BEFORE THE STATE OF WASHINGTON

ENERGY FACILITY SITE EVALUATION COUNCIL

In the Matter of the Application of: Scout Clean Energy, LLC, for Horse Heaven Wind Farm, LLC, Applicant	Docket No. EF-210011 MOTION TO SUPPLEMENT THE RECORD

ATTACHMENT B

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In the Matter Of:

In Re: Scout Clean Energy, LLC

JAMES WATSON

July 14, 2023

Job Number: 996615

BEFORE THE STATE OF WASHINGTON

ENERGY FACILITY SITE EVALUATION COUNCIL

In The Matter of the Application of: Scout Clean Energy, LLC, for Horse Heaven Wind Farm, LLC, Applicant	Docket No. EF-210011 CERTIFIED COPY

DEPOSITION UPON ORAL EXAMINATION

VIA VIDEOCONFERENCE

OF

JAMES WATSON

[Witness Located in Burlington, Washington]

DATE TAKEN: Friday July 14, 2023, 9:00 a.m.

JOB NUMBER: 996615

REPORTED BY: Danielle Schemm, CCR 3395

A P P E A R A N C E S

APPEARING FOR YAKAMA NATION:

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(Continued)

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PAM K.M. PINELLI

E X A M I N A T I O N I N D E X

E X H I B I T I N D E X

JAMES WATSON, Witness,

having been first duly sworn by a certified court

reporter, appeared and testified as follows:

EXAMINATION

BY MS. VOELCKERS:

Q Good morning, Mr. Watson. My name is Shona Voelckers. I am attorney for the Confederated Tribes and Bands of the Yakama Nation. This deposition is being taken under the Washington State Rules of Civil Procedure.

Can you please state, again, your full name for the record?

A My name is James Ward Watson.

Q And for the record, we have your legal counsel joining us remotely today as well as counsel for a number of other parties in the proceeding.

Have you ever been deposed before?

A I have.

Q How many times have you been deposed?

A Probably three times, maybe, three or four, maybe.

Q Okay. I'm still going to go over some ground rules for today's deposition so we can create a clean record.

A Okay.

Q And a clear transcript. Everything we both say is being recorded by our court reporter, so it is important

that we speak clearly. Instead of saying mm-hmm or uh-huh, please say yes or no when you answer; do you understand that?
A Yes.
Q It is also important that we don't speak over each other today, so please wait until I finish each of my questions before answering, even if you think you know what the rest of the question will be. Is that okay?
A Yes.
Q You've just taken an oath that requires you to tell the whole truth and nothing but the truth during today's deposition; do you understand that?
A Yes.
Q That is the same oath you would take if you were to testify in court; do you understand that?
A Yes.
Q We are here today to find out everything you know about the topics that we discuss, so please give full and complete answers. If you remember additional information later in the deposition, will you tell me?
A Yes.
Q If I ask an unclear question, will you let me know so I can rephrase the question?
A Yes.
Q When I use the acronym "WDFW" today, I'm referring

to the Washington State Department of Fish and Wildlife; do you understand that?

A Yes.

Q When I use the term "project" today, I'm referring to the Horse Heaven wind and solar project; do you understand that?

A Yes.

Q When I refer to "Scout" or "the applicant" today, I'm referring to Scout Clean Energy, LLC; do you understand that?

A Yes.

Q When I use the acronym "EFSEC" today, I'm referring to the Washington State Energy Facility Site Evaluation Council; do you understand that?

A Yes.

Q And I'm not going to ask you anything today about conversations between you and your legal counsel or for information that's otherwise protected by the attorney-client privilege.

While I expect that your work on the project or with EFSEC may have involved conversations with Mr. John Thompson, my understanding is that he represents EFSEC in this proceeding and does not represent you directly; do you understand that?

A Yes.

Q Therefore, any conversations between you and Mr. Thompson are not protected from attorney-client in the same way that your direct conversations with WDFW's legal counsel; do you understand that?

A Yes.

Q Unless the answer involves privileged communications, I do ask that you answer every question, even if one of the attorneys makes an objection; do you understand that?

A Yes.

Q You were served with a subpoena for this deposition which includes certain sideboards on what I will be asking you about today. I do not intend to ask questions about your direct communications with EFSEC staff or EFSEC's consultants regarding the project or your opinions regarding the draft environment impact statement recently issued for the project. Do you understand that?

