younger birds from previous analyses (e.g., Dugger et al., 2016) was much lower than fecundity of adult owls and there were very few birds that bred as S1 or S2 owls. The effect of individual owl and NSO territory were very small (Dugger et al., 2016), so we ignored those effects. To be consistent with previous meta-analyses, we analyzed the number of young produced per territorial female per year (NY) as fecundity, which was calculated as NYF = NY/2 because the sex ratio of juvenile owls at hatching was approximately 1:1 (Franklin et al., 2020).

We used the annual means for each study area as the basis for analysis in a mixed-model regression with PROC MIXED in SAS (SAS Institute Inc., 2015). This weighted all years equally regardless of the number of owls sampled within a year. For each site, the models were of the form:

$$\overline{F} = f(\text{covariates})$$

(using a standard model notation) where $\overline{F}$ was the average fecundity for a study area within a year and f(covariates) depended on the model in the model set. The use of a linear model on the yearly averages rather than a generalized linear mixed model on the individual fecundity values follows McDonald and White (2010). Analyzing the mean fecundity also makes the study area-year the experimental unit (matching the level of the covariates) and avoids the need to include a random year-effect in a generalized linear mixed model to account for year-specific effects not captured by the covariates that operate on all birds on a study area-year simultaneously.

We developed an a priori model set (see protocol in Appendix A) and used a linear mixed model approach to investigate patterns of variation and hypothesized relationships between time trends and covariates with NYF. Time-trend models included annual time variation (YEAR), and linear (T), quadratic (TT), even-odd (EO), and spline (SPLINE) trends in annual NYF (Table 3). The EO trend hypothesized that years of high NYF alternated with years of low NYF but required consistent changes in NYF, which may be unrealistic. Therefore, we also fit a model where annual fluctuations in NYF around the long-term average followed an autoregressive 1-year lag process (AR1) as a covariance structure. In this model, a strict EO process was relaxed to allow longer or irregular increases and decreases in NYF. Additional models included the BO and ECO covariates, the HABp, RHS, DISThi-p, DISTlo-p, DISTtot, and EDGEp covariates, and the PDO and SOI climate covariates (Table 3). Because PDO and SOI were correlated ($r = -0.74$), these two covariates did not appear together in the same model. In addition, we removed models with high collinearity, where covariates had substantial covariances.

2.7. Analysis of apparent survival

We used the capture-recapture data and Cormack-Jolly-Seber open population capture-recapture models (Lebreton et al., 1992) in program MARK (White and Burnham, 1999) to estimate capture probabilities (p) and annual apparent survival probabilities (ϕ) of territorial, second-year subadult (S2) and adult (A) owls combined, where apparent survival rate was the probability that a bird in the sampled population of territory holders during sampling in year t was alive and present as a territory holder in year t+1. Following Dugger et al. (2016), captures of first-year subadults (S1) were not included because data for S1 owls were generally sparse, and S1 individuals were more likely to emigrate from study areas (Forsman et al., 2002). Annual estimates of survival were estimated roughly from 15 June in year t to 14 June in year t+1, which was the approximate mid-point of the annual field season during which capture-recapture data were collected from March through August (Dugger et al., 2016). In keeping with previous meta-analyses on NSO demographics (Dugger et al., 2016; Forsman et al., 2011), we did not estimate juvenile survival rates because high rates of permanent emigration of juvenile NSOs negatively bias estimates of apparent survival for juveniles (Burnham et al., 1996). We assumed no extra-binomial variation (overdispersion) in ϕ; we used $\hat{c} = 1$ because this was very close to the mean $\hat{c}$ across all study areas in previous analyses (Anthony et al., 2006; Dugger et al., 2016; Forsman et al., 2011). In addition, regression inferences about covariate effects on parameters such as ϕ and λ are robust to over-dispersion when random effects models are used (Burnham and White, 2002).

Similar to Dugger et al. (2016), we used a hierarchical strategy to develop model sets, (Doherty et al., 2012). We first modeled detection probabilities (p) to determine the best structure on p. We examined interactive combinations of SEX, AREA, and YEAR on p while using two structures on ϕ, ϕ(SEX*AREA*YEAR) and ϕ(AREA*YEAR). We also included an additive random effect of individual heterogeneity (σ_p) on p (Gimenez and Choquet, 2010), while fixing a constant σ_ϕ to zero ($\sigma_\phi(.) = 0$) because the original model of Gimenez and Choquet (2010) included ϕ. In doing so, we assumed most of the individual heterogeneity was in p and little heterogeneity was in ϕ. One issue in incorporating σ_p to model p is that these models require considerable optimization time (>24 h), particularly given that the default in program MARK for these models is to use 101 nodes for the Gauss-Hermite numerical integration. To reduce this optimization time, we reduced the number of nodes for integration to 15. This only had a reduction of <0.002% on the value of $-2\log L$. Therefore, the random effects models considered here were based on 15 nodes in program MARK. Although only 12 models were initially specified in the meta-analysis protocol (Appendix A), additional intermediate models were required to provide starting values for the more complex initial models. Of this set of models, the model with the lowest AIC_c provided the structure on p used in further modeling ϕ.

After selecting an appropriate structure for p, we then ran random effects models on ϕ in Program MARK (White et al., 2001) to investigate the effect of covariates and time trends on apparent survival, always excluding the last confounded estimate of survival (ϕ_{K-1}) (Burnham, 2019; Burnham and White, 2002). In the meta-analysis of survival, we included AREA and BO effects, T and SPLINE as time effects, PDO and SOI as regional climate effects, and HABp, RHS, DISThi-p, DISTlo-p, DISTtot, and EDGEp as effects of different habitat components (Table 3).

Estimates and model selection results were generated using the Method of Moments random effects module in Program MARK (White and Burnham, 1999) from a fixed effect global model, which was either the ϕ(SEX*AREA*YEAR) or ϕ(AREA*YEAR) model that was selected during the initial modeling of p.

2.8. Annual rates of population change

We estimated the annual finite rate of population change (λ) across all the study areas using the temporal symmetry modeling approach of Pradel (1996), as implemented in program MARK (Franklin, 2001; White and Burnham, 1999) using RMark (Laake, 2013). Expansions or contractions of areas surveyed on some study areas (Fig. 2) were dealt with through changes in the design matrix (see Appendix C), such that all study areas had estimates of λ that reflected changes in owl numbers that were not confounded with changes in areas sampled or with BO removal experiments. We used all territorial S2 and adult birds, combined and treated as a single age class. Data from 1993 through 2018 were used for all study areas except HUP, for which data extended only through 2013 when BO removals began over the entire study area.

Initial modeling retained general structures for apparent survival, ϕ(AREA*YEAR), and recruitment rate, f(AREA*YEAR), and focused on obtaining a good structure for capture probability, p. Recruitment rate was defined as the expected number of new owls in the territorial population in the sampling period of year t+1 per owl in the territorial population in the sampling period of year t. Four different structures for capture probability were tested: p(AREA*YEAR), p(YEAR), σ_p(.) p(.), and σ_p(.) p(AREA*YEAR). The σ_p(.) p(.) structure models capture probability among individuals as a random effect. This model assumed a common distribution of capture probabilities for all individuals across all study areas and years, with the σ notation indicating the standard deviation of the capture distribution on the logit scale (Gimenez and Choquet, 2010). The σ_p(.) p(AREA*YEAR) structure again modeled capture probability among individuals as a random effect, permitting heterogeneity that was characterized by a different distribution for each area during each year.

Using the selected model for capture probability, and retaining the general model structure for survival and recruitment, we estimated $\lambda_{a,t}$ (where a denotes AREA and t is YEAR) as a derived parameter:

$$\widehat{\lambda}_{a,t} = \widehat{\phi}_{a,t} + \widehat{f}_{a,t}$$

For general models with time-specific capture and survival probabilities, the first and last estimates of rate of population change (λ_1, λ_{k-1}) are confounded with other parameters, and the 2nd estimate (λ_2) is frequently biased (Hines and Nichols, 2002). Thus, we present no estimates of λ for 1993, 1994 or 2017. As a summary statistic characterizing the entire study period, we computed the geometric mean of the estimated annual rates of λ for each study area. Standard errors for the geometric mean summary statistics, and, thus, approximate 95% confidence intervals, were computed based on the variance-covariance matrix of the survival and recruitment parameter estimates with the delta method.

Based on the general model used to estimate λ, we then developed models for recruitment rate using a random effects approach based on the fixed effect model, ϕ(AREA*YEAR) f(AREA*YEAR) σ_p(.) p(AREA*YEAR). The random effects approach postulates a distribution of recruitment rates that is characterized with a different mean for each AREA*YEAR combination, but equal variances across all years and areas. The different means are based on linear-logistic models using the covariates that correspond to the specific area and year. These models were designed to test the relevance of a set of covariates to recruitment rate (see protocol in Appendix A). These covariates (Table 3) for $f_{a,t}$ included BO (predicted lower recruitment in years with higher BO occupancy), R lagged by one year (predicted to be positively associated with recruitment rate because NSO can acquire a breeding territory at the end of their first year), HABp (predicted to be positively associated with recruitment), EDGEp (expected to have variable effects), DISThi-p and DISTlo-p (hypothesized to be negatively associated with recruitment rate), WMT and WP (predicted to have negative effects on recruitment rate), and PDO (predicted to positively influence recruitment rate) (Dugger et al., 2016).

We used the methods described in Franklin et al. (2004), to convert estimates of λ_t to estimates of realized population change ($\widehat{\Delta}_t$). This method provides a visual portrayal of the population trajectory ($\Delta_t = N_t/N_x$) in each year (N_t) of the study relative to population size in the first year (N_x) that λ_t was estimated. Annual estimates of realized population change ($\widehat{\Delta}_t$) on each study area were computed as:

$$\widehat{\Delta}_t = \prod_{i=x}^{t-1} \widehat{\lambda}_i$$

Approximate 95% confidence intervals for the estimates of realized population change were computed using a parametric bootstrap that incorporated both sampling variation of the parameter estimates and demographic stochasticity characterizing the birth-death process of population dynamics (see Appendix C for details).

2.9. Analysis of two-species occupancy

The co-occurrence dynamics of NSOs and BOs were based on 26 years of detection/non-detection data for both species (1993–2018) in 10 study areas and 21 years of detection data in the HUP study area (1993–2013). In 3 study areas (CLE, COA, and GDR) the number of monitored territories declined in recent years because we excluded data from territories where BOs were removed during the removal period. Sampling periods occurred from 1 March through 31 August each year and each sampling period was divided into 12 subsampling occasions corresponding to the first and second half of each month. We created detection histories that signified whether 1) no owls were detected, 2) BOs only were detected, 3) NSOs only were detected, or 4) both species were detected in each subsampling occasion in each year and in each study area. We applied these data to the multi-season (robust design) extension of the conditional, 2-species occupancy model (MacKenzie et al., 2018) following (Yackulic et al., 2014) and (Dugger et al., 2016) and used program R-PRESENCE (https://www.mbr-pwrc.usgs.gov/software/presence.html) to estimate occupancy parameters and model selection results. We did not use any random effects to model NSO occupancy dynamics using two-species occupancy modeling because of the complexity of the analysis and the extent of the data.

Model parameters included initial occupancy (ψ_1), colonization (γ_i), extinction (ε_i), and detection probabilities (p_{ij}) for both species as potential functions of presence of the other species. For initial occupancy, we used the parameterization of Richmond et al. (2010) and assumed that BOs were the dominant species (coded as "A") and that the NSO was the subordinate species (coded as "B"). The primary parameters of interest were: (1) initial probability of occupancy by NSOs when BOs were absent (ψ_1^B) and when BOs were present (ψ_1^{BA}), (2) the probability that a territory unoccupied by a NSO in year i was occupied by a NSO the following year (i.e. colonization) when BOs were present (γ_i^{BA}) and when BOs were absent (γ_i^B), (3) the probability that a territory occupied by a NSO in year i was unoccupied the following year (i.e. local extinction) when BOs were present (ε_i^{BA}) and when BOs were absent (ε_i^B), and (4) annual probability of territory occupancy by NSOs when BOs were present (ψ_i^{BA}) and when BOs were absent (ψ_i^B), which was derived using the best-supported model structure for detection, extinction, and colonization rates using a forward conditional approach (Yackulic et al., 2020). While of secondary importance, we also examined patterns in occupancy, colonization, and extinction probabilities for BOs.

Given the large number of parameters and hypothesized structures, we defined a fixed structure for detection of both species informed by past studies. Specifically, each species was allowed to have study area-specific seasonal variation in detection described by a quadratic

Table 4
Modeling stages used in strategy to model two-species occupancy dynamics of northern spotted and barred owls on 11 study areas in Washington, Oregon, and California from 1993–2018.

Stage	Modeling description
1	Interspecific interactions on dynamic rates (i.e., colonization and extinction) of both species.
2	Species-specific covariates of habitat components on initial occupancy and dynamic rates of both species (HABa and RHS for spotted owls, and ELEV and TPI for barred owls).
3	Trend effects on colonization and extinction of both species, as well as on barred owl detection as was commonly observed in past studies (e.g., Dugger et al., 2016).
4	Effects of two climate variables (SOI and PDO) on dynamic rates for both species.
5	All combinations based on models with ΔAIC <10 in the first 4 stages, excluding models with uninformative parameters (sensu Arnold, 2010).
6	Study area specific intercepts.
7	Study area specific climate effects.
8	Study area specific trends.
9	Study area specific effects of habitat components.
10	Study area specific interspecific interactions.

function, and an interspecific interaction effect and a trap response that was shared across study areas. We then employed a 'build-up' modeling strategy (Morin et al., 2020) to limit the number of models fit while identifying factors influencing the occupancy dynamics of the two owl species. Our build-up strategy consisted of five initial stages with no study area effects, followed by five stages in which we considered study area-specific responses. Specifically, our stages were defined by hypotheses, and each stage considered the top model from prior stages and all models with ΔAIC < 10 in stage 5 and all subsequent stages (Table 4). In all cases, we excluded models with uninformative parameters (Arnold, 2010).

3. Results

3.1. Fecundity

Estimates of fecundity were based on 11,117 observations of the number of young produced by territorial adult females. Estimation of spatial (territory), temporal (annual), and residual variance on the territory-specific data indicated that the proportion of variance in number of young fledged attributable to territories and/or individual owls was generally low (<5%; Table 5). The proportion of variance attributable to fluctuations over time was usually in the range of 6–25%, while the proportion of unexplained variation (residual) was generally very high (>74%; Table 5). Consequently, the explainable variation in fecundity by time and by territory was overwhelmed by unexplained, residual variation.

Table 5
Variance components (percent of total) of the number of young fledged by adult northern spotted owls from a mixed-model analysis of year- and territory-specific estimates. Spatial variability is the random effects estimate of territory variability and temporal variability is the random effects estimate of year variability.

Study area	Spatial	Temporal	Residual	Total estimate
Washington				
CLE[a]	3%	16%	80%	0.907
OLY	1%	24%	74%	0.466
RAI	0%	12%	87%	0.502
Oregon				
CAS	2%	21%	75%	0.766
COA[a]	2%	15%	81%	0.538
HJA	0%	21%	78%	0.716
KLA	2%	7%	90%	0.665
TYE	2%	13%	83%	0.631
California				
GDR	1%	6%	92%	0.645
HUP[a]	5%	11%	83%	0.603
NWC	0%	8%	91%	0.699

[a] Includes only territories where no barred owl removals took place.

Table 6
Model selection results from the 10 top-ranked models based on AIC_c for the meta-analysis of the number of young fledged by adult female northern spotted owls on 11 study areas in Washington, Oregon, and California from 1993–2018. Model selection results for all models are listed in Appendix D.

Model[a]	K[b]	$-2\ln L$	AIC_c	ΔAIC_c[c]	Akaike weights
ECO+BO+TT+EO+AR1	12	212.40	237.60	0.0	0.47
ECO+BO+T+EO+AR1	11	215.60	238.70	1.1	0.28
ECO+BO+EO+AR1	10	219.30	240.20	2.6	0.13
ECO+PDO+TT+EO+AR1	12	216.90	242.00	4.5	0.05
ECO+DISTlo-p+T+EO+AR1	11	221.80	244.80	7.2	0.01
ECO+DISTlo-p+TT+EO+AR1	12	220.50	245.70	8.1	0.01
ECO+DISTlo-p+SPLINE+AR1	16	211.80	245.90	8.3	0.01
ECO+TT+EO+AR1	11	224.20	247.20	9.7	0.00
ECO+T+EO+AR1	10	226.90	247.80	10.2	0.00
ECO+PDO+T+EO+AR1	11	224.90	247.90	10.3	0.00

[a] Model notation indicates structure for fixed effects of ecological region (ECO), linear time (T), quadratic time (TT), even-odd years (EO), barred owls (BO), Pacific Decadal Oscillation (PDO), spline time trends (SPLINE) and autoregressive effects of time lagged by 1 year (AR1) as a covariance structure.
[b] K = number of parameters in the model, including covariance parameters.
[c] ΔAIC_c = difference between the model listed and best AIC_c model.

The meta-analysis of fecundity produced three competitive models (Table 6). The best model included the additive fixed effects of ecological region (ECO), quadratic relationship of time (TT), BO, the even-odd effect (EO), and with a lagged auto-regressive covariance structure (AR1) (Table 6). In the meta-analysis, collinearity between BO and TT was not considered a problem because BO varied across years and study areas, but the annual trend was common for all study areas (e.g., some study areas had no BO and some had BO in the same year). The biennial pattern of high reproduction in even years and low reproduction in odd years seen in the previous analyses continued (Fig. 4a–c) for most study areas. In all cases, the estimated autocorrelation term is negative (Table 7) indicating that years with higher reproductive output tend to be followed by years with lower reproductive output.