A Yes.

Q We are here today to better understand your personal scientific opinion and analysis. If your legal counsel has any concerns about the scope of a specific question that I ask, he and I can resolve those concerns between the two of us on a break; do you understand that?

A Yes.

Q I anticipate that between my questions and those of the other parties who are joining us today, we will be talking at least until lunch, possibly after. I plan to take a break about every 60 minutes. If you need a break before then, please let me know. I only ask that you answer the most recently asked question before taking a break. Is that okay?

A Yes.

Q Is there any reason, medical or otherwise, you cannot give full, complete, and accurate testimony during today's deposition?

A No.

Q I'm handing you what has been marked as Exhibit 1. And for those on Zoom, this was sent on the email, Mr. Watson's CV. Are you familiar with this document?

(Deposition Exhibit No. 1 was marked for identification.)

A Yes.

Q How are you familiar with this document?

A I created it.

Q When was that document last updated?

A Two weeks ago, three weeks ago.

Q Okay. I won't make you walk through it this morning, but is it fair to say that Exhibit 1 includes all of your professional work experience and publications?

A Yes.

MS. PERLMUTTER: Sorry. I don't mean to interrupt, Shona. I don't think we received the CV or it wasn't in this morning's email.
MS. VOELCKERS: Okay.
MS. PERLMUTTER: I hate to be a pain in your neck right off the bat, but it was not in there.
MS. VOELCKERS: No, that's okay. I appreciate that. Let's go off record.
[Off record at 9:11 a.m.]
[On record at 9:14 a.m.]
BY MS. VOELCKERS:
Q So in Exhibit 1, your current position with WDFW is listed as research scientist, with your previous position listed as wildlife research biologist. Can you explain the difference between your previous and current position?
A They're actually identical. It's just a position upgrade, CQ, within the agency. So essentially it's the same position, just a revision in the name.
Q What does your current work as research and scientist entail, generally?
A My research position involves assessing needs of management biologists within the agency, specifically related to raptors, raptor ecology; assessing what those needs are; formulating ideas to -- or resolve those

questions, ways we can develop projects to resolve those questions.

Then developing the projects, conducting the projects, collecting the data, analyzing the data, publishing the data, you know, and reports and peer-reviewed publications, to make that information available for the managers. So essentially my job is a bird's advocate.

Q So is it fair to say that your job is consulting with other agency staff in order to facilitate additional research?

A That would be correct.

Q And then do you also conduct your own research?

A I'm not -- the research I conduct is solely to answer questions within -- you know, management needs within our agency and within our state as far as raptors. So I'm not sure -- my own research -- what that would...

Q So I can ask the question another way.

When you are engaging in WDFW's research --

A Right.

Q -- are you doing it independently or collaboratively with other staff members?

A Collaborative, everything is collaborative, yes.

Q Okay. And what types of work product do you create?

A As I mentioned, two primary work products. One would be typically a report that synthesizes the information that we have generated from the study, that would be provided within the agency and to other agency personnel. It would include information that may not be included in a second type of publication, which would be a peer-reviewed publication, that would be for the scientific community, a more stringent review that would go out into the open literature.

Q What do you understand the goal or purpose of your work as research scientist to be?

A My goal or purpose would be to provide the best science regarding raptor needs within the state of Washington to promote their conservation.

Q During this deposition and this proceeding, Mr. Michael Ritter referred to you as WDFW's "Raptor Specialist." Do you think that's a fair characterization?

A Yes.

Q Is there anyone else currently working for WDFW that has much as expertise as you with regard to falcon species?

A No.

Q What division or program of WDFW do you work within?

A Yes, I work in the wildlife program in the science division.

Q Who are your direct supervisors?

A Brian Kertson is my direct supervisor.

Q And who is his supervisor?

A His supervisor would be Donny Martorello.

Q How is your work as a research scientist for WDFW currently funded?

A Would you repeat that?

Q How is your work as a research scientist for WDFW funded?

A Several funding sources including -- several funding sources, but the two primary sources would be personalized license plates, the nongame or diversity funding that we get as an agency that's distributed for diversity projects, but also through individual contract studies that I would develop with other people that are interested in doing research and providing funding of that research.

Q Is any of your work funded by WDFW's contract with EFSEC?

A No.

Q How often do you work with Michael Ritter?

A Regularly work or consult with Mike monthly.