The three models with highest support (Table 6) included the BO covariate and the estimates of the coefficient for the BO effect for these models were negative, similar in magnitude, and different from zero, based on 95% confidence intervals (Table 7), suggesting fecundity decreased with increased proportion of territories where BOs were detected. No covariates describing habitat components or climate were supported (Table 6, Appendix D). Thus, fecundity varied by time with an oscillating pattern, but in parallel across regions (Fig. 4d), with evidence for an additional BO effect. Average fecundity was substantially higher for the mixed-conifer region in Washington but similar for all other ecological regions (Fig. 5).

3.2. Apparent survival

In the first step to identify a base model for ϕ from which to run the random effects models, all the σ_p models that provided an individual random effect for p were ranked higher than the model without an individual random effect on p (Table 8), including even the simplest σ_p models (e.g., without year or study area effects). Within the models without an individual random effect on p, the top model was an additive model ϕ(AREA+YEAR) p(SEX+AREA+YEAR). However, this model was not appropriate for use in the random effects models for covariates because of the additive constraint. Therefore, the model ϕ(AREA*YEAR)

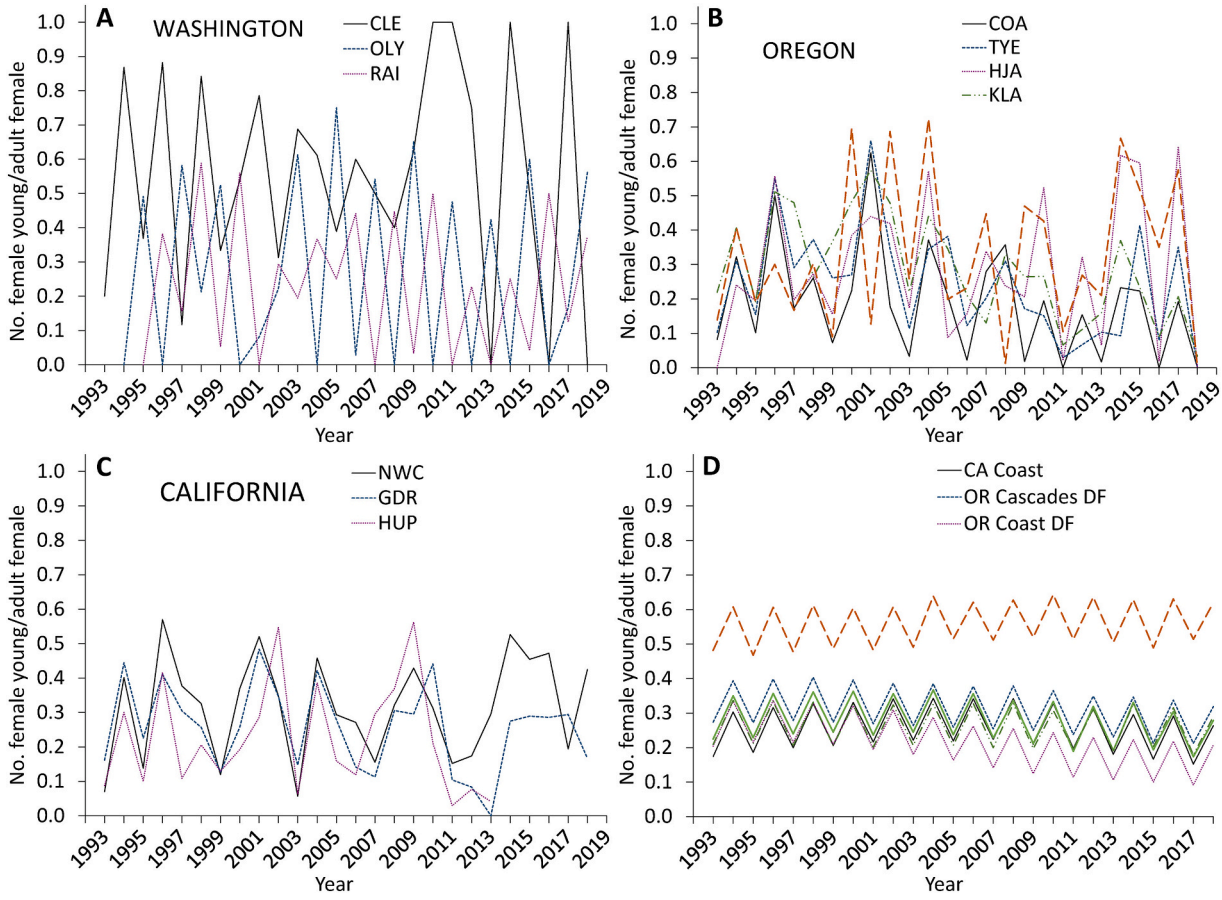

Fig. 4. Mean fecundity (mean number of young fledged per adult female) of northern spotted owls on 11 study areas. Raw estimates are shown for individual study areas in (A) Washington, (B) Oregon, and (C) California during 1993–2018. Top model ECO+BO+TT+EO+AR1 from the meta-analysis of mean fecundity is shown in (D).

Table 7

Parameter estimates ($\widehat{\beta}$) and 95% confidence intervals for fixed effects from the three top-ranked random effects models of fecundity for adult northern spotted owls on 11 study areas in Washington, Oregon, and California from 1993–2018.

Effect	Model 1[a]		Model 2		Model 3	
	$\widehat{\beta}$	95% CI	$\widehat{\beta}$	95% CI	$\widehat{\beta}$	95% CI
Intercept	1.419	1.274, 1.564	1.401	1.257, 1.545	1.349	1.213, 1.484
ECO (CACOA)[b]	−0.731	−0.894, −0.569	−0.728	−0.891, −0.566	−0.667	−0.818, −0.514
ECO (ORCAS)	−0.475	−0.602, −0.349	−0.476	−0.602, −0.350	−0.484	−0.612, −0.356
ECO (ORCOA)	−0.563	−0.707, −0.420	−0.566	−0.710, −0.423	−0.625	−0.758, −0.493
ECO (ORCAMC)	−0.578	−0.697, −0.457	−0.575	−0.695, −0.454	−0.568	−0.690, −0.446
ECO (WADF)	−0.468	−0.613, −0.323	−0.471	−0.616, −0.326	−0.533	−0.665, −0.400
ECO (WAMC)	–	–	–	–	–	–
BO	−0.595	−0.930, −0.260	−0.581	−0.915, −0.246	−0.294	−0.459, −0.130
T	0.016	0.004, 0.027	0.009	−0.001, 0.018	–	–
TT	−0.001	−0.001, 0.000	–	–	–	–
EO	−0.247	−0.372, −0.123	−0.248	−0.374, −0.121	−0.252	−0.377, −0.126
AR1[c]	−0.342	–	−0.350	–	−0.338	–

[a] Model 1 = ECO+BO+TT+EO+AR1; Model 2 = ECO+BO+T+EO+AR1; Model 3 = ECO+BO+EO+AR1.

[b] CACOA = California Coast; ORCAS = Oregon Cascades Douglas Fir; ORCOA = Oregon Coastal Douglas Fir; ORCAMC = Oregon/California Mixed Conifer; WADF = Washington Douglas Fir; WAMC = Washington Mixed Conifer.

[c] Covariance parameter.

$\sigma_p(.)$ p(AREA*YEAR) was used to generate the random effects models for covariates. The estimate of σ_p was 1.568 (SE = 0.057) on a logit scale, which demonstrated considerable individual variation in p (Fig. E1 in Appendix E). This estimate of σ_p was across all 11 study areas, while p was YEAR and AREA specific. Under the distribution in Fig. E1, the mean p on the real scale was 0.783 with 50% of the values >0.860, and a mode of 0.984. As the median value of p shifted towards 0.5, the distribution flattened out whereas, when the median p value shifted towards 1, the distribution became even more peaked.

The annual estimates of ϕ from model $\sigma_\phi(.) = 0$ ϕ(AREA*YEAR) $\sigma_p(.)$ p(AREA*YEAR) were used for the random effects models, except for 2017 where ϕ was confounded with p. In addition, data from 2013–2017 were removed for the HUP study area because BOs were removed from the entire study area during that period. Estimates from 2008 and 2013

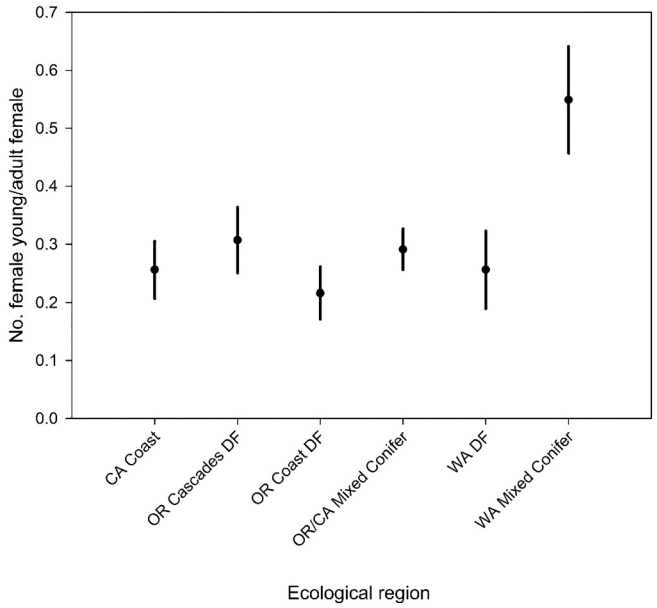

Fig. 5. Estimates of mean annual fecundity (number female young per adult female) of northern spotted owls for 6 ecological regions. Error bars are 95% confidence intervals.

for CLE and 2005 for OLY were also removed because the estimates were 1.0 with SE = 0 due to small sample sizes. In this situation, the zero standard errors would have forced shrinkage estimates to be 1, and hence no shrinkage would be allowed.

In the random effects models, the only covariate models that demonstrated any important AIC_c weight were SPLINE, T, and BO (Table 9). These 3 covariates were in all models that received any weight. None of the models with covariates just describing habitat components or climate contributed weight on their own, and these covariates only appeared in models that incorporated BO as part of the 4 additional models in the protocol that incorporated covariates with BO (Table 9). We did not include time trend effects, such as T and SPLINE, with the BO effect in the same model because all three covariates explained trends across years and were therefore correlated. While the models including T and SPLINE effects provided only trends, models with BO effects provided a potential mechanism that explained those trends. Thus, in the top 5 ranked models (Table 9), the models with the BO effect can be considered separately from the time trend models. In addition, we chose random effects model ϕ(AREA+BO) for inferences about the effects of BOs on apparent survival because it had a nearly identical AIC_c value with model ϕ(AREA+BO+SOI).

In the top-ranked random effects model ϕ(AREA+SPLINE), there was a period of gradual decline since 1993 that was followed by a notable steep decline in apparent survival after 2011 (Table 10, Fig. 6a). Based on random effects model ϕ(AREA+BO), there was also a strong negative effect of BO on apparent survival (BO) (Table 11, Fig. 6b). This varied by study area but only in the starting values of apparent survival in 1993; the trends were the same across all study areas because of the additive BO effect.

3.3. Annual rates of population change

Estimates of rates of population change (λ) were based on capture histories of 4429 S2 and adult birds marked and resighted from 1993 through 2018 on the 11 study areas. Our initial investigation of models for capture probability (p) provided strong evidence ($\Delta AIC > 100$) for models that included variation associated with year and study area, as well as heterogeneity among individuals within each area by year category (denoted as σ_p(.) p(AREA*YEAR), see below).

Table 8
Model selection results for base models used to select an appropriate structure on recapture probabilities (p) for the meta-analysis of apparent survival (ϕ) for northern spotted owls on 11 study areas in Washington, Oregon, California from 1993–2018.

Model[a]	K[b]	−2log$L$	AIC_c	ΔAIC_c[c]	Akaike weights
ϕ(AREA*YEAR), σ_p(.), p (AREA*YEAR)	530	39683.30	40765.54	0.00	1.00
ϕ(AREA*YEAR), σ_p(.), p (AREA)	287	40389.78	40970.25	204.70	0.00
ϕ(AREA*YEAR), σ_p(.), p (SEX*AREA)	298	40371.67	40974.65	209.11	0.00
ϕ(YEAR), σ_p(.), p(YEAR)	50	40967.76	41067.96	302.42	0.00
ϕ(AREA*YEAR), σ_p(.), p (SEX*AREA*YEAR)	800	39421.49	41072.67	307.13	0.00
ϕ(SEX+AREA*YEAR), σ_p(.), p (SEX*AREA*YEAR)	801	39420.79	41074.10	308.56	0.00
ϕ(AREA*YEAR), σ_p(.), p (YEAR)	296	40549.33	41148.22	382.68	0.00
ϕ(YEAR), σ_p(.), p(.)	27	41095.58	41149.64	384.09	0.00
ϕ(AREA*YEAR), σ_p(.), p (.)	272	40677.36	41227.17	461.62	0.00
ϕ(.), σ_p(.), p(.)	3	41316.31	41322.31	556.76	0.00
ϕ(AREA+YEAR), p (SEX+AREA+YEAR)	70	41943.37	42083.75	1318.21	0.00
ϕ(SEX+AREA+YEAR), p(SEX+AREA+YEAR)	71	41943.40	42085.76	1320.21	0.00
ϕ(AREA*YEAR), p (SEX+AREA*YEAR)	530	41018.48	42100.72	1335.18	0.00
ϕ(SEX+AREA*YEAR), p (SEX+AREA*YEAR)	531	41018.47	42102.80	1337.25	0.00
ϕ(AREA+YEAR), p (AREA+YEAR)	69	41969.28	42107.66	1342.11	0.00
ϕ(SEX+AREA+YEAR), p(AREA+YEAR)	70	41969.13	42109.51	1343.97	0.00
ϕ(AREA*YEAR), p (AREA*YEAR)	529	41044.32	42124.47	1358.93	0.00
ϕ(SEX+AREA*YEAR), p (AREA*YEAR)	530	41044.15	42126.39	1360.85	0.00
ϕ(AREA+YEAR), p (SEX*AREA*YEAR)	548	41066.36	42186.15	1420.61	0.00
ϕ(AREA*YEAR), p (SEX*AREA*YEAR)	799	40779.03	42428.08	1662.54	0.00
ϕ(SEX+AREA*YEAR), p (SEX*AREA*YEAR)	800	40779.03	42430.21	1664.67	0.00
ϕ(SEX*AREA*YEAR), p (AREA*YEAR)	799	40826.29	42475.35	1709.81	0.00
ϕ(SEX*AREA*YEAR), p (SEX*AREA*YEAR)	1058	40580.10	42786.54	2020.99	0.00
ϕ(YEAR), p(YEAR)	49	42703.10	42801.29	2035.75	0.00
ϕ(SEX*YEAR), p (SEX*YEAR)	98	42638.51	42835.27	2069.72	0.00
ϕ(AREA*YEAR), p (YEAR)	294	42286.25	42881.04	2115.50	0.00
ϕ(.), p(.)	2	43176.45	43180.45	2414.91	0.00

[a] Model notation: ϕ = apparent survival; p = capture probability; σ_ϕ = individual heterogeneity for ϕ; σ_p = individual heterogeneity for p. Covariates are described in Table 3. No models were fit with individual heterogeneity on ϕ by fixing σ_ϕ(.) = 0. Models with no individual heterogeneity on either ϕ or p do not include σ_ϕ and σ_p terms. Additive models are constructed as additive terms, e.g., SEX+AREA. Interaction models are constructed as multiplicative terms, e.g., AREA*YEAR. The dot (.) notation means no variation of the parameter in the model being estimated.

[b] Number of estimable parameters.

[c] ΔAIC_c = difference between the model listed and best AIC_c model.

Rates of population change were estimated as derived parameters based on general model ϕ(AREA*YEAR) f(AREA*YEAR) σ_p(.) p (AREA*YEAR). Area- and time-specific λ was then estimated as the sum of ϕ and f estimates (see Methods). Estimated geometric mean λ for HJA, TYE, CAS, NWC and HUP (where mean corresponded to 1995–2012) were between 0.95 and 0.98, whereas means for all other areas fell between 0.91 and 0.95 for the period 1995–2017 (Fig. 7). In all cases,

Table 9
Model selection results from random effects models used to examine the effects of covariates on apparent survival of northern spotted owls from 1993–2018 on 11 study areas in Washington, Oregon, and California.