Q What characteristics of a project determine whether or not you would be consulting with Michael Ritter

on in his role?

A Right. Mike would request my assistance for input when it involves raptors. Specifically and most typically it would be Golden Eagles, ferruginous hawks, species that are of interest, conservation-needing species within the state. So those two are of particular importance.

Q So you are based out of Concrete, which is very much the northwest corner of the state. Prior to engaging on the project, the Horse Heaven Hills project, were you familiar with the Horse Heaven Hills area?

A Yes, I was.

MS. VOELCKERS: Can we go off record?

[Off record at 9:21 a.m.]

[On record at 9:22 a.m.]

BY MS. VOELCKERS:

Q How are you familiar with the Horse Heaven Hills area?

A Some of the early ferruginous hawk research that I conducted, beginning back in the early 2000s, that was part of our project area which included, you know, the Benton County region. So I spent time at the nest sites located there to understand the birds ecology.

Q So is it fair to say, then, that you are familiar with the area because of its importance to the species?

A That's correct.

Q The ferruginous hawks?

A Yes.

Q Prior to your involvement with the project, what was your understanding regarding which wildlife species and habitat impacts would be of concern for new renewable energy development in the Horse Heaven Hills?

A Restate it one more time, please.

Q Prior to your involvement with the project, what was your understanding regarding which wildlife species and habitat impacts would be of concern for new renewable energy development in the Horse Heaven Hills area?

A Probably -- probably at least ferruginous hawks, burrowing owls, prairie falcons. Those would be the three species of which I would recognize in that area as being of potential concern.

Q Before knowing any specifics about a project, correct?

A That's correct.

Q And why is that?

A Those three species, based on my background and understanding, have particularly -- are particularly susceptible to impacts from human activities in Washington. Those species have been identified as having particular concerns related to their populations and potential for declines - particularly with ferruginous hawks as an endangered species and kind of a precarious status for burrowing owls and uncertain status for prairie falcons.

Q We are primarily here today to talk about the ferruginous hawk. Before we go further, though, in discussing the species, I want to make sure that I understand how you are using specific terms. So when we use the phrase "core-use areas" today with reference to the ferruginous hawk, what do you understand that phrase to mean?

A Core use is typically used in raptor studies to identify a use area that's of primary importance around -- within a ferruginous hawk home range, another term. But home range is the broader area that the birds use during a nesting season and throughout the year.

So the core area is the area they use most intensively, typically including nests, some of the key prey, the most frequently used areas by a particular pair of birds.

Q My next question was going to be about the home range, the use of that term, so I think you've answered that. Is there anything else you'd like to add about the meaning of the home range for the ferruginous hawk?

A Well, the home range would include the whole area that we know the birds need to provide for nesting during nest season, that the birds may expand out from that core area. And then within that, there's actually what's called a territory, if that terms comes up, which is a defended portion of the home range. It's a little, small area; I don't know if we'll come across that term.

But the core area, again, and home range, those are the two key concepts when we talk about the birds' use of a particular area and where they're nesting.

Q   And when you refer to a defended territory, what is the bird defending from?

A   Bird is defending from adjacent nesting pairs. So it's basically the birds are identifying an area that they need to protect in order to nest successfully, and that would be defended by from adjacent birds.

Q   Adjacent ferruginous hawks?

A   That would be correct.

Q   Okay. And how do you define an active nesting site?

A   That term is actually not a good term. It's one that's a little bit obsolete as of the last ten years. It was typically used in the past to define a nest that was being actively used by a pair of birds. The more accurate use and terminology would be a nest that is being used on an occupied territory.

By way of explanation, a pair of birds can use more than one nest. They may have alternative nests, and we are interested, when we manage these birds, in the territory concept rather than the nest concept. We're interested in protecting what the birds are using as far as all their nests and not simply one nest. So that's why we have a broader perspective there.

Q And that broader perspective is based on best available science?

A That would be correct.

Q And if I use the terms unartfully today and incorrectly today, will you correct me?

A Yes.

Q Okay. How do you define an historic nesting site?

A An historical nesting site would be, again, conceptually a territory that has previously been used by birds overtime and we have documented use by, in this case, for ferruginous hawks on that particular territory.

You're using the word "site."

Q Uh-huh.

A Which is another obsolete term, but we would use the word territory. It's been used by ferruginous hawks in the past. It's been documented at some point.

Q So I'm going to try to use a hypothetical here to try to use the right terms I'm hearing. So is it -- if you were to observe a pair in a nest, would you then refer

to that as an occupied territory?

A That's correct.

Q Okay.

A And the nest they were using would be the nest -- the used nest for that season; other nests would be alternative nests.

Q And is it possible for them to use an alternative nest that same season, or would you expect to see that the next year or two?

A They may perch on the alternative nest, perch around it, but they won't actually be nesting in that nest, laying eggs, that kind of thing.

Q Based upon your research and experience, is it important to avoid siting solar projects close to occupied ferruginous hawk territory?

A Solar projects?

Q Yes.

A So little is known about solar projects that much of what we understand would be an issue has not been demonstrated through active, engaging projects with actual -- actually how the birds are responding.

However, based on what we know about solar projects and the intensity of use of those solar projects when they are built - and have been in a few cases, have been built near nesting hawks - they occupy or remove habitat. So habitat loss is the number one concern from solar projects just because of the density of the projects and the size and scope of some of these projects.

Q And based upon your research and experience, is it important to avoid siting wind projects close to occupied ferruginous hawk territory?

A Yes.

Q And why is that?

A Little background information, ferruginous hawks are a classic sensitive species. They're sensitive to disturbance. They're also a specialized species in terms of diet. They're dietary specialists. They feed primarily on burrowing mammals as well as rabbits, and they're specialized on feeding on those.

Because of that, they're associated with particular habitats where those species are found - typically shrubsteppe habitats and native habitats. The sensitivity of the species has been demonstrated from years ago. They're much akin to a Spotted Owl, in the owl world, that would be sensitive to human activities.

So combining those things, wind projects really have potentially a three-fold impact on ferruginous hawks. Number one, the direct mortality concerns when turbines are built within the core areas that we discussed. Because the birds are using those areas on a regular basis, flying in and out of turbines that are built on the territory, it increases the probability that it's going to be struck by a turbine at some point, which has been demonstrated.

But the reality is that's not where the impacts of wind turbines or other intense development would impact ferruginous hawks. The longer-term perspective is habitat alteration. These birds, as I mentioned, this species is sensitive to habitat alteration. They are what I would call "anthropogenically sensitive species," unlike other raptors. Anthropogenic is the idea of human activity and how do birds relate to that. So these bird are sensitive to changes within that habitat.

In the longer term, then, that presents an issue because as we alter habitat, that we are attempting to protect the quality of that habitat such that new birds will move into that habitat and nest there, we're reducing the probability of that happening with this species because they're sensitive to that habitat alteration.

There's a third point, though, related to wind turbine development and other intense development or human activities that is a -- kind of a really insidious one, and that is we're increasing the probability of competing or predating species of moving into those developed areas.

Those species would be more anthropogenically favored by human activities - that is, they're more tolerant of it - and those would include such things as ravens, common ravens, great horned owls, red-tailed hawks, Swainson's hawks.

But at least the first two species, critically, those are species that predate -- not just compete with but they actually predate ferruginous hawks.

So the problem is when we alter these habitats, making them less favorable to future generations of ferruginous hawks, we may also be inviting these other species that compete and predate them into those areas, so it's kind of a double whammy.

So that's kind of, in a nutshell, how I would look at the impacts of wind turbine development on ferruginous hawks kind of collectively.

Q Thank you for that nutshell summary. I'll ask for your patience for some repetition later when I get into some of the specific studies.

A Sure.

Q Thank you for that. You mentioned shrubsteppe. What is the importance of shrubsteppe habitat to the ferruginous hawk?

MS. PERLMUTTER: I'm sorry. What's the importance of what kind of habitat?

MS. VOELCKERS: Shrubsteppe. Shrubsteppe.

MS. PERLMUTTER: Can you spell it, please?
MS. VOELCKERS: S-h-r-u-b-s-t-e-p-p-e.
MS. PERLMUTTER: Thank you.
A And I would -- shrubsteppe could include -- actually, because the species, if we look range-wide, it would include native grasslands, other native habitats, and the key is the word native.
Ferruginous hawks are a tertiary consumer, which means they are not tied directly to the habitat. They are tied to the prey that's found within those key habitats. And that would be unlike -- sage-grouse would be a species that is tied, actually, to the habitat.
This species is tied to the prey in the habitat; meaning those native prey that I mentioned: The fossorial mammals, those that burrow; ground squirrels; in other places, prairie dogs, pocket gophers; as well as jackrabbits, cottontails, the leporids, the rabbit species - so those species, unlike others that may thrive in a disturbed environment, you know, that are not tied to native habitats.
The key would be these birds are going to where those prey exist in the landscape, the forage.
Q [BY: MS. VOELCKERS] What is the importance, if any, of arid agricultural land to the ferruginous hawk?
A We've found over the years, past few years, as

ferruginous hawk populations have actually declined in some places, that some of the birds actually are persisting by feeding on pocket gophers associated with some of the edges of some of this agricultural land.