Model[a]	K[b]	$-2\log L$	AIC_c	ΔAIC_c[c]	Akaike weights
AREA+SPLINE	432.05	39761.02	40639.86	0.00	0.73
AREA+T	434.53	39759.23	40643.19	3.33	0.14
Intercept+SPLINE	436.79	39756.58	40645.22	5.36	0.05
AREA+BO+SOI	437.54	39757.14	40647.32	7.46	0.02
AREA+BO	437.86	39756.89	40647.75	7.89	0.01
Intercept+T	438.68	39755.20	40647.75	7.90	0.01
AREA+BO+RHS	438.11	39756.98	40648.34	8.48	0.01
AREA+BO+BO^2	438.61	39756.10	40648.50	8.64	0.01
AREA+BO+PDO	438.53	39756.36	40648.60	8.74	0.01
AREA+BO+EDGEp	438.74	39756.21	40648.87	9.01	0.01
AREA*BO	443.10	39752.71	40654.41	14.55	0.00
Intercept+BO+DISTtot	447.74	39747.95	40659.26	19.41	0.00
Intercept+BO+DISThi-p	448.59	39747.55	40660.62	20.76	0.00
AREA+EDGEp	448.49	39749.58	40662.43	22.57	0.00
Intercept+BO+SOI	450.29	39746.97	40663.57	23.71	0.00
Intercept+BO	451.10	39746.34	40664.60	24.75	0.00
AREA+RHS	448.87	39750.96	40664.62	24.76	0.00
Intercept+BO+PDO	451.30	39746.30	40664.99	25.13	0.00
AREA+DISThi-p	450.81	39747.74	40665.41	25.55	0.00
Intercept+BO+BO^2	451.68	39745.95	40665.42	25.56	0.00
Intercept+DISTtot	450.93	39747.90	40665.80	25.94	0.00
Intercept+DISThi-p	451.17	39747.78	40666.19	26.34	0.00
AREA+DISTtot	451.86	39746.92	40666.76	26.90	0.00
AREA+HABp	452.09	39746.82	40667.13	27.27	0.00
Intercept+DISTlo-p	452.24	39746.98	40667.62	27.77	0.00
Intercept+RHS	451.41	39749.31	40668.22	28.36	0.00
AREA+SOI	452.37	39747.38	40668.29	28.43	0.00
Intercept+SOI	452.51	39747.24	40668.43	28.57	0.00
Intercept+PDO	453.69	39746.62	40670.24	30.39	0.00
AREA+PDO	453.71	39746.66	40670.34	30.48	0.00
Intercept	453.93	39746.32	40670.44	30.58	0.00
AREA+DISTlo-p	454.48	39745.33	40670.61	30.75	0.00
AREA	454.22	39745.98	40670.71	30.85	0.00
Intercept+EDGEp	454.42	39745.94	40671.09	31.23	0.00
Intercept+HABp	454.52	39745.79	40671.14	31.28	0.00
Base model[d]	530.00	39683.30	40765.54	125.69	0.00

[a] Model notation: Covariates used in the linear random effects models are described in Table 3 with BO^2 being BO squared. Models including Area have area-specific intercepts, whereas Intercept models have the same intercept for all study areas in the linear model.
[b] Number of estimable parameters.
[c] ΔAIC_c = difference between the model listed and best AIC_c model.
[d] Model ϕ(AREA*YEAR), σ_p(.), p(AREA*YEAR) from Table 8.

95% confidence intervals did not overlap 1, indicating that estimates were indicative of declining populations. Thus, NSO populations were significantly declining by 5–9% annually on 6 study areas and by 2–5% annually on the other 5 study areas.

For all the study areas combined, the arithmetic mean $\hat{\lambda}$ was 0.944 (SE = 0.020, 95% CI = 0.905, 0.983) and 0.947 (SE = 0.018, 95% CI = 0.912, 0.982) if HUP was excluded because it had a shorter time interval than the other study areas. In both cases, arithmetic mean $\hat{\lambda}$ was substantially lower than 1.

3.4. Realized population change

The analysis of realized population change (Δ_t) included the period 1995–2017 because the first 2 years and the last year of λ estimates were either biased or confounded and therefore eliminated. The annual estimates of Δ_t (Fig. 8) provide a depiction of the cumulative consequences of the annual estimates of λ, expressed relative to an initial population in 1995. Annual estimates >1 indicate population size for those years was greater than the starting population size in 1995, and estimates <1 indicate that estimated population size was less than in 1995. Despite some fluctuations with estimates >1 during early and middle portions of

Table 10
Parameter estimates ($\hat{\beta}$), standard errors (SE), and 95% confidence intervals from the random effects model of apparent survival ϕ(AREA+SPLINE) with the lowest AIC for adult northern spotted owls on 11 study areas in Washington, Oregon, and California from 1993–2018. Estimates are real and not logit-transformed.

Effect	$\hat{\beta}$	SE	95% confidence interval	
			Lower	Upper
Intercept (CAS)	0.872	0.015	0.842	0.903
Intercept (CLE)	0.839	0.018	0.803	0.875
Intercept (COA)	0.895	0.015	0.866	0.924
Intercept (GDR)	0.864	0.015	0.834	0.893
Intercept (HJA)	0.892	0.015	0.862	0.921
Intercept (HUP)	0.868	0.018	0.833	0.902
Intercept (KLA)	0.864	0.015	0.834	0.894
Intercept (NWC)	0.862	0.016	0.831	0.893
Intercept (OLY)	0.863	0.017	0.830	0.896
Intercept (RAI)	0.877	0.018	0.842	0.911
Intercept (TYE)	0.890	0.015	0.860	0.920
Spline-linear	−0.002	0.026	−0.053	0.048
Spline-quadratic	−0.012	0.020	−0.051	0.028
Spline-cubic (1994)	−0.010	0.022	−0.054	0.034
Spline-cubic (1999)	−0.064	0.024	−0.112	−0.016
Spline-cubic (2005)	−0.032	0.029	−0.089	0.025
Spline-cubic (2011)	−0.142	0.028	−0.196	−0.088

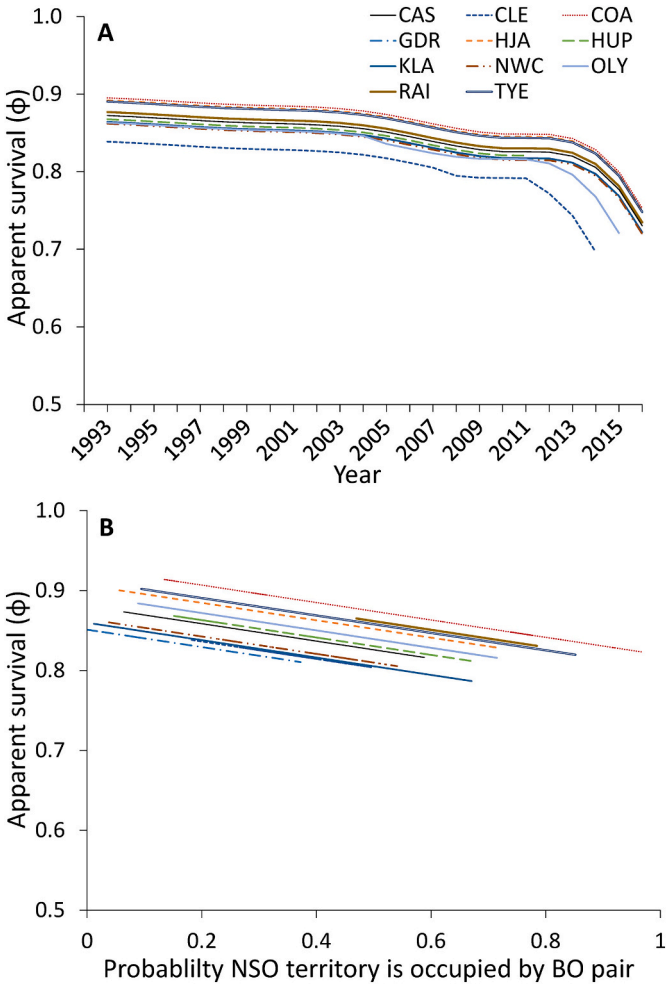

Fig. 6. Trends in apparent survival from 1993–2017 for northern spotted owls on 11 study areas in Washington, Oregon, and California based on (A) time from random effects model ϕ(AREA+SPLINE), and (B) effects of barred owl presence from random effects model ϕ(AREA+BO). Length of the lines in graph B are determined by the range of values in the x-axis for each study area.

Table 11
Parameter estimates ($\widehat{\beta}$), standard errors (SE), and 95% confidence intervals from the random effects model of apparent survival ϕ(AREA+BO) with the effect of barred owls on adult northern spotted owls on 11 study areas in Washington, Oregon, and California from 1993–2018.

Effect	$\widehat{\beta}$	SE	95% confidence interval	
			Lower	Upper
Intercept (CAS)	0.880	0.011	0.859	0.902
Intercept (CLE)	0.858	0.015	0.828	0.888
Intercept (COA)	0.929	0.012	0.904	0.953
Intercept (GDR)	0.851	0.009	0.833	0.869
Intercept (HJA)	0.906	0.011	0.885	0.928
Intercept (HUP)	0.885	0.014	0.857	0.912
Intercept (KLA)	0.860	0.010	0.840	0.879
Intercept (NWC)	0.864	0.011	0.842	0.886
Intercept (OLY)	0.894	0.014	0.866	0.921
Intercept (RAI)	0.916	0.017	0.883	0.949
Intercept (TYE)	0.912	0.012	0.889	0.936
BO	−0.109	0.017	−0.143	−0.075

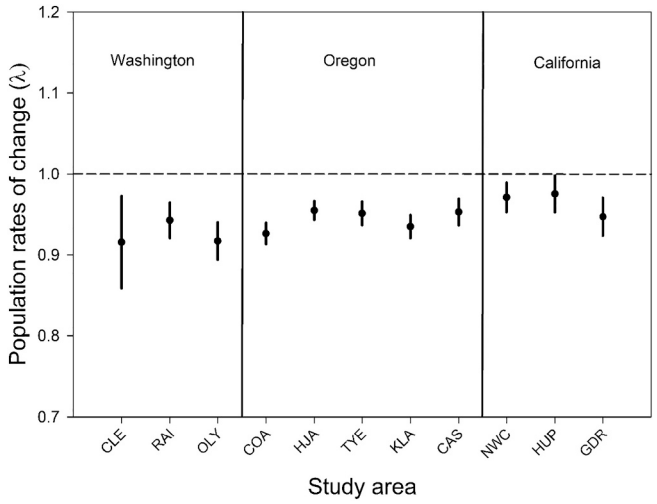

Fig. 7. Estimates of geometric mean rates of population change (λ) and approximate 95% confidence intervals for northern spotted owls on 11 study areas in Washington, Oregon, and California. Means were estimated from 1995–2017 for all study areas except for the HUP study area, which included only data from 1995–2012.

the time series for some areas, all estimates were <1 for all study areas after 2010 (Fig. 8).

In Washington state, estimated population sizes in 2017 had declined by >80% relative to those in 1995 for the OLY and CLE study areas and almost 75% for the RAI study area. In Oregon, all study areas declined by >60%, with COA and KLA declining by >75%. In California, NWC declined by about 50%, HUP by about 30% (by 2012), and GDR had declined by >60%. These estimates (Fig. 8) differed from the previous meta-analysis (Dugger et al., 2016) because the initial year used for previous estimates varied across the analyses. Final realized change estimates can also be viewed as the percentage of the NSO population that remained in 2017 on the 10 study areas relative to initial populations in 1995. Seven of the study areas had ≤35% of their populations remaining with the other three study areas having ≤50% of their populations (Fig. 8).

3.5. Recruitment rate

All the random effects modeling of recruitment rate was based on estimates from the general model ϕ(AREA*YEAR) f(AREA*YEAR) σ_p(.) p (AREA*YEAR), the same model used to produce the rates of population change and realized change estimates (e.g., Figs. 7 and 8). There was substantial uncertainty associated with model selection, but only 5 models showed non-negligible Akaike weights ≥0.01 (Table 12). All of these low-AIC$_c$ models included the covariate BO, and the $\widehat{\beta}$ for this covariate was negative in all models, with a confidence interval that did not overlap zero (Table 13). The negative relationship followed our predictions, and our analyses thus provided strong evidence that recruitment rates between years t and t+1 declined as the proportion of NSO territories occupied by BOs in year t increased.

Recruitment model RE f(BO+Lag1R) was one of the top models, and the $\widehat{\beta}$ for Lag1R was positive with confidence intervals that did not overlap zero (Table 13). The Lag1R covariate was the average number of young produced per pair of NSOs in the breeding season of year t−1. The positive relationship between reproduction in year t−1 indicates that some of the young fledged in year t−1 returned to recruit into the territorial population in subsequent years. The other three models receiving Akaike weights >0.01 (Table 13) included covariates HABp, EDGEp, and DISThi-p, but all $\widehat{\beta}$ had confidence intervals that broadly overlapped 0 (Table 13). HABp and EDGEp were both predicted to influence recruitment positively, and the $\widehat{\beta}$ were consistent with these predictions. DISThi-p was predicted to be a negative influence on recruitment, and its $\widehat{\beta}$ was consistent with this prediction. However, other than the strong negative BO effect, none of the models provided strong evidence for effects of the covariates describing habitat components. Finally, we note that none of the models with climate covariates received any support, all having AIC$_c$ weights <0.01.

3.6. Two-species occupancy

The top model included a mixture of effects specific to study areas as well as effects shared across study areas, including interspecific interactions and trends on all dynamic rates, effects of habitat components (HABa and ELEV) on three of the four vital rates, and climate impacts on NSO local extinction rates only (Table 14). According to the top model identified through our model selection process, NSO territory occupancy has declined substantially in all study areas coincident with increasing BO occupancy in all study areas (Fig. 9). We found strong and consistent effects of BO presence on colonization and extinction of NSO territories across study areas (Fig. 10). Colonization of NSO territories was positively affected by HABa but colonization still had a negative trend across most study areas (Fig. 10). Extinction of NSO territories was similar across study areas and showed a negative association with HABa and a positive association with BO presence, climate (SOI), and exhibited an overall increasing trend (Fig. 10). BO colonization increased through time in all study areas and was positively associated with the presence of NSOs and lower elevations in most study areas (Fig. 10). In contrast, BO extinction was clearly higher in territories co-occupied with NSOs, while any trend in extinction was inconsistent across study areas. The positive relationship of NSO presence to both BO colonization and extinction was probably due to either habitat conditions not represented by our covariates (i.e., BO are selecting similar conditions to NSO) or behavioral attraction (i.e., BOs are attracted by NSO territorial vocalizations).

4. Discussion

Since the last meta-analysis (Dugger et al., 2016), we found that NSO populations continued to experience dramatic declines on study areas distributed across the species' geographic range. Evidence that the presence of BOs was a primary causative factor for those declines is stronger, and BO presence was found to negatively affect every demographic trait we estimated for NSO (Fig. 11). These declines and effects were reinforced by analyzing two types of data, capture-recapture data to estimate demographic traits and rates of population change, and detection/non-detection data to estimate two-species territory occupancy. Both data sets corroborated each other by documenting declines

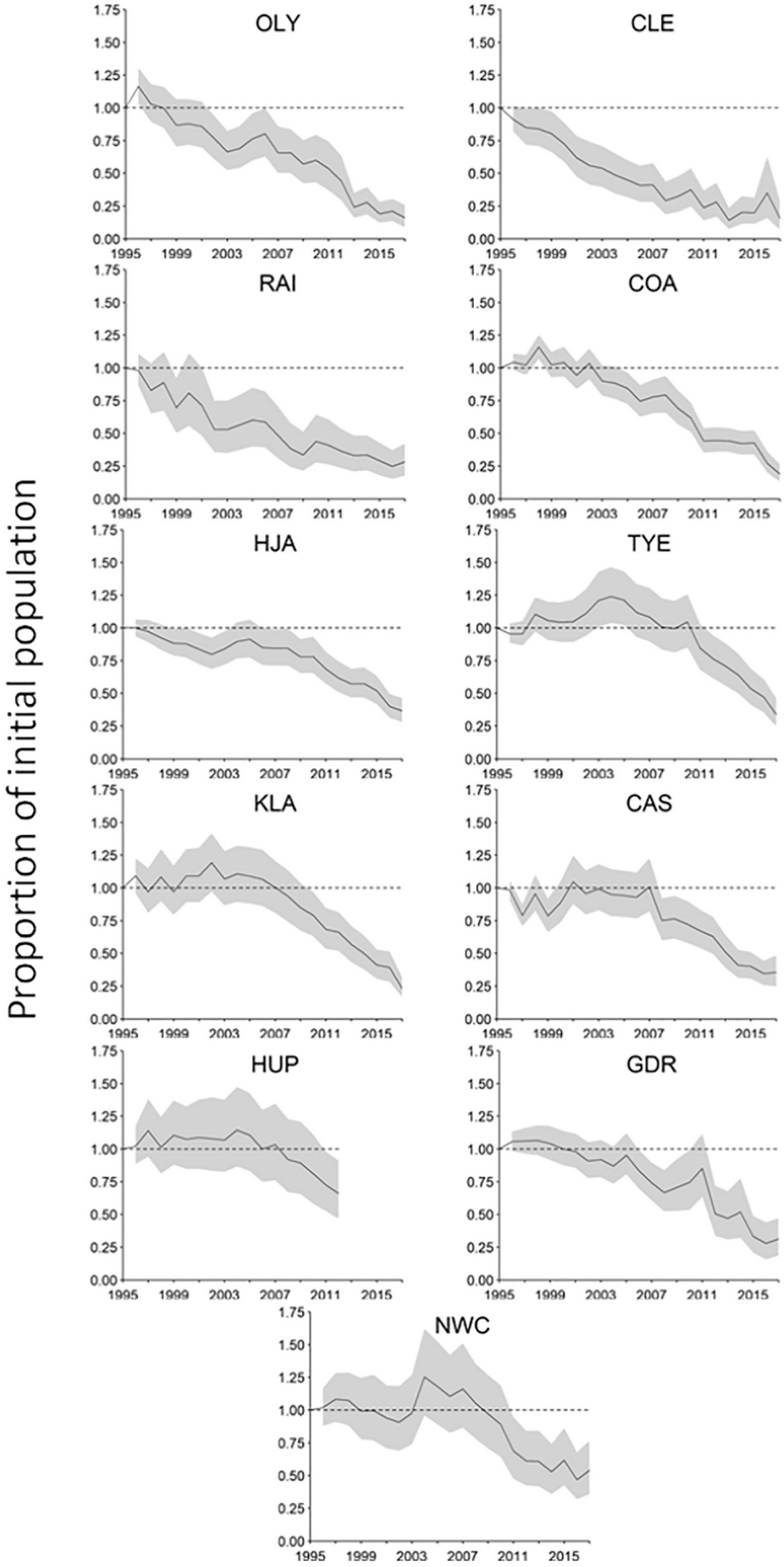

Fig. 8. Annual estimates of realized population change with approximate 95% confidence intervals (shaded area) for northern spotted owls on 11 study areas in Washington, Oregon, and California from 1995–2017.