Now, large-scale, monotypic AG land is not going to be a benefit to ferruginous hawks, but the edges - and a lot of times these are irrigated edges where pocket gophers persist on hillsides next to the agricultural land - those may be key foraging areas for ferruginous hawks that are unable to find, you know, ground squirrels or other prey in their environment.

Q And then what is the importance of irrigated agricultural habitat to the ferruginous hawk?

A The importance of that would be the causing these -- or enhancing these pocket gopher populations; maybe I didn't make that clear. But that would be the edges potentially are where these pocket gophers would persist in this irrigated agricultural.

Q Could they persist in the arid agricultural or only the irrigated agriculture?

A No, they could persist in different -- the key is the mono -- the species would not be favored by large monotypic stands of agriculture where there is no opportunity for prey to persist. But the edges, whether it's arid or irritated, would also be opportunities for these birds to forage.

Q You can give that one to our court reporter.

A Okay.

Q Thank you. Handing you what's been marked Exhibit 2, and for those online, this is the periodic status report or review that I'm pretty confident was all emailed to everyone, but please let me know if you don't have it.

(Deposition Exhibit No. 2 was marked for identification.)

MS. PERLMUTTER: Which document is this?

Q [BY: MS. VOELCKERS] The periodic status review.

Are you familiar with this document?

A Yes, I am.

Q What is this document?

A This document is a review of the status of the ferruginous hawk, formally listed as a threatened species. It's a process and a document, resulting document, that is used for species of concern that are listed -- periodically their status is reviewed to see if we're making progress as far as their recovery.

Q And did you contribute to this document?

A I did. I'm one of the coauthors, yes.

Q On page 3 -- the little 3, sorry.

A The executive summary?

Q Yes, the executive summary.
A Okay.
Q I don't know exactly how to say "the little 3."
But the executive summary refers to an average count of 55 breeding pairs in Benton County between 1992 and '95. Do you know approximately how many breeding pairs are left in Benton County today?
A That would be a question I would have to look up for the answer. That information, too, is based on, of course, the earlier status review and initial review of the plan, so it's older information. But I'd have to look up that specific information.
Q Okay. And again, for this question, would you be able to look up approximately how many breeding pairs are left today in Washington state as a whole?
A I would, and actually there's updated information. We conducted a 2021 statewide survey. We had 34 occupied territories out of the historical 284 territories, and I believe 27 of those actually produced young. So statewide we had 34 pairs that were occupying historical territories.
Q So less statewide today than in just Benton County --
A That's correct.
Q -- a couple decades ago, correct?

A That's correct, yes. Sorry.

Q I have some general questions not tied to the exhibit, so you can put it down, if you like.

A Oh, okay.

Q Based on your research and understanding of ferruginous hawk biology, what are the main factors contributing to the decline of the breeding population of ferruginous hawks in Washington state?

A The decline is related back to the key ecological need which is prey, first and foremost, loss of ground squirrels in the state. Two species of ground squirrels - Washington ground squirrel, Townsend's ground squirrel - are both candidates for species listing; meaning they decline precipitously.

So whereas in other areas this species will thrive on ground squirrels, hawks in our state have to make a living on other prey. And that's all related largely to loss of -- loss of native habitats to agriculture and agricultural invasion.