Table 12
Model selection results for random effects (RE) modeling of recruitment rate, based on the general model ϕ(AREA*YEAR) f(AREA*YEAR) σ_p(.) p(AREA*YEAR) for northern spotted owls on 11 study areas in Washington, Oregon, and California from 1993–2018.

Model[a]	K[b]	−2ln$L$	AIC$_c$[c]	ΔAIC$_c$	Akaike weights
σ_p(.) p(AREA*YEAR), RE BO+HABp	728.10	63312.20	64816.75	0.00	0.35
σ_p(.) p(AREA*YEAR), RE BO+EDGEp	727.97	63312.60	64816.88	0.13	0.33
σ_p(.) p(AREA*YEAR), RE BO+Lag1R	724.23	63321.30	64817.60	0.85	0.23
σ_p(.) p(AREA*YEAR), RE BO+DISThi-p	727.98	63315.71	64820.01	3.26	0.07
σ_p(.) p(AREA*YEAR), RE BO	727.77	63320.92	64824.77	8.02	0.01
σ_p(.) p(AREA*YEAR), RE Lag2R+DISThi-p	736.26	63303.61	64825.59	8.84	0.00
σ_p(.) p(AREA*YEAR), RE WMT+WP	738.17	63302.77	64828.84	12.09	0.00
σ_p(.) p(AREA*YEAR), RE DISThi-p	737.85	63305.15	64830.53	13.78	0.00
σ_p(.) p(AREA*YEAR), RE Lag1R+EDGEp	733.33	63316.15	64831.87	15.12	0.00
σ_p(.) p(AREA*YEAR), RE Lag2R+DISTlo-p	737.66	63307.12	64832.10	15.35	0.00
σ_p(.) p(AREA*YEAR), RE WP	738.04	63306.86	64832.65	15.9	0.00
σ_p(.) p(AREA*YEAR), RE DISTlo-p	737.77	63307.46	64832.67	15.92	0.00
σ_p(.) p(AREA*YEAR), RE BO+DISTlo-p	728.58	63327.75	64833.33	16.58	0.00
σ_p(.) p(AREA*YEAR), RE WMT+PDO	738.2	63307.43	64833.56	16.81	0.00
σ_p(.) p(AREA*YEAR), RE EDGEp	737.43	63310.49	64834.97	18.22	0.00
σ_p(.) p(AREA*YEAR), RE BO+Lag2R	728.3	63330.85	64835.84	19.09	0.00
σ_p(.) p(AREA*YEAR), RE Lag2R+HABp	737.26	63311.82	64835.94	19.19	0.00
σ_p(.) p(AREA*YEAR), RE WP*PDO	738.89	63308.98	64836.58	19.83	0.00
σ_p(.) p(AREA*YEAR), RE Lag2R	737.23	63314.32	64838.38	21.63	0.00
σ_p(.) p(AREA*YEAR), RE WMT*WP	738.33	63312.61	64839.02	22.27	0.00
σ_p(.) p(AREA*YEAR), RE HABp	737.65	63314.21	64839.16	22.41	0.00
σ_p(.) p(AREA*YEAR), RE WP+PDO	738.37	63313.38	64839.88	23.13	0.00
σ_p(.) p(AREA*YEAR), RE Lag1R+DISTlo-p	733.87	63324.88	64841.76	25.01	0.00
σ_p(.) p(AREA*YEAR), RE Lag1R+DISThi-p	733.13	63333.33	64848.63	31.88	0.00
σ_p(.) p(AREA*YEAR), RE PDO	737.93	63327.42	64852.97	36.22	0.00
σ_p(.) p(AREA*YEAR), RE WMT*PDO	738.05	63327.45	64853.26	36.51	0.00
σ_p(.) p(AREA*YEAR), RE WMT	737.73	63330.20	64855.33	38.58	0.00
σ_p(.) p(AREA*YEAR), RE Lag2R+EDGEp	737.08	63342.03	64865.77	49.02	0.00
σ_p(.) p(AREA*YEAR), RE Intercept	737.64	63342.8	64867.73	50.98	0.00
σ_p(.) p(AREA*YEAR)	797	63282.24	64934.35	117.6	0.00
p(AREA*YEAR, π)	836	63344.61	65080.66	263.91	0.00
σ_p(.) p(.)	554	64168.79	65304.57	487.82	0.00
p(.,π)	555	64303.63	65441.52	624.77	0.00
p(AREA*YEAR)	830	64315.72	66038.84	1222.09	0.00
p(YEAR)	576	65544.81	66726.88	1910.13	0.00
p(.)	553	65790.03	66923.72	2106.97	0.00

[a] Covariates are described in Table 3, except for Lag1R and Lag2 R, which are Reproductive Effort (R) lagged by 1 and 2 years, respectively. Model p(AREA*YEAR, π) indicates a different 2-point finite mixture model for capture probability for each study area and year; σ_p(.) p(.) indicates a heterogeneous capture probability model in which there is a single distribution over all areas and years; p(.,π) indicates a heterogeneous capture probability model based on a single 2-point finite mixture which is the same for all areas and years; p(YEAR) indicates a single year-specific capture probability parameter for all areas; and p(.) indicates a single capture probability for all areas and years. Models in which the capture probability notation is not followed by RE indicate the base ϕ(AREA*YEAR) f(AREA*YEAR) model with no random effects modeling of recruitment. The notation following "RE" denotes the covariate(s) associated with the recruitment modeling. "Int" denotes an intercept-only RE recruitment model.

[b] Number of estimable parameters.

[c] ΔAIC$_c$ = difference between the model listed and best AIC$_c$ model.

in NSO populations and identifying BO presence as the primary factor associated with those declines.

Substantial evidence has accumulated showing that interspecific interactions and competition for space, habitat, and food with rapidly expanding populations of invasive BOs has negatively affected the population viability of NSO (Anthony et al., 2006; Dugger et al., 2016; Forsman et al., 2011; Long and Wolfe, 2019). The underlying mechanisms by which BO negatively impact NSO is likely through a combination of exploitation competition for shared habitat and prey resources and interference competition via interspecific exclusion from breeding territories (Gutiérrez et al., 2007; Hamer et al., 2007; Hamer et al., 2001; Wiens et al., 2014). Our study provides range-wide evidence that the negative consequences of interspecific competition with BO have increasingly overwhelmed dwindling populations of NSO since the last meta-analysis reported by Dugger et al. (2016).

Although BOs were the dominant negative effect on NSO populations, this does not suggest that other factors, such as habitat loss through logging and wildfire or climatic changes, were not important. We found little evidence that changes to NSO habitat components due to logging or fire disturbance had significant range-wide effects on trends in NSO populations. These may be important at smaller scales where they affect smaller segments of NSO populations, but they did not appear as major drivers across the entire range of the owl. Because this was a range-wide analysis, the covariates that were important in the analysis were those that were ubiquitous over all or most of the study areas. BOs increased substantially since 1993, are now common across the range of the owl, and occupy most of the landscape occupied by northern spotted owls (Fig. 9). In comparison, net range-wide changes in the amount of NSO nesting and roosting habitat from 1994 to 2013 have been relatively small (1.5% net decrease) (Davis et al., 2016).

4.1. Demographic components of λ

The demographic parameters we examined are related to the rate of population change (λ) either directly or indirectly (Fig. 11). For example, fecundity directly contributes to future recruitment of new individuals into NSO populations, whereas it is the additive effects of recruitment and apparent survival that directly define λ (Fig. 11). In NSOs, apparent survival determines the magnitude of λ while recruitment is largely responsible for the annual variation in λ (Franklin et al., 2000); if recruitment becomes zero, then λ = ϕ. Thus, the linkages among fecundity, recruitment, and apparent survival, all negatively impacted by BO, are critically important for maintaining stationary populations of NSOs over time.

Of the extrinsic factors we hypothesized to contribute to NSO population declines, the presence of BOs was the dominant effect, with BO presence negatively affecting all the demographic components we examined. Although the negative effect of BOs on fecundity appeared weaker relative to an oscillating time trend, this was the first meta-analysis we have conducted where we detected a negative effect of BOs on NSO fecundity. In addition, the negative effect of BOs on apparent survival and recruitment was pronounced, which ultimately

Table 13
Coefficient estimates ($\widehat{\beta}$) and standard errors (SE) for covariates appearing in the top 5 ranked random effects models for recruitment rate in northern spotted owls on 11 study areas in Washington, Oregon, and California from 1993–2018.

Model	Akaike weight	Covariate				
		BO	HABp	EDGEp	Lag1R[a]	DISThi-p
		$\widehat{\beta}$ (SE)	$\widehat{\beta}$ (SE)	$\widehat{\beta}$ (SE)	$\widehat{\beta}$ (SE)	$\widehat{\beta}$ (SE)
RE *f*(BO+HABp)	0.35	−0.085 (0.012)	0.020 (0.025)	–	–	–
RE *f*(BO+EDGEp)	0.33	−0.084 (0.015)	–	0.088 (0.084)	–	–
RE *f*(BO+Lag1R)	0.23	−0.074 (0.015)	–	–	0.030 (0.010)	–
RE *f*(BO+DISThi-p)	0.07	−0.085 (0.015)	–	–	–	−0.168 (0.155)
RE *f*(BO)	0.01	−0.086 (0.015)	–	–	–	–

[a] Reproductive rate (R) lagged by 1 year.

Table 14
Model selection results for two species occupancy models from each stage (see Table 4) for northern spotted owls on 11 study areas in Washington, Oregon, and California from 1993–2018. Letters and symbols are defined as follows: B = BO; H = habitat components; T = linear time trend; N = northern spotted owl; S = SOI; E = ELEV; P = TPI; g = AREA; * = interaction; # = the probability of detection model for barred owl included many components that were held constant across all models. In stages where multiple models were competitive, bold is used to highlight the model components in which alternative structures were supported.

Stage	Spotted owl parameters			Barred owl parameters				K	−2LnL	AIC	ΔAIC	Akaike weight
	Ψ_1	γ	ε	Ψ_1	γ	ε	p					
1: Interspecific interactions	.	*B*	*B*	.	*N*	*N*	#	81	170935.5	171097.5	2223.8	>0.01
2: Habitat covariates	*H*	*B, H*	*B, H*	**.**	*N, E*	*N*	#	85	170783.4	170953.4	2079.7	>0.01
	H	*B, H*	*B, H*	***E***	*N, E*	*N*	#	86	170781.1	170953.1	2079.4	>0.01
	H	*B, H*	*B, H*	***P***	*N, E*	*N*	#	86	170779.2	170951.2	2077.5	>0.01
3: Trends	*H*	*B, H, T*	*B, H, T*	*P*	*N, E, T*	*N, T*	*T*, #	91	169589.7	169771.7	898.0	>0.01
4: Climate covariates	*H*	*B, H, T*	*B, H, T, S*	*P*	*N, E, T*	***N, T***	*T*, #	92	169584.0	169768.0	894.3	>0.01
	H	*B, H, T*	*B, H, T, S*	*P*	*N, E, T*	***N, T, S***	*T*, #	93	169580.8	169766.8	893.1	>0.01
5: Combine	*H*	*B, H, T*	*B, H, T, S*	***E***	*N, E, T*	***N, T***	*T*, #	92	169581.5	169765.5	891.8	>0.01
	H	*B, H, T*	*B, H, T, S*	***E***	*N, E, T*	***N, T, S***	*T*, #	93	169578.2	169764.2	890.5	>0.01
	H	*B, H, T*	*B, H, T, S*	**.**	*N, E, T*	***N, T***	*T*, #	91	169586.1	169768.1	894.4	>0.01
	H	*B, H, T*	*B, H, T, S*	**.**	*N, E, T*	***N, T, S***	*T*, #	92	169582.8	169766.8	893.1	>0.01
	H	*B, H, T*	*B, H, T, S*	***P***	*N, E, T*	***N, T***	*T*, #	92	169584.0	169768.0	894.3	>0.01
	H	*B, H, T*	*B, H, T, S*	***P***	*N, E, T*	***N, T, S***	*T*, #	93	169580.8	169766.8	893.1	>0.01
6: SAS[a] intercepts	*g, H*	*g, B, H, T*	*g, B, H, T, S*	*g*	*g, N, E, T*	***g, N, T, S***	*T*, #	152	168821.8	169125.8	252.1	>0.01
	g, H	*g, B, H, T*	*g, B, H, T, S*	*g*	*g, N, E, T*	***g, N, T***	*T*, #	151	168824.1	169126.1	252.4	>0.01
7: SAS climate	* no models tested in this stage led to improvements in AIC											
8: SAS trends	*g, H*	*g, B, H, g*T*	*g, B, H, T, S*	*g*	*g, N, E, g*T*	*g, N, g*T, S*	*T*, #	182	168630.8	168994.8	121.1	>0.01
9: SAS habitat	*g, g*H*	*g, B, g*H, g*T*	*g, B, H, T, S*	*g*	*g, N, g*E, g*T*	*g, N, g*T, S*	*T*, #	212	168458.7	168882.7	9.0	0.01
10: SAS Interspecific interactions	*g, g*H*	*g, B, g*H, g*T*	*g, B, H, T, S*	*g*	*g, g*N, g*E, g*T*	*g, N, g*T*	*T*, #	221	168431.7	168873.7	0.0	0.99

[a] Study area specific.

had strong negative effects on λ. The negative effects of BOs on the range-wide demographic parameters we reported here have been further corroborated by positive responses of NSO populations to experimental removal of BOs (Wiens et al., 2020).

Since 2014, the declines in both apparent survival and recruitment have accelerated, resulting in further losses to NSO populations beyond those reported by Dugger et al. (2016). In earlier years, permanent emigration from study areas was minimal for non-juvenile NSOs (Forsman et al., 2002; Zimmerman et al., 2007) so previous meta-analyses assumed that apparent survival was similar to true survival (Dugger et al., 2016). More recent evidence indicates that non-juvenile NSOs are dispersing at higher rates and moving farther distances when in competition with BOs (Jenkins et al., 2021; Jenkins et al., 2019). These changing dispersal dynamics could lead to higher permanent emigration, which could translate into larger differences between apparent and true survival rates. If true, we would expect to observe a reciprocal increase in recruitment rates of non-breeding NSOs from outside the study areas (assuming NSOs outside the study areas were moving farther and at higher rates as well). However, we observed steep declines in recruitment along with survival. Therefore, the trends in apparent survival still appear to be representative of true survival in the breeding population of NSOs rather than increased rates of permanent emigration. The high weight on models with individual heterogeneity on *p* also likely reflected the impact of BO affecting NSO responses

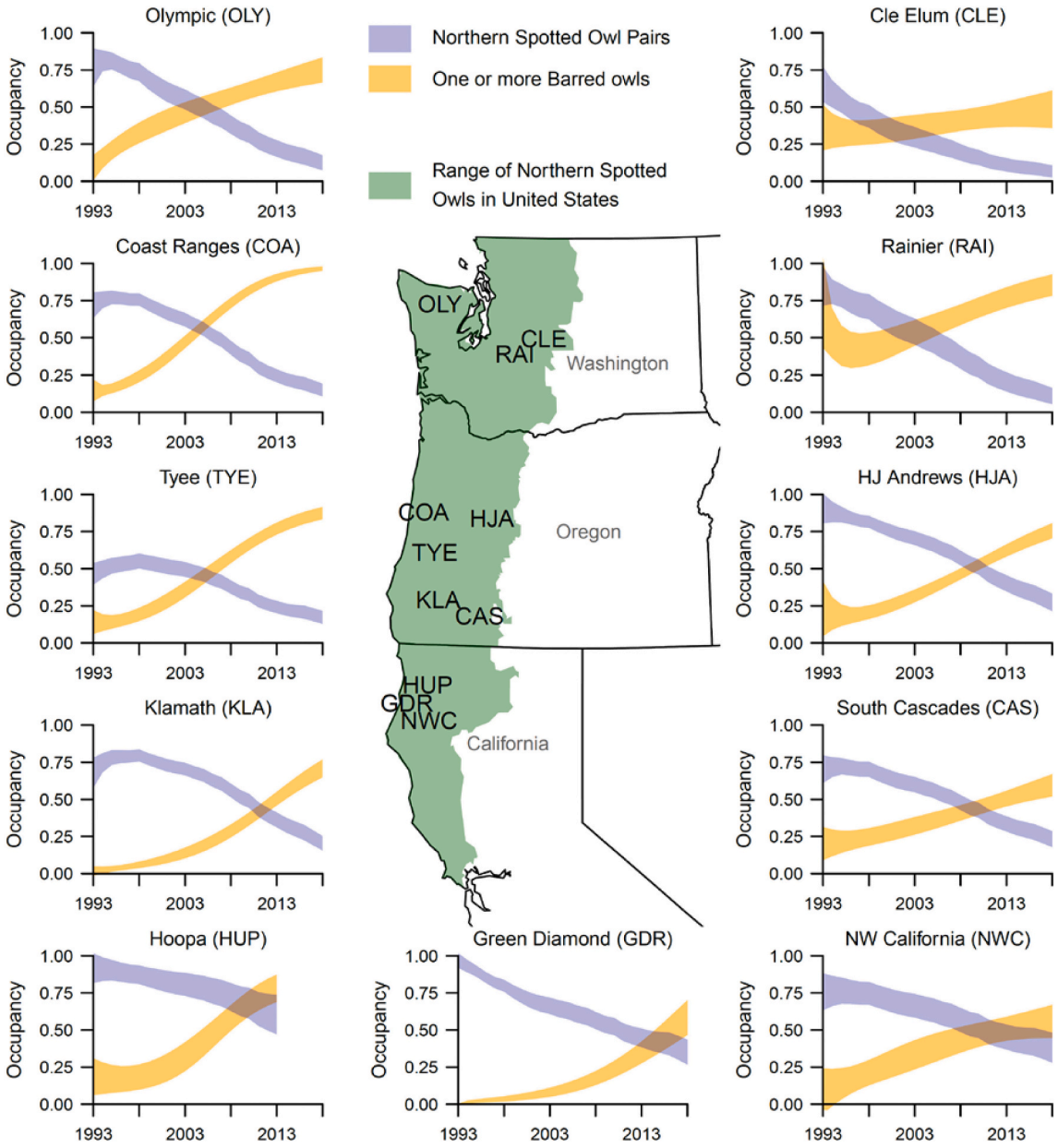

Fig. 9. Trends in territory occupancy for northern spotted owl pairs and barred owls on 11 study areas in Washington, Oregon, and California based on two-species occupancy models from 1993–2018.

4.2. Rates of population change (λ)

Mean estimates of λ for NSOs were <1 for the period 1995–2017 for all 10 study areas, and from 1995–2012 for HUP, indicating declining populations. The 95% confidence intervals for mean λ for all 11 study areas failed to include 1 and, thus, differed from a stationary population ($\lambda = 1$; Fig. 7). In six of the study areas, mean λ was <0.95. The meta-analysis of λ provided strong evidence of population declines over the 1995–2017 period on all study areas, with greater declines documented in Washington than in Oregon and California. However, mean estimates of λ were <0.95 for two study areas in Oregon and one in California. The estimates of realized population change ($\widehat{\Delta}_t$) computed from the annual estimates of λ illustrated the magnitude of declines in population size (Fig. 8). By 2017, all the Washington and Oregon study areas had declined by $>50\%$ since 1995, with four of the study area populations declining by 75% or more. This left most study areas with only 20–30% of the original populations that occupied those areas in 1995.

The recruitment modeling that was conducted as a part of the analyses of λ was focused on covariates that might explain some of the variation in recruitment rate. Evidence was very strong for a negative association between NSO recruitment rate and proportion of NSO territories occupied by BO. Proportion of territories occupied by BO increased monotonically over the years of this analysis, raising the possibility that NSO population change was caused by some other variable with a similar time trend. However, territory-specific inferences about effects of BO on NSO occupancy dynamics (Diller et al., 2016; Dugger et al., 2016; Wiens et al., 2021; Yackulic et al., 2014; this paper) provided strong evidence of BO effects, lending more confidence to the assertion that increases in BO are contributing to lower recruitment rate of NSO populations. The negative effect of BO on both NSO fecundity

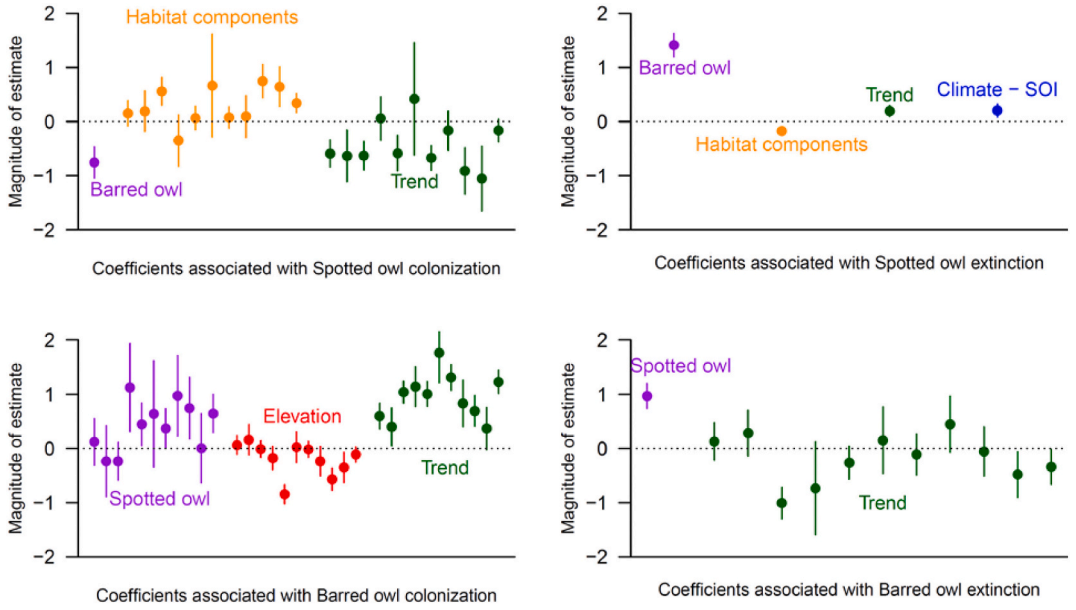

Fig. 10. Effects included in the top-ranked model used to estimate two-species occupancy dynamics for northern spotted and barred owls on 11 study areas in Washington, Oregon, and California from 1993–2018. Points signify means and whiskers span 95% confidence intervals. Single points in a given color signify effects that were shared across study areas, whereas eleven points signify study area specific effects arranged from left to right as follows: CAS, CLE, COA, GDR, HJA, HUP, KLA, NWC, OLY, RAI and TYE.

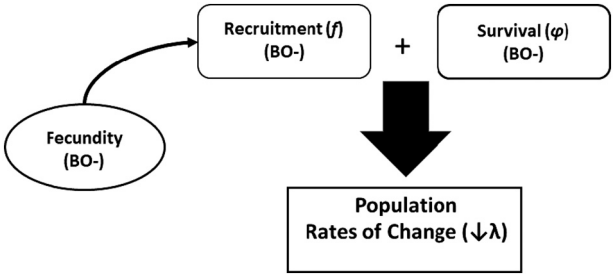

Fig. 11. Relationship of demographic traits to each other and ultimately to the rate of population change (λ). Direction of the effect of barred owl presence is indicated below each trait.

and recruitment rate suggests that competition with BO not only lowers NSO reproductive potential but also the ability of younger NSO to acquire breeding territories.

We also found some evidence that average number of young per breeding pair of NSO in year $t-1$ (Lag1R) was positively associated with recruitment rates between year t and $t+1$ This effect was consistent with the prediction that greater reproductive output in one year would lead to more recruits in later years. Model selection results provided weak support for a positive relationship between recruitment rate and two habitat components, HABp and EDGEp, and a negative relationship between recruitment rate and proportion of territories with high-severity disturbance (DISTp-hi). All three of these weak relationships were in the predicted directions. There was no support for effects of any covariates describing climate or other habitat components.

4.3. Trends in territory occupancy

The two-species occupancy analysis provided results consistent with the analysis of demographic parameters and rates of population change; NSO territory occupancy was declining substantially, coincident with increased BO occupancy of those territories. While BO occupancy was a dominant negative effect on colonization and positive effect on extinction of NSO territories, other factors, such as habitat components and climate, were also important in the dynamics of territory occupancy. These results were similar to previous findings (Dugger et al., 2016; Yackulic et al., 2019) and reinforced the importance of maintaining NSO habitat on the landscape, even if it is unoccupied by NSOs in the face of competitive exclusion by BOs (Dugger et al., 2011). Maintenance of such a landscape provides 1) areas available for re-colonization by NSOs should management actions allow for reduction of BO populations and 2) it facilitates connectivity by dispersing NSO among occupied areas (Sovern et al., 2014).

4.4. What will be the fate of NSO populations?

Based on our analysis, there are two alternative hypotheses concerning the future trajectory of NSO populations if no management actions are taken. The first is that these populations continue to decline to extinction. We observed this negative linear trajectory on several study areas (Fig. 8). Past projections based on range-wide vital rates and territory occupancy, and assuming no BO management, suggested a greater than 50% chance that NSOs would be extirpated within 50 years on 7 of the 11 study areas examined here (Yackulic et al., 2019) and eventual competitive exclusion of NSOs throughout their range (Yackulic, 2017). The second hypothesis is that current NSO populations will stabilize at smaller population sizes and continue to co-exist with larger BO populations for some time. This scenario is weakly indicated by study areas, such as RAI and NWC, where realized population declines appear to have slowed in recent years (Fig. 8). Based on our analyses here, it is highly unlikely that NSO populations will increase to their former levels if BOs continue to occupy the landscape at their current levels. Therefore, an expectation that NSO populations will return to levels above those currently reported is probably untenable unless there is large-scale management of BO populations.

Although the hypothesis for coexistence between BOs and NSOs is more optimistic, it needs to be tempered by the increased vulnerability of small populations to catastrophic events and genetic effects of inbreeding, already documented for NSOs in Washington (Miller et al., 2018). Real-world examples of these issues include the extinction of the middle-spotted woodpecker (*Dendrocopos medius*) in Sweden and the heath hen (*Tympanuchus cupido cupido*) on Martha's Vineyard island in

the United States. The middle-spotted woodpecker exhibited a small but stationary population from 1967–1974 and then declined dramatically to extinction during 1975–1983 because of reduced fecundity due to inbreeding depression (Pettersson, 1985). The heath hen was extirpated from the eastern U. S. except for a small population of 300 birds on Martha's Vineyard island. However, a series of catastrophic events, including a severe wildfire followed by an unusually cold winter and an invasion of northern goshawks (*Accipiter gentilis*) reduced the population to a single pair of birds in 1928 and the subsequent extinction of the subspecies in 1932 (Simberloff, 1986). In this way, uncontrollable events can cause the extinction of small populations that were remnants of formerly larger populations.

Thus, without removal or reduction of BO populations, the more realistic scenario is probably that NSOs will become extirpated from portions of their range and possibly linger on as small populations in other areas until those populations are eliminated because of catastrophic events, resulting in the extinction of this subspecies. Increasing wildfire activity in the Pacific Northwest due to climate change coupled with past fire suppression (Davis et al., 2017; Reilly et al., 2017) is one avenue where catastrophic events may negatively affect NSO populations when large areas of older forest are degraded (Jones et al., 2016; Rockweit et al., 2017). For example, the recent large, severe wildfires of 2020 burned about 8900 km^2 of forest within the NSO range. Range-wide, these fires resulted in the loss of about 1510 km^2 of forest cover type used for nesting and roosting by NSOs (R. J. Davis, unpublished data). These large, severe wildfires usually occur under abnormal weather conditions; under normal conditions, intact stands of forests used by NSO for nesting and roosting may serve as fire refugia (Lesmeister et al., 2019).

Current trends and the predictability about future trends in NSO populations, based on this and previous meta-analyses, suggests that these populations will face extirpation if competition from BOs is not ameliorated in the short term.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.biocon.2021.109168.

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2023-25 Biennial Budget Development

Board of Forestry - Policy Option Package Overview

April 27, 2022

Overview

- Agency Request Budget (ARB)
- Governor’s Budget (GB)
- Legislatively Adopted Budget (LAB)
- Policy option packages (POPs) – Proposed changes to our programs not included in our Current Service Level (CSL) budget
- Developed using the guiding principals presented in January
- Framed within the current 23-25 Department of Administrative Services (DAS) budget instructions

Timeline to ARB Submittal

- April 27 – BOF overview of agency POPs
- June 8 – BOF provides final approval of agency POPs
- July 20 – BOF reviews and approves the ARB
- Aug 31– Agency submits ARB to Chief Financial Office of DAS

Policy Option Package Areas

- Program Development (3)
- Continuing Business (6)
- Capital Investments (5)

Program Development

- Community Engagement & Climate Change
  - Implementing Climate-Smart Forestry
  - Planning and Responding to Changing Climate and Forests
  - Interpretive Education
  - Electric Vehicle Infrastructure
- Emergency Response & Life Safety
  - Continuity of Operations Planning
  - Smoke Detection Cameras
  - Radio Repeaters
- Document Management System Preparation

Continuing Business

- Private Forest Accord Program Development
- SB 762 – Continuing Investments
- Federal Forest Restoration (FFR) Program Infrastructure Investment
- Facility Management Capacity
- ODF Severity
- Landowner Rate Offset Continuation

Capital Investments

- SB 1067 Deferred Maintenance Investments
- Facility Replacement
  - Toledo
  - Klamath
  - Santiam
- State Foresters Office Renovation

Questions?

Wild Salmon Center • OLCV • Lincoln City Audubon Society • KS Wild • NW Steelheaders

April 24, 2022

Oregon Board of Forestry
Oregon Department of Forestry
2600 State Street
Salem, Oregon 97310

submitted via email: boardofforestry@oregon.gov

Re: Agenda Item #4—Input on FY 2023-25 Agency Request Budget and Legislative Concepts

Dear Chair Kelly, Board Members, State Forester Mukamoto and ODF Staff:

We write with input on the Oregon Department of Forestry's (ODF) budget and legislative concept priorities for the 2023 Oregon Legislative Session. As ODF and the Board work to finalize the Agency Request Budget (ARB) as well as further advance Legislative Concepts with the Governor's Office and legislature, we ask that you integrate and/or address these suggestions as part of your deliberations. Much of the feedback below is focused on state forest-related needs, which remains an ongoing focus of a coalition of various organizations, including those signed onto this letter.

Our understanding is:

- Given deadlines, ODF has already submitted Legislative Concepts to the Dept. of Administrative Services and Governor's Office. We were hoping for further development around concepts with state forest business model implications, including Board conversation, so please regard the comments below as relevant to future steps.
- The Board will provide final input on and approval of ODF's draft Budget Policy Option Packages at its June 8, 2022 meeting, followed by approval of ODF's 2023-25 Agency Request Budget at its July 20, 2022, meeting.

Oregon is well known for its forests, and ODF plays the lead role in ensuring sustainability and resilience on state and private forest lands. We support a robust agency capable of advancing the wide variety of values and outcomes the public seeks for Oregon's forests and related communities. While our organizational objectives fall under a green or conservation-oriented posture, we are also mindful and supportive of financial viability objectives. Budget Policy Option Packages (POPs) and LCs are needed to improve performance on climate change, conservation, equity and rural community viability outcomes, as well as a financially viable business model to support them.

We are excited to see the important attention some of ODF's draft budget POPs would bring to these matters, but more is needed, per below. Further, more work is needed related to legislative concepts tied to key business model needs. And, the cost side of the budget ledger also merits internal attention as part of a financial viability focus.

In short, Oregon's forests and communities need urgent attention now. By the time Oregon's 2023 legislative session concludes: Climate change impacts will have grown, a court decision will be rendered in the *Linn County* litigation (which, regardless of the outcome, has daylighted key disconnects in timber volume demands as well as how Oregon funds rural county services), and the Board will have made significant decisions on a state forest Habitat Conservation Plan, a revised Forest Management Plan, and implementation of a Climate Change and Carbon Plan. Now is an important time to be proactive in light of that horizon. Until ODF and the Board meaningfully work to increase state forest capacity (through direct engagement of the legislative process) as well as cost fairness across its respective divisions, constraints from the old business model will hamper the ability of Oregon's state forests and managers to meet today's challenges and opportunities.

Budget Priorities:

ODF appears to have consolidated several budget requests into an estimated $10 million / biennium POP for ***"Community Engagement & Climate Change"*** (see Board Materials, Agenda Item 4, p.2). This POP is broken out into four elements:

1. Implementing Climate-Smart Forestry
2. Planning and Responding to Changing Climate and Forests
3. Interpretive Education
4. Electric Vehicle Infrastructure

Overall, we are excited to see this POP and its content. Its elements are important to not just to the overall header of "Community Engagement & Climate Change" but ODF's state forest business model and revenue structure. And we welcome ODF's attention to diversity, equity and inclusion with the intent, through this POP, to more deliberately bring Oregon's forests, the agency, and its programs closer to serving the broader public. We suggest the following to enhance the effectiveness of this POP in meeting the underlying needs.

Climate-Related:

Increasingly, and appropriately, Oregon's decision-makers are well aware of climate change and its impacts. Addressing this context should remain a lens on overall budget and policy decisions not just by elected officials like the Governor and legislators, but agencies, boards/ commissions, and those charged with stewarding Oregon's natural resources.

In November 2021, the Board unanimously adopted the Climate Change and Carbon Plan (CCCP) for Oregon's forests. The CCCP lays out a framework to implement much needed changes that would ensure Oregon's forests provide a full range of social, economic and environmental benefits to the people of Oregon. This plan rightly recognizes that, with respect to the state forest lands managed by ODF, responsible climate action is not just consistent with achieving Greatest Permanent Value to the people of Oregon, but fundamental to it. And as to Oregon's forested landscape as a whole, the Plan represents a

crucial first step in Oregon becoming a leader in climate-smart forestry, and creating a model for how to best use forests as a critical natural climate solution.

Through previous input, groups including many on this letter have indicated a desire for more urgency and specificity on CCCP implementation than provided in work-plan drafts at the January 05, 2022 Board meeting. And importantly, we are prepared to help prioritize and advocate for resources supporting ODF's work in this arena.

With respect to the two climate-focused POP elements ("Implementing Climate-Smart Forestry", and "Planning and Responding to Changing Climate and Forests") we ask that ODF create a crosswalk between CCCP actions and goals, divisions and programs responsible for meeting these goals, and how funding/capacity sought through these POP Elements is tied to meeting these goals. In addition, we ask that the following be addressed. Doing these things would help us in supporting this POP.