It's also related to mortality. Mortality is a key issue. These birds are away from Washington for six to seven, possibly seven, months of the year when they migrate and are exposed to a lot of other mortality factors outside the state. But also within the state, there are still issues related to wind turbine mortality,

shooting mortality, other factors.
So those are -- those are two of the primary issues facing ferruginous hawks in our state.
Q Is it correct to say that home-range sizes and core-use areas are larger for ferruginous hawks in Washington than in other western states?
A That would be correct, and it's based on very recent information. We conducted a research project that we published down in the southern part of the state where we radioed with GPS telemetry several birds -- several adult birds on territories to look at home range and other aspects of their ecology.
And these birds ranged over very large areas, very large home ranges relative to birds throughout the rest of their distribution, and that information then was key to providing us an understanding as to the home-range size and core-area size in the projects that we're looking at like the one today.
Q And why do you think that their home-range size and core-use areas are larger?
A Again, it relates back to the changes in habitat and associated changes in prey distribution. So essentially when a habitat is lost throughout the range of the species where it nests, the bird have to go farther and wider to find these little pockets of prey to forage,

so you get larger home ranges, much more movement throughout the landscape by these birds.

Q The ferruginous hawk is now listed an endangered species under state law. In general terms, what do you understand that listing to mean?

A That listing means that unless we do active management and, you know, and follow up with tasks to benefit the species and improve the population, that it's likely to go extinct in Washington.

Q So is it fair to say, then, that it would be likely to go extinct if we maintain the status quo?

A Based on the population trajectories, for example, that we demonstrated in this status review, that would be correct, yes.

Q In your experience, how does the listing of any species as endangered impact -- endangered under state law -- impact WDFW's work?

A It pushes it to a priority, that particular species. Obviously a lot of our design and structure within WDFW is to focus on priority species. We have so many species that have needs but we have to obviously triage, and so threatened endangered species are at the top of the list of the species for which we are concerned, you know, programmatically throughout the agency.

Q Does WDFW have a recovery plan developed for the

ferruginous hawk?

A We do.

Q Was that produced in the records in response to the subpoena?

A It's an old document, 1996, so maybe predated what the requests were for.

Q Okay. Does that -- is that plan being updated to reflect your recent findings or WDFW's recent findings?

A Good question. This status review is the interim step for that. It's -- unfortunately, even though they're a threatened species, it takes a long time for the process to actually come to fruition as far as status reviews and recovery plan.

So the initial recovery plan was done in 1996. The species status review, the recent one we looked at, is the next step, and then forthcoming out of our conservation section would be, you know, an updated recovery plan.

Q Which will be based in part on the status review we're discussing?

A That's correct. This would be the impetus for updating the recovery plan.

Q Is it fair to say that it takes time to put together a scientifically sound recovery plan?

A It does. And that's, again, out of my arena.

That's covered by a whole different section.

Q   Can you tell me, again, the name of the section?

A   That would be the -- within the diversity section, under the section manager, she -- her title is endangered species section manager. Currently Wendy Connally as of the next couple days; I think she's changing positions.

So endangered species section manager, under her oversight, and then conservation assessment section.

We can discuss that a bit.

Q   Has the endangered species section been involved in conversations about the project?

A   Yes.

Q   And to your knowledge, has Mr. Ritter consulted with them and providing feedback to EFSEC regarding the project?

A   You'd have to ask Mike. I know I have consulted with them, but, again, it's -- you'd have to ask Mike.

Q   You also coauthored a 2019 report regarding the migration patterns of ferruginous hawks.

A   That's correct.

Q   Do you recall that report?

A   Yes. Yes.

Q   Is it fair to say that the study -- that that study indicated that ferruginous hawks have high fidelity to specific breeding ranges?

A Yes.
Q And what does high fidelity to specific breeding ranges mean in layperson terms?
A High fidelity means that this species returns each year -- a pair of birds returns each year to the place they nested formally, where they nested formally, and there's a high consistency, high tradition, in returning to those areas, presuming they survive. But if they don't survive, there will be a recruitment of new individuals on those territories to continue to reproduce and provide.
Q So when you say return to that area, you're referring to the territory or just the core-use area?
A No, it would be the territory. And the key factor, again, would be location of nest sites. This species uses particular nest sites that are low in structure and often times cliff sites or lone trees that are limited in this type of environment that we're talking about. So it's those -- those are attractants, again, for future generations to move into an area, but also the necessity of that prey being there is, again, a critical factor.
Q If there isn't the prey, they're not going to nest in that location; is that correct?
A That's correct.
Q What is the longest recorded time, that you are

aware of, between different years of use for a single nesting site?

A That's a good question. This, anecdotally, in my brief review, we have, I know, biologists in Districts 3 and 4 - that would be Jason Fidorra and Mark Vekasy - who have documented ferruginous hawks returning to long-unoccupied territories. I would say long in relative terms