POP Element 1: Implementing Climate-Smart Forestry

- As an overarching matter, given that this element is distinct from the Planning Division (Element 2), we are unclear where the positions and other funding would go (what Division)? We had heard the Forest Resources Division was preparing a POP that would include new funding for Urban Forestry, and we have been curious what other climate goals Forest Resources is seeking to meet with additional funding. This POP Element 1 seems like the answer. But while there is clarity around the positions as well as "Additional Funds" tied to Urban Forestry, are these funds and positions to be housed in the Forest Resources Division? Further, as to the other funded positions (not tied directly to Urban Forestry) the POP language should clarify where they would be housed as well as what CCCP or climate-smart forestry objectives they would advance.

- ODF's description of Element 1 calls out the CCCP's climate smart goals, and while it mentions urban and community forestry as a focal area, it fails to mention state forests. Given that state forests are the part of Oregon's forested landscape over which ODF and the Board have the most influence, the language here should specifically call out the connection between this POP and the State Forest Division's implementation of climate smart forestry on state forest lands. For example:
    - As part of clarifying how this POP will advance carbon analysis work on state forests, we believe this should include modeling and evaluation of carbon sequestration and storage contributions, and be updated over time.
    - In addition, we would like to understand whether or how funding from this POP would be used in the context of FMP revision and carbon / climate goals and strategies, including allocations and potential future carbon projects (e.g Habitat Conservation Areas that can be co-managed for endangered species and carbon storage/sequestration).

- The additional capacity related to urban forestry investments is positive. But while there is funding for a "Revolving Seedling Fund", there does not seem to be adequate attention to funding for growing and maintaining seedlings to full-potential trees.

Various organizations have raised this issue before, and we would like to see it addressed with intentional and adequate funding (or at least understand whether the Seedling Fund will be used for maintenance)

POP Element 2: *Planning and Responding to Changing Climate and Forests*

ODF's language rightly recognizes the existing condition of "insufficient capacity and expertise to monitor, evaluate and inform response to climate change" and the need to build this into the Planning Division. We support Element 2's effort to do this, and our questions relate primarily to wanting more details about the specific responsibilities of the staff ODF seeks to fund, including their role in implementing the CCCP.

For example, we believe the work elements of this POP will have positive and meaningful value to the understanding of how upcoming HCP and FMP decisions relate to climate and carbon outcomes–including efforts to "monitor, evaluate and inform" how these decisions fit in the overall context of climate change response. But this is unstated. In addition, we welcome Element 2's "Additional Funds" investments in the FIA Plot Network as well as work to link remote sensing and ground based measurement. But, we aren't clear how or where that will happen.

As part of refining Element 2 language, we ask that ODF:

- clarify and/or more specifically recognize the connection between Element 2 staff / work and the longer-term efforts tied to policy decisions including the HCP and FMP for state forests.
- clarify whether the FIA plot work and work to link remote sense / ground-based measurement would be specific to the state forest landscape, or broader?

State Forest-specific

POP Element 3: *Interpretive Education*

This Element would add needed capacity to the State Forest Division. We are also glad to see the agency's education and interpretive efforts expanded beyond the Tillamook Forest Center (while still valuing the Center and the important enhanced role it can also play). The mobile interpretive education approach has value in addressing equity issues (i.e., access to opportunities to learn about forests and the values they provide, and in turn ways to engage and support Oregon's forests) as well as in improving the agency's public perception and leadership position in the forest context.

But, more is needed.

- We appreciate that this Element would fund 3 new positions and advance a fund shift (or partial fund shift) for 5 positions. In the context of supporting diversification of the State Forest Division's business / revenue model, are the fund shifts moving staff currently funded by timber revenue onto General Fund dollars?
- Interpretive Education is within the State Forest Division's Recreation, Education, and Information (REI) program. Element 3 only speaks to Interpretation and Education, while being silent as to Recreation. The REI program is a prime example of an under-capacity program in the context of growing public demand for the services it provides, or could provide.
    - We are aware the REI program is advancing ongoing strategic planning, and we understand part of the reason for not including Recreation funds in Element 3 relates to ODF wanting to develop this planning effort further before making Recreation-related budget asks. There may be merit to this, including the identification of future funding partnership opportunities, and we have little doubt the need will persist into another future legislative session.
    - That said, we feel the time is ripe to diversify ODF's state forest revenue model to ensure timber harvest dollars are not expected to float the freight for the REI program. This could be done with position fund shifts for base positions (i.e., off of timber revenue funding and onto general fund) that, in our view, would not result in any conflict with an ongoing strategic planning process that may identify other budget requests later. Doing so would allow state forests to serve public recreation values independent of harvest levels and also relieve budget stress on other state forest program budget needs.

Legislative Concepts

In order to achieve Greatest Permanent Value (GPV) on the state's public forest lands, ODF currently must fund public programs through timber harvest dollars. What's more, ODF's management programs for achieving broad public outcomes on these lands must be sustained on only 36% of any dollar derived from timber. This greatly hamstrings ODF's ability to advance broad public values tied to GPV on the land base to which this directive is tied. We are encouraged by ODF and the Board's work to date in advancing a Habitat Conservation Plan tied to wildlife values under the Endangered Species Act as well as a revised Forest Management Plan tied to broader public values. These decisions lay ahead in 2023, and they will not be without consequence or consideration of tradeoffs. The same can be said of a decision in the *Linn County* lawsuit.

Budget POPs are not enough to address the fundamental shortcomings of today's state forest business model. ODF and the Board should proactively recognize this and engage in needed legislative conversations. This includes funding concepts that could address the tension between the legitimate need for state government to adequately fund rural county services on the one hand, and on the other, the need to comply with environmental laws, meet agency plan goals and performance measures, and provide meaningful public outcomes consistent with GPV. This is a big-dial conversation that is beyond the Board or ODF's ability to solve

alone, but without Board and ODF engagement and leadership here, a very meaningful voice to solving the issue remains absent.

We have not yet seen the Legislative Concepts (LC) that ODF submitted to the Department of Administrative Services and Governor's Office. But the conversations to date–before the board and otherwise–do not suggest ODF will be advancing this kind of big-dial proposal.

On the LC's of which we are aware, more should be done to include elements that help address state forest business model changes and improve ODF's financial viability. These may not be big-dial changes, and some of that may be understandable given the pending *Linn County* litigation and yet unresolved HCP and FMP decisions, but they would provide meaningful change for the state forest business model and sustainability. This includes:

- Harvest Tax LC--include an element on direction of harvest tax revenue derived from state forest logs back into the State Forest Division.

- Large Fire Funding LC—ensure the funding and reorganization advanced by this LC will (a) enable key state forest personnel (and other key ODF staff) to be exempt from militia-model wildfire operations enlistment—and more able to advance their regular jobs and program work—except during critical events as determined by the State Forester, and (b) address cost inequities the State Forest Division faces around fire funding (double payment).

We look forward to working with ODF, the Board, Governor's Office and Legislature on further advancement of this policy work, both related to budget and legislation development before the next legislative session and advancement in 2023. Thank you for your consideration of this input.

Sincerely,

Brett Brownscombe,
On behalf of the Wild Salmon Center

Julia DeGraw,
On behalf of the Oregon League of Conservation Voters

Joseph Youren,
On behalf of Audubon Society of Lincoln City

Tamsin Fleming,
On behalf of the Northwest Steelheaders Association

Joseph Vaile,
On behalf of Klamath-Siskiyou Wild

MGO RECOMMENDATIONS

Implementation Management Plan

PRESENTED TO

Board of Forestry

April 2022

mgo

PRESENTATION

AGENDA

DISCUSSION TOPICS

01 REVIEW METHODOLOGY

02 IMPLEMENTATION STATUS AND HIGHLIGHTS

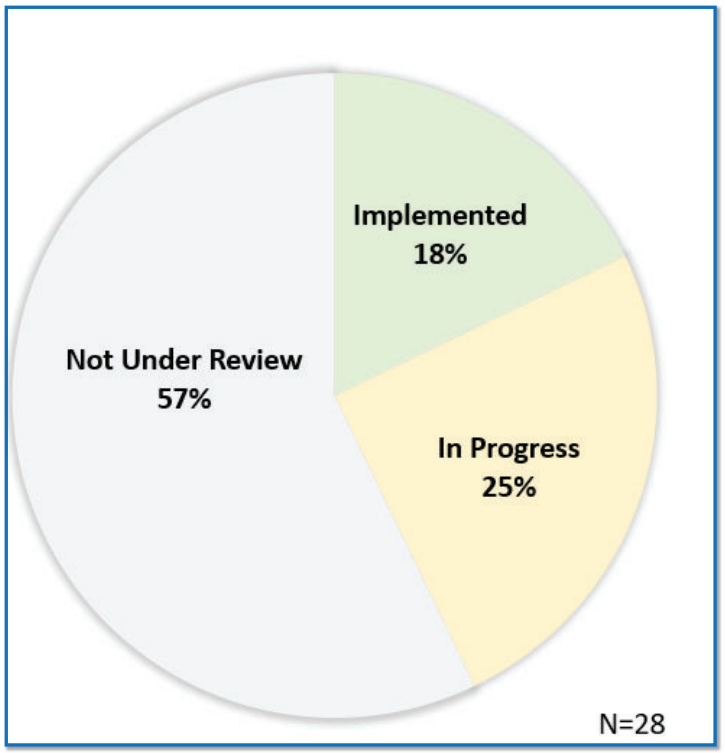
03 MANAGEMENT UPDATE

04 SHARED DISCUSSION AND FEEDBACK

METHODOLOGY

- **Identify Documentation to Satisfy Each Recommendation**
- **Prioritize Recommendations for Review**
- **Request Documentation**
- **Conduct Analysis**
- **Summarize Status and Rationale**

IMPLEMENTATION STATUS OVERVIEW



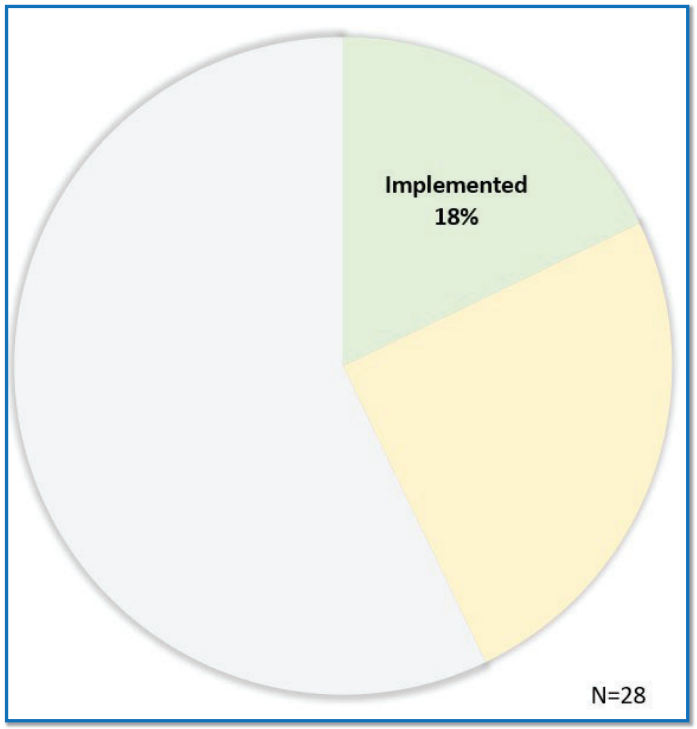
PERIOD RESULTS

- **Five Recommendations Implemented**

  #16 - Board of Forestry Oversight Policy Implemented

- **Significant Progress with Organizational Restructure and Accounting Policy Changes**

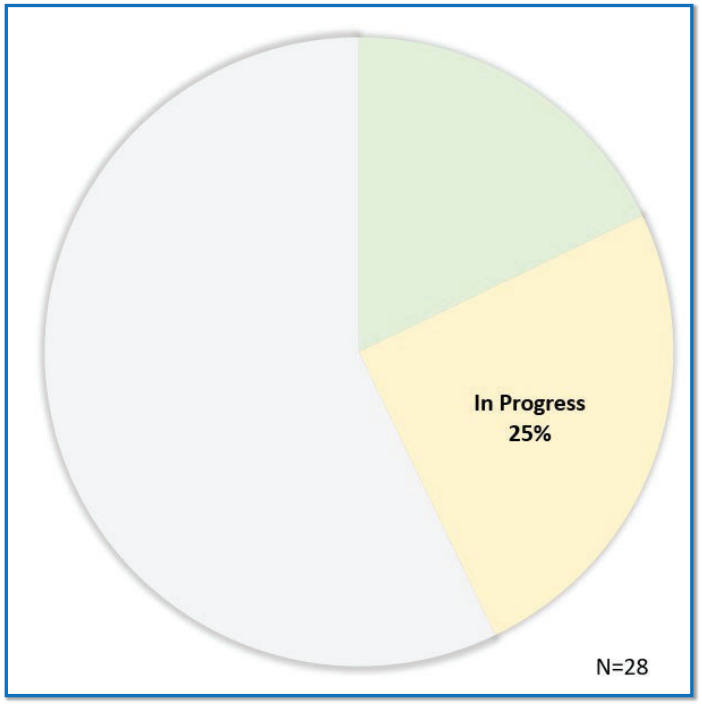
RECOMMENDATIONS - IMPLEMENTED



		Risk Rating as of April 2022		
Rec #	**Theme**	**High**	**Medium**	**Low**
1	Cost Share Agreements	↓		X
2	Cost Share Settlements	↓		X
3	Cost Share Collections	↓		X
16	Board of Forestry Oversight		↓	X
27	Information Technology			- X

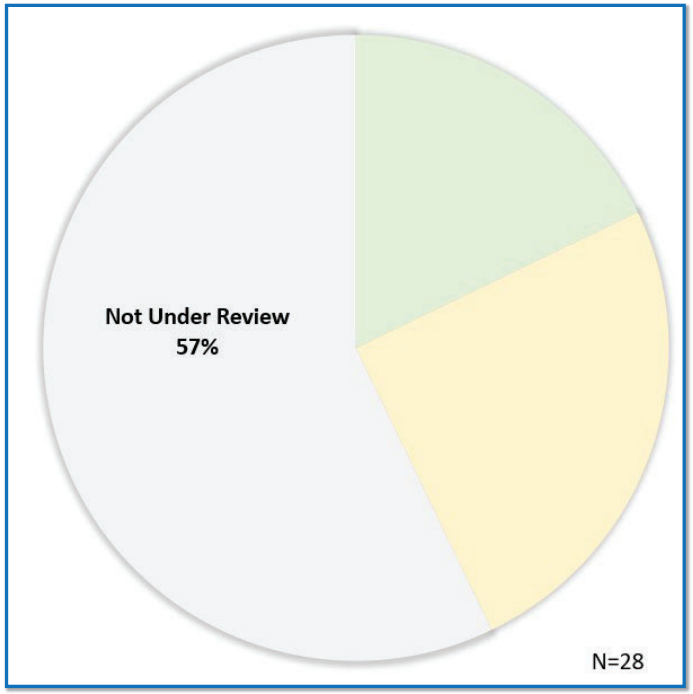
X is the current rating of the recommendation as of April 2022.
↓ in the box of the April 2021 risk rating means the risk rating as of April 2022 has been lowered
– in the box of the April 2021 risk rating means the risk rating as of April 2022 has not changed..

RECOMMENDATIONS – IN PROGRESS



		Risk Rating As of April 2022		
Rec #	**Theme**	**High**	**Medium**	**Low**
4	Cash Flow Projections	↓	X	
7	Cost Estimates	↓	X	
9	AP	↓	X	
13	Oversight Reports		- X	
15	ODF Standardized Policies and Procedures		- X	
17	District Finance/ Accounting Oversight		- X	
20	Finance/Accounting Resources		- X	

RECOMMENDATIONS – NOT UNDER REVIEW



6 Recommendations – High Risk Rating

7 Recommendations – Medium Risk Rating

3 Recommendations – Low Risk Rating

ODF MANAGEMENT UPDATE

Implementation

Successes

Opportunities

ODF MANAGEMENT UPDATE

IMPLEMENTATION

ODF IMP Version 4

Total: 28 Recommendations

- 16 Active
  - 13 progressing
    - 3 recently initiated
- 4 Pending/On Hold
- 3 Not Started
- 5 Complete

ODF MANAGEMENT UPDATE

SUCCESSES

- Policy and Procedures
- Training and Guidance
- Communications and Tracking Tools
- MGO Engagement in Review

ODF MANAGEMENT UPDATE

OPPORTUNITIES

- Resource Capacity
- Transitioning Duties
- Continued Policy Development

SHARED DISCUSSION & FEEDBACK

- Work Products and Process
- Information for Oversight Role
- Priorities for Next Review Cycle
- Areas for ODF to Prioritize
- Requests for Next Presentation

OREGON DEPARTMENT OF FORESTRY

Implementation Management Plan Review

April 2022

Certified
Public
Accountants

OREGON DEPARTMENT OF FORESTRY
Implementation Management Plan Review

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OREGON DEPARTMENT OF FORESTRY
Implementation Management Plan Review

OVERVIEW

Macias Gini & O'Connell LLP (MGO) was engaged by the Oregon Department of Administrative Services (ODAS) to provide an independent third-party assessment of the Oregon Department of Forestry's (ODF) Accounts Receivable (AR) and Accounts Payable (AP) practices. MGO performed the work in accordance with the Statements on Standards for Consulting Services issued by the American Institute of Certified Public Accountants. The objective of the engagement was to review, reconcile, evaluate, and make recommendations on ODF's:

- AR and AP functions as a whole.
- AR and AP policies and procedures.
- Policy and procedures involving the Federal requirements for submission of claims and reimbursement, focusing on the Federal Emergency Management Agency (FEMA) Fire Management Assistance Grant (FMAG) Program.
- AR and AP statutory and policy structure.

The final report was published on April 22, 2021 and contained 28 recommendations in the thematic areas of budgeting, financial resources, information technology, oversight, and policies and procedures. The report also categorized recommendations into the three risk categories of high, medium, and low. In October 2021, MGO was engaged by ODF to assess the status of the Implementation Management Plan (IMP).

SCOPE AND OBJECTIVES

The scope of our review includes the assessment of the implementation activities related to the 28 recommendations in the April 2021 MGO Report. The objectives of the review are to:

1. Assess the status of the IMP and ODF's efforts to implement the MGO recommendations.
2. Monitor ODF progress by providing written status reports and making recommendations for keeping implementation on time and in alignment with objectives.
3. Provide background, observations, and context of MGO recommendations.

METHODOLOGY FOR IMPLEMENTATION MANAGEMENT PLAN REVIEW

To assess and monitor the status of the IMP, we:

1. Reviewed the MGO April 2021 Report to identify the documentation necessary to deem recommendations implemented.
2. Completed a recommendation prioritization matrix, organized by category (e.g., policies and procedures, information technology, etc.), theme (e.g., cost share agreements, cost estimates, etc.), risk rating (low, medium, and high), and due date to identify the items of primary focus for this first round of review. Risk ratings were based on the definitions below.

High	• Design of controls is ineffective in addressing key risks or no process exists to manage the risk. • Controls/policies/procedures documentation is incomplete, unclear or outdated, not monitored and/ or does not exist. • Controls are not in operation or have not yet been implemented. • There is non-compliance with laws/regulations/policies/procedures and there are opportunities to develop new controls to provide a more appropriate level of assurance. • Immediate need for corrective and/or improvement actions to be undertaken.
Medium	• Design of controls only partially addresses key risks and does not provide adequate assurance that all objectives will be achieved. • Controls/policies/procedures are documented, up-to-date, and monitored, but there are some gaps in the documentation relied upon to provide evidence that the key controls are operating effectively. • Controls are not operating consistently and/or effectively or have not been fully implemented. Identified general compliance with laws regulations/policies/procedures with a few minor exceptions. • There are some opportunities to improve existing controls, strengthen compensating controls and/or awareness of the controls. • There is a cost/benefit advantage to implement improvement opportunities.
Low	• Design of controls is adequate in addressing key risks, providing a reasonable level of assurance that objectives are being achieved. • Controls/policies/procedures are documented, up-to-date, and monitored. • Controls are fully implemented and operating effectively and efficiently. • Identified high level of compliance with laws/regulations/policies/procedures. • Some improvement opportunities have been identified but not yet actioned.

3. Requested documentation for recommendations under review and created a ShareFile to serve as a central repository for document facilitation. For this initial period of review, items for review pertained foundational documentation (e.g., policies and procedures), high-risk items, and items that had overlap with multiple recommendations.
4. Evaluated submitted documentation against criteria identified for deeming the recommendations implemented and via conversations with ODF staff.
5. Summarized the recommendation status and rationale in this report. Recommendation implementation is classified as follows:
    a. ***Implemented*** – the corrective actions and/or advisements proposed in the recommendation have been met.
    b. ***In Progress –*** clear demonstration of efforts to implement the recommendation have been initiated or may have been initiated and placed on hold due to resource needs.
    c. ***Not Under Review*** – the recommendations were not included during the review cycle due to reasons such as corrective actions and/or advisements have not been initiated, other recommendations were prioritized, etc.

We will follow the same process moving forward, being flexible to items that are high-risks, items that may become higher priority over time, and understanding that the promptness of implementation is pending available resources.

DISCLAIMER

The results of the assessment reported do not constitute an examination made in accordance with attestation standards, the objective of which would be to express an opinion or conclusion, respectively we do not express such an opinion or conclusion. Furthermore, this includes any opinion or representation related to the accuracy or completeness of the information provided by management. The sufficiency of the scope is solely the responsibility of the ODF. We make no representation regarding the sufficiency of the scope of services to identify all significant matters or reveal errors in the underlying information, instances of fraud, or illegal acts, if any. We have no obligation to update this report or to revise the information contained herein to reflect events and transactions occurring subsequent to the date of this report. This report is intended solely for the information and use of the Board of Forestry and ODF management and is not intended to be, and should not be, used by anyone other than this specified parties.

RECOMMENDATION STATUS

For this cycle, we reviewed twelve recommendations, all of which pertain to the control environment. As defined by the *Committee of Sponsoring Organizations of the Treadway Commission (COSO) Internal Control Integrated Framework*, the control environment encompasses standards, processes, organizational structures, and the tone at the top. These elements are necessary for aligning entity goals and resources, securing stakeholder buy-in, and explicitly stating expectations regarding organizational performance and values.

The recommendations under review this cycle center around:

1) the development of policies and procedures intended to standardize accounts receivable and accounts payable practices.
2) the delineation of related oversight responsibilities.
3) the clear expression of management expectations about the importance of following these protocols.
4) information technology. The review status and implementation status of the recommendations are listed in the charts below.

OREGON DEPARTMENT OF FORESTRY
Implementation Management Plan Review

MGO Recommendation Implementation Status as of April 2022

				Risk Rating as of April 2022		
	Rec	Category	Theme	High	Medium	Low
Implemented	1	Policies & Procedures	Cost Share Agreements	↓		X
	2	Policies & Procedures	Cost Share Settlements	↓		X
	3	Policies and Procedures	Cost Share Collections	↓		X
	16	Oversight	Board of Forestry Oversight		↓	X
	27	Information Technology	OregonBuys			– X
In Progress	4	Policies & Procedures	Cash Flow Projections	↓	X	
	7	Information Technology	Cost Estimates	↓	X	
	9	Policies & Procedures	AP	↓	X	
	13	Oversight	Oversight Reports		– X	
	15	Oversight	ODF Standardized P&P		– X	
	17	Oversight	District Finance/Accounting Oversight		– X	
	20	Finance/Accounting Resources	Finance/Accounting Resources		– X	
Not Under Review	5	Policies & Procedures	Accounts Receivable Collections	X		
	6	Information Technology	Policies and Procedures Storage	X		
	8	Information Technology	BRIO Report Access	X		
	10	Information Technology	Electronic Records	X		
	11	Information Technology	Information Technology Systems	X		
	12	Budget	Annual Rate Assessment	X		
	14	Training	Training		X	
	18	Oversight	Change Management		X	
	19	Policies & Procedures	Invoicing		X	
	21	Finance/Accounting Resources	Finance/Accounting Skillsets		X	
	22	Information Technology	ODF Online Financial Reporting System		X	
	23	Budgeting	Budgeting Requirements		X	
	24	Budgeting	Budgeting Reconciliation		X	
	25	Policies & Procedures	Operating Associations Advances			X
	26	Policies & Procedures	FEMA			X
	28	Budgeting	Encumbrances			X

X is the current rating of the recommendation as of April 2022.
↓ in the box of the April 2021 risk rating means the risk rating as of April 2022 has been lowered.
↑ in the box of the April 2021 risk rating means the risk rating as of April 2022 has been increased.
– in the box of the April 2021 risk rating means the risk rating as of April 2022 has not changed.

AREAS TO HIGHLIGHT

In this review cycle, five of the twelve recommendations under review have been deemed implemented. Recommendations 1, 2, and 3 focused on developing policies and procedures related to cost share agreements, cost share settlements, and cost share collections. Effective April 12, 2022, ODF completed implementation of Recommendation 16 by codifying the Oregon Department of Forestry Policy Document entitled Financial Oversight of the Board of Forestry. The policy formalizes policy and procedures that define its financial oversight. Lastly, Recommendation 27 focused on the transition of vendors to the use of OregonBuys as the primary system for end-to-end eProcurement processing. Detailed observations for these recommendations are located in the Implemented section of this report.

ODF has also made substantial progress in its organizational restructuring to improve oversight of personnel with finance and accounting responsibilities. Notably, ODF has moved the Protection Finance Unit under the direction of Finance Services within the Administrative Branch. More detailed observations are provided in the summaries for Recommendations 15, 17, and 20 located in the In Progress section of this report.

AREAS FOR MANAGEMENT ATTENTION

Recommendation 8 – Brio Report Access will be reviewed for relevancy and/or a recommendation modification in the next cycle. The April 2021 report recommended that District Offices be provided with read-only real-time access to key financial data within BRIO and trained on the purpose of reports in the system and how to run them.[1] However, the use of the BRIO system may be discontinued.

We will also continue to monitor the recommendations in the In Progress section. The summaries provide insight into what information and/or actions are necessary to deem the implementation of the recommendations completed.

Lastly, we encourage input from the Board and ODF regarding which recommendations to prioritize. We will factor the feedback into our next cycle of review.

[1] The term District Offices is a term that is inclusive of district, state, and unit headquarters, as well as the protection districts and units within the Oregon Department of Forestry.

IMPLEMENTED

COST SHARE AGREEMENTS

Recommendation Number: 1

Implementation Status: Implemented

Risk Rating: **Report: High** **April 2022 Review: Low**

Recommendation

The ODF Operations and Administrative Branches should clearly define policies and procedures for cost share agreements to ensure the terms utilized by the District Offices are appropriate (based on applicable regulations) and to ensure the ODF Operations and Administrative Branch are kept informed of the cost share terms and status.

Key Items to Deem Recommendation Implemented

1. Formalized, written, and clearly defined policies and procedures for cost-sharing agreements.
2. Communications mechanisms to ensure ODF Operations and Administrative Branch are informed about cost sharing terms and status.

Implementation Status Analysis

This recommendation is implemented, and the risk rating reduced to low. The core issues identified in the report were that the ODF Operations and Administrative Branch was not consistently included in the cost share agreement decision-making process and was not consistently informed of agreement terms prior to reconciliation. Also, the current cost share agreement policies and procedures did not include procedures for ongoing monitoring or interdepartmental communication of executed cost share agreements.

Based on discussions and a review of documentation, ODF has developed formalized, written, and clearly defined guidelines for cost sharing agreements and communications. Notably:

- The Master Cooperative Wildland Fire Management and Stafford Act Response Agreement and the Oregon Operating Plan outline specific steps for developing cost share agreements, including acceptable methodologies and guidance on the distribution and review of agreements – including the routing of agreements to designated ODF Operations and Administrative Branch personnel.

- Chapter 80 Cost Share Field Procedures set policies and procedures for establishing, tracking, reconciling, and settling expenditures associated with cost share agreements. This includes guidance for acceptable methodologies, completing weekly and daily cost summaries, completing reconciliation spreadsheets, identifying personnel for settlement attendance, and outlining decision-making authority limits relative to settlements.

- The codification of cost share tracking procedures, effective June 30, 2021, that require the use of tracking spreadsheet as a tool for communicating the status and terms of cost share agreements. Data captured includes estimated fire costs, estimated ODF expenses, settlement date, and estimated settlement amount and is updated daily and communicated weekly and bi-monthly to designated personnel.

COST SHARE AGREEMENTS

Recommendation Number:	**2**	
Implementation Status:	**Implemented**	
Risk Rating:	**Report: High**	**April 2022 Review: Low**

Recommendation

The ODF Operations and Administrative Branches should establish formal policies regarding cost share decision making authority limits and settlement attendance.

Key Items to Deem Recommendation Implemented

1. Formalized, written, and clearly defined policies and procedures for cost-sharing settlements, specifically with directives for decision-making authority limits and settlement attendance.

Implementation Status Analysis

This recommendation is implemented, and the risk rating reduced to low. The core issues identified in the report was that lack of authority limits and/or formal procedures related to settlement attendance could result in unauthorized individuals entering commitments on behalf of ODF.
Based on discussions and a review of documentation, ODF has developed formalized, written, and clearly defined guidelines for cost sharing settlements. Notably:

- The Master Cooperative Wildland Fire Management and Stafford Act Response Agreement Document provides cost share settlement guidance with direction on how to conduct the reconciliation process. The process includes using a reconciliation balance sheet for billing and states the period for submitting final invoices for settlement (within 30 days of final reconciliation).

- Chapter 80 Cost Share Field Procedures set policies and procedures for establishing, tracking, reconciling, and settling expenditures associated with cost share agreements. This includes guidance for cost share settlements including identifying personnel for settlement attendance and outlining decision-making authority limits relative to settlements. Specifically,

    - The steps in the cost settlement process include developing a narrative to recap the final signed cost share agreement. The narrative is the foundational directive on how expenses of the fire are determined eligible/not eligible between agencies. The process also states

that incident finance staff from each agency agree on a date to jointly review each other's financial documentation. Subsequently, the parties agree on final costs to each agency.

- Decision-making authority limits are set in Chapter 80 of the Green Book and in the Oregon Department of Forestry Policy Document for Delegation of Authority, effective December 31, 2021. The Delegation of Authority policy document describes types of authority (e.g., accounting batch release authority, expenditure authority, proxy use in OregonBuys, etc.) and limits by level (e.g., State Forester, Deputy State Forester, etc., have unlimited expenditure authority, etc.).

COST SHARE COLLECTIONS

Recommendation Number: **3**

Implementation Status: **Implemented**

Risk Rating: **Report: High** **April 2022 Review: Low**

Recommendation

Formal procedures related to cost share partner collection efforts should be implemented and include, at minimum, monthly reconciliation and collection meetings with the respective cost share partners. Additionally, roles and responsibilities should be clearly defined between ODF Operations and Administrative Branches as related to collection efforts.

Key Items to Deem Recommendation Implemented

1. Formalized, written, and clearly defined policies and procedures for cost share collection procedures which include, at minimum, monthly reconciliation and collection meetings with cost share partners and clearly defined roles and responsibilities for collection efforts between ODF Operations and Administrative Branches.

Implementation Status Analysis

This recommendation is implemented, and the risk rating reduced to low. The core issues identified in the report were: 1) collection efforts with cost share partners were performed on an as needed basis; and 2) formalized policies and procedures related to ongoing cost share collection efforts, including defined roles and responsibilities, did not exist. The lack of formalized policies and procedures placed ODF at risk of increases in aging of past due balances, which would negatively impact the availability of cash.

Based on discussions and a review of documentation, ODF has demonstrated that it has formalized policies and procedures that delineate the frequency of review and that clearly define the roles and responsibilities associated with cost share collection efforts. Notably:

- ODF codified the AR/AP Aging Meeting Procedures, effective 6/30/21, to provide guidelines for collecting accounts receivable associated with federal cost share agreements that have incident costs that have been settled and billed for cost recovery. The guidance includes directions for recording AR/AP aging and expectations for meeting frequency (quarterly and monthly) review.

Moreover, ODF is following its protocols as demonstrated by the AR/AP tracker with BLM/USFS recoding items such as incident name and date, AR/AP status, amount to date, and ongoing comments between ODF and BLM/USFS that communicate progress towards closure.

BOARD OF FORESTRY OVERSIGHT

Recommendation Number:	**16**	
Implementation Status:	**Implemented**	
Risk Rating:	**Report: Medium**	**April 2022 Review: Low**

Recommendation

Formalized policies and procedures should be established by the Board of Forestry (BOF) related to financial oversight of ODF, including clearly defining the reporting requirements of ODF to the BOF.

Key Items to Deem Recommendation Implemented

1. Formalized, written, P&Ps for reporting (financial oversight) of ODF financial activities to BOF, including reporting requirements

Implementation Status Analysis

Implementation of this recommendation is implemented, and the risk rating reduced to low. The core issue identified in the report was that the Board of Forestry (BOF) has a statutory responsibility to oversee the expenditures incurred by ODF, but that reporting of finance related activities to the Board was limited and inconsistent. Such inconsistency would result in a lack of adequate oversight and transparency of finance related activities to the BOF.

Based on inquiries, ODF represented that monthly financial conditions reports have been submitted to the Legislative Fiscal Office, Chief Financial Office, Oregon State Treasury, Board of Forestry, and Governor's Office since Fall of 2020. MGO reviewed the reports from the most recent quarter (January, February, and March 2022) to confirm the completeness of these reports. The reports include summaries related to cash balances, Fire Protection Division's General Fund appropriation, debt carried, cost awaiting reimbursement from federal agencies, projections, and accounts payable and receivable.

Additionally, effective April 12, 2022, the Board codified the Oregon Department of Forestry Policy Document entitled Financial Oversight of the Board of Forestry. The policy includes responsibilities and standards pertaining to financial reporting, financial policies and procedures, financial planning, and financial management. Notably, the policy requires ODF to provide the Board with financial information, including:

- Quarterly agency actuals to budget and financial statements with performance indictors relevant to financial position, operations, and cash flows
- Comparative views of current financial performance compared to that of previous years

It also requires ODF to ensure policies and procedures for financial transactions are documented, reviewed, and updated and ensure that financial policies and procedures are being followed.

OREGONBUYS

Recommendation Number:	**27**	
Implementation Status:	**Implemented**	
Risk Rating:	**Report: Low**	**April 2022 Review: Low**

Recommendation

All vendors should be required to register in OregonBuys. If a vendor refuses to register within OregonBuys, then the vendors should be entered into the system by DAS and/ or ODF and communication should be provided to the vendor related to the use of OregonBuys. Once all vendors have been input into OregonBuys, all previous purchasing systems should have input access removed.

Key Items to Deem Recommendation Implemented

1. Demonstration that vendors are registered in OregonBuys, that there is a process for vendors refusing to register within OregonBuys, and that previous purchasing systems are no longer accessible by employees for use in creating purchase orders for payment.

Implementation Status Analysis

This recommendation is implemented, and the risk rating remains low. The core issues identified in the report was that certain vendors were not registered in OregonBuys resulting in District Offices continued use of the predecessor purchasing and payment system. Using the predecessor systems in addition to OregonBuys could result in missed payments and/or incomplete financial information.

OregonBuys is a web-based solution providing end-to-end eProcurement processing. ODF has completed its implementation of OregonBuys and discontinued the use the of the Forestry Order System (FOS). ODF has established a policy requiring all vendors to be registered in OregonBuys and for all purchases to be made through OregonBuys for all procurement related and purchasing activities (e.g., purchases from price agreements, competitively bid goods and services and direct awards). For applicable vendors that refuse to register in OregonBuys and/or payments that may fall under certain exemptions, ODF has developed a process where the employee completes the Forestry Purchase Order Form (FPO) to request payment on a vendor's invoice, and the Accounts Payable Unit uses the form to enter information into the system for payment.

The January 2022 Edition of the OregonBuys Project eNewsletter bulletin issued by the Oregon Department of Administrative Services (DAS), identified a list of transaction exemptions that are not considered procurement-related. These exemptions are not to be processed in OregonBuys and "will continue to be processed using existing agency methods." Examples of these exemptions are as follows:

- Utilities
- Rent
- Agency to agency invoices (Balance Transfers)
- Non-goods or services.

Furthermore, ODF has established that one-time purchases from or grant payments to individuals, nonprofit, for profit and/or governmental entities that are not likely to have recurring business with ODF are also excluded from the OregonBuys process to reduce administrative burden.

Moreover, as of July 2021, FOS is no longer accessible for employee use. The data has been extracted and data access is available via a server reporting tool for historical data lookup.

Lastly, effective December 31, 2021, ODF codified its Oregon Department of Forestry Policy Document for Delegation of Authority. This guidance describes authority limits by level, including authority for approval paths within the security of the OregonBuys system.

IN PROGRESS

CASH FLOW PROJECTIONS

Recommendation Number:	**4**	
Implementation Status:	**In Progress**	
Risk Rating:	**Report: High**	**April 2022 Review: Medium**

Recommendation

ODF Administrative Branch should develop and implement controls/policies/procedures as related to accounts payable, accounts receivable, and cash flow projections. Procedures related to accounts payable and receivables should include recording details at a transactional level, when possible.

Key Items to Deem Recommendation Implemented

1. Demonstration of policies and procedures and controls for accounts payable (AP), accounts receivable (AR), and cash flow projections. Should include recording details at transactional level for AR and AR when possible.

Implementation Status Analysis

This recommendation is in progress and the risk rating has been reduced to medium. The core issues identified in the report were that: 1) formalized policies and procedures related to cash flow projections did not exist; and 2) the ODF Administrative Branch lacked the ability to appropriately estimate or project future cash flow due to the lack of accurate accounts payable and accounts receivable data.

Based on discussions, email reviews, and a review of documentation, ODF developed a Statewide Outstanding Assets and Liabilities Tracker and CO-OP Tracker. The purpose of the tracker is to create a collaborative tracking mechanism for outstanding assets (accounts receivable) and liabilities (accounts payable) for cash flow planning and financial reporting. The tracker is designed to capture items that are not able to be officially invoiced under GAAP guidance allowing ODF to estimate and monitor upcoming/potential costs. With this interim tracking supplementary to other financial data, ODF has additional information at its disposal for cash flow projection analyses.

Moreover, the tracker is to: 1) be updated at least monthly; 2) include outstanding accounts receivable and accounts payable; 3) be included in bi-weekly collaborative meetings; and 4) reflect payments in OregonBuys and invoices in Sage.

The reliability of the estimates from this data is only as good as the timeliness of data input. While reviewing the tracker, we observed that at least two District Offices had not updated their AR/AP entries in over a month or more. While ODF does notify late District Offices, it is worth stating that management, the Board, and Legislature, should continue to voice their expectations about the importance of timely completion of the tracker to encourage continued adherence to process regarding their roles in ensuring all parties have access to reliable cash flow data.

Lastly, ODF has developed training videos, on topics such as cost shares, payments and audits, etc., that provide instruction on policies and procedures related to ODF finance and accounting. The policies and procedures are formalized in documents such as the Green Book and internal policy documents. Moreover, ODF has developed a Financial Outlook for Fiscal Years 2022 and 2023 which includes budgeted data, timber revenue projections, extra costs projections, and reconciliation and cash adjustments.

This recommendation will remain open to monitor the progress, consistency, and efficacy of cash flow projections, including data inputs, transactional level detail, policies and procedures, etc.

COST ESTIMATES

Recommendation Number:	**7**	
Implementation Status:	**In Progress**	
Risk Rating:	**Report: High**	**April 2022 Review: Medium**

Recommendation

The ODF Executive Team (with the ODF Operations and Administrative Branch) should limit cost estimate generators to e-ISuite and FIRES. The ODF Operations and Administrative Branches should define policies and procedures related to the use of the two systems and provide onboarding and ongoing training to ensure all personnel understand how to properly and efficiently use the systems.

Key Items to Deem Recommendation Implemented

1. Demonstration that systems for generating cost estimates has been reduced to e-ISuite and FIRES.
2. Demonstration of formalized P&P related to use of the systems.
3. Demonstration of onboarding and training schedules and/or completed activities.

Implementation Status Analysis

The implementation of this recommendation is in progress and the risk rating reduced to medium. The core issues identified in the report were that: 1) multiple systems are utilized for generating cost estimates; and 2) policies and procedures did not specifically define the criteria for determining which cost estimate systems would be utilized by incident.

Based on discussions, a review of the Management Response in the April 2021 report, and a review of documentation, ODF sees value in having the flexibility of using all three cost share estimate solutions – e-iSuite, EFCC, and FIRES. For ODF, each system serves the needs of the project in which it is used. For example, federal agencies use e-iSuite and ODF uses e-iSuite for large fires. ODF uses FIRES for cost estimates on smaller district fires and input of other non-finance related incident data. ODF also uses an Excel spreadsheet in the field during the first few days of a incident, which is more expedient that setting up e-iSuite (which needs internet availability in the field, etc.) while providing a tool for tracking cost estimates.

ODF has developed policies and procedures in the Chapter 80 Cost Share Field Procedures manual that describe how to process cost share estimates within the various solutions (e.g., templates for weekly cost summaries, weekly cost detail, spreadsheets with predefined rates, etc.). ODF has also developed training videos, on topics such as cost shares, payments and audits, etc., that provide instruction on policies and procedures related to ODF finance and accounting.

This recommendation will remain in progress this cycle as discussions continue regarding the use of all three systems and conducting due diligence to ensure that whether the final determination is the use of one system or the continued use of multiple systems, the chosen option will produce data that is not duplicated and will produce data that is consistent accurate (as best of possible for estimates), and complete.

Furthermore, whether using one system or multiple, policies and procedures and training content and materials should be continually updated to reflect current practices and systems.

ACCOUNTS PAYABLE

Recommendation Number: 9

Implementation Status: In Progress

Risk Rating: Report: High April 2022 Review: Medium

Recommendation

ODF Administrative Branch should implement processes and procedures related to expense accruals and consider the use of purchase orders within OregonBuys.

Key Items to Deem Recommendation Implemented

1. Formalized, written, and clearly defined policies and procedures related to expense accruals
    a. Inclusive of Purchase Orders being utilized prior to receipt of vendor invoices.
2. Demonstration of ODF's assessment and decision regarding the use of purchase orders within OregonBuys

Implementation Status Analysis

This recommendation is in progress and the risk rating reduced to medium. The core issues identified in the report were that: 1) purchase orders (POs) were not utilized for purchasing goods and services prior to the receipt of vendor invoices; and 2) vendor invoices took years for ODF to receive. Notably, POs were created within the OregonBuys system after vendor invoices were received for payment. A PO should be created prior to invoicing as it details items to be purchased, the quantity and price of those items, and is the source document for tracking expenditures prior to invoice payment. OregonBuys is a web-based solution providing end to end eProcurement processing.

Based on discussions, email reviews, and a review of documentation, ODF developed a Statewide Outstanding Assets and Liabilities Tracker and CO-OP Tracker that provides monthly updates of outstanding assets (accounts receivable) and liabilities (accounts payable) for the purposes of cash flow planning and financial reporting.

Moreover, ODF is entering a Phase II Implementation that will activate a purchase order module with OregonBuys. ODF has required all vendors to be registered in OregonBuys and for all purchases to be made through this system. For vendors that refuse to register in OregonBuys, ODF has developed an additional process where vendor information is entered into the Forestry Purchase Order Form and entered in the system by Accounts Payable. Effective December 31, 2021, ODF codified its Oregon Department of Forestry Policy Document for Delegation of Authority. This guidance describes authority limits by level, including authority for approval paths within the security of the OregonBuys system.

This recommendation will remain open to monitor the progress of the phase II OregonBuys Implementation and to monitor and/or recommend supplementary adjustments like updates to policies and procedures. The goal of implementation is to mitigate risks associated with creating purchase orders after invoicing including changes in agreed-upon pricing, inability to track orders, difficulty in expense monitoring, etc.

OVERSIGHT REPORTS

Recommendation Number: **13**

Implementation Status: **In Progress**

Risk Rating: **Report: Medium** **April 2022 Review: Medium**

Recommendation

ODF Administrative Branch should establish documented controls/policies/procedures related to oversight of fire protection finance, including the preparation and timely review of standardized reports.

Key Items to Deem Recommendation Implemented

1. Demonstration of policies and procedures and controls in the oversight of fire protection finance, including preparation and timely review of standardized reports

Implementation Status Analysis

This recommendation is in progress and the risk rating remains at medium. The core issues identified in the report were that: 1) reports for oversight of fire protection appear to be ad-hoc and manually manipulated: and 2) formalized policies and procedures related to preparation and review of fire protection finance did not appear to exist. The use of ad-hoc and manually manipulated reports could result in use of incomplete and inaccurate data for management decisions.

Based on inquiries, ODF represented that monthly financial conditions reports have been submitted to the Legislative Fiscal Office, Chief Financial Office, Oregon State Treasury, Board of Forestry, and

Governor's Office since Fall of 2020. MGO reviewed the reports from the most recent quarter (January, February, and March 2022) to confirm the completeness of these reports. The reports include summaries related to cash balances, Fire Protection Division's General Fund appropriation, debt carried, cost awaiting reimbursement from federal agencies, projections, and accounts payable and receivable.

Additionally, effective April 12, 2022, the Board codified the Oregon Department of Forestry Policy Document entitled Financial Oversight of the Board of Forestry. The policy includes responsibilities and standards pertaining to financial reporting, financial policies and procedures, financial planning, and financial management. Notably, the policy requires ODF to provide the Board with financial information, including:

- Quarterly agency actuals to budget and financial statements with performance indictors relevant to financial position, operations, and cash flows
- Comparative views of current financial performance compared to that of previous years

It also requires ODF to ensure policies and procedures for financial transactions are documented, reviewed, and updated and ensure that financial policies and procedures are being followed.

Moreover, ODF has developed a Statewide Outstanding Assets and Liabilities Tracker and CO-OP Tracker that provides monthly updates of outstanding assets (accounts receivable) and liabilities (accounts payable) for the purposes of cash flow planning and financial reporting.

This recommendation will remain open to monitor the progress, consistency, and usefulness of the reports and to monitor and/or recommend supplementary adjustments like updates to policies and procedures.

ODF STANDARDIZED POLICIES AND PROCEDURES

Recommendation Number:	**15**	
Implementation Status:	**In Progress**	
Risk Rating:	**Report: Medium**	**April 2022 Review: Medium**

Recommendation

ODF Operations and Administrative Branches should develop and implement standardized processes and procedures for the District Offices, and assist in the implementation and continued oversight of the processes and procedures to ensure consistency in application.

Key Items to Deem Recommendation Implemented

1. Formalized, written, policies and procedures for District Offices that will minimize independent operation.
2. Demonstration of continued oversight of policies and procedures.

Implementation Status Analysis

The implementation of this recommendation is in progress with the risk rating remaining at medium. The core issues identified in the report were that: 1) District Offices appeared to operate independently; and 2) District Offices lacked standardized processes and procedures.

To assist in addressing the District Offices operating independently, ODF has reconfigured its organizational structure moving the Protection Finance Unit under the direction of Finance Services within the Administrative Branch. ODF has developed and/or updated standardized policies and procedures for District Offices, including the Green Book with guidance on cost accounting and reporting and cost shares, incident payments and coding, etc. ODF has also developed training videos, on topics such as cost shares, payments and audits, etc., that provide instruction on policies and procedures related to ODF finance and accounting.

This recommendation will remain open to monitor whether the organizational change and other efforts are producing the intended result of creating more cohesion amongst the District Offices and ODF and to monitor and/or recommend supplementary adjustments like updates to policies and procedures.

DISTRICT FINANCE/ACCOUNTING OVERSIGHT

Recommendation Number:	**17**	
Implementation Status:	**In Progress**	
Risk Rating:	**Report: Medium**	**April 2022 Review: Medium**

Recommendation

The ODF Administrative Branch should establish policies and procedures related to oversight of finance/ accounting functions within the District Offices. The policies and procedures should include, but not be limited to:

1. Definition of reporting lines from the District Offices to the ODF Administrative Branch.
2. Identification of reporting requirements and key financial metrics from the District Offices to the ODF Administrative Branch.
3. Ongoing monitoring of key financial metrics within the District Offices.

In addition, the ODF Executive Team, with the ODF Operations and Administrative Branches, should set a clear "tone at the top" with respect to financial accountability within the District Offices.

Key Items to Deem Recommendation Implemented

1. Formalized, written, P&Ps that create an organizational structure requiring District Offices to report to ODF. Include:
    a. Definition of reporting lines from District Offices to ODF Administrative Branch

b. Identification of reporting requirements and key financial metrics from District Offices to ODF

c. Ongoing monitoring of key financial metrics within District Offices

2. Demonstration of ODF Executive Team, with ODF Operations and Administrative, setting clear tone at top

Implementation Status Analysis

The implementation of this recommendation is in progress and the risk rating remains at medium. The core issue identified in the report was District Offices operated with limited oversight as related to finance and accounting. The current organizational structure did not include District Offices reporting to the ODF Administrative Branch. Moreover, a clearer "tone at the top" with respect to financial accountability within the District Offices was also recommended.

Based on discussions, email reviews, and a review of documentation, ODF leadership has set a "tone at the top" by demonstrating its commitment to financial accountability within the District Offices. Furthermore, ODF has also reconfigured its organizational structure so that District Offices report to ODF. Notably, ODF has moved the Protection Finance Unit under the direction of Finance Services within the Administrative Branch. Additionally, ODF is in the process of developing clear and appropriate job descriptions (e.g., aligning job duties with commensurate experience and skillsets) as it engages in recruitment efforts for filling vacancies associated with finance and accounting personnel.

ODF has developed and/or updated standardized policies and procedures for District Offices, including the Green Book with guidance on cost accounting and reporting and cost shares, incident payments and coding, etc. It has also developed foundational policies and procedures for tracking, monitoring, and analyzing accounts receivable and accounts payable for financial reporting through documents such as its Cost Share Tracker and the Statewide Outstanding Assets and Liabilities tracker. To that end, ODF has also developed training videos, on topics such as cost shares, payments and audits, etc., that provide instruction on policies and procedures related to ODF finance and accounting.

To deem this recommendation implemented, ODF has expressed that it would first want to ensure that the following policies and procedures and updated:

- Disbursements Policy;
- Credit Card Policy;
- Procurement Policy; and
- Accounting for Revenues and Receivables.

Furthermore, to deem this recommendation implemented, ODF will need to demonstrate how it is monitoring key financial metrics within the District Offices through mechanisms such as the identification of key financial metrics and reporting requirements from the District Offices to the ODF Administrative Branch.

FINANCE/ACCOUNTING RESOURCES

Recommendation Number:	**20**	
Implementation Status:	**In Progress**	
Risk Rating:	**Report: Medium**	**April 2022 Review: Medium**

Recommendation

Job descriptions of current ODF personnel should be reviewed and the following reassignments should be made:

1. Individuals with primarily finance and accounting responsibilities should be reassigned to the ODF Administrative Branch.

2. Finance and accounting related job duties of individuals within the ODF Operations Branch should be reassigned to personnel within the ODF Administrative Branch.

In addition, the ODF Operations and Administrative Branches should review and approve job requisitions with finance and accounting responsibilities to determine whether the roles and responsibilities are appropriate given the position identified.

Key Items to Deem Recommendation Implemented

1. Demonstration of an organizational restructure that ensures those with finance and accounting responsibilities are reporting to appropriate authorities to effectuate better communication and financial oversight

Implementation Status Analysis

This recommendation is in progress and the risk rating remains at medium. The core issues identified in the report were that: 1) under the current organizational structure, personnel with finance or accounting responsibilities report to the ODF Operations Branch rather than the Administrative Branch; and 2) certain positions within the ODF Administrative Branch have finance and accounting related job duties but do not consistently communicate with appropriate personnel within ODF Administrative Branch regarding the execution of those duties.

Based on discussions and a review of documentation, it should be highlighted that ODF has made significant progress in its organizational restructuring. Notably, ODF has moved the Protection Finance Unit under the direction of Finance Services within the Administrative Branch. ODF is in the process of developing clear and appropriate job descriptions (e.g., aligning job duties with commensurate experience and skillsets) as it engages in recruitment efforts for filling vacancies associated with finance and accounting personnel. Additionally, effective December 31, 2021, ODF codified its Oregon Department of Forestry Policy Document for Delegation of Authority. This guidance delegates authority to enter legal

obligations by position and sets authorization limits for items such as expenditure authority, cost share agreement settlement authority, etc.

This recommendation will remain open to monitor whether the organizational change is producing the intended result of facilitating ODF oversight of its finance and accounting personnel and job functions. Also, to monitor whether streamlining the finance and accounting staff is resulting in improved communications related to financial reporting, recording of accounts receivables and payables, and forecasting cash flows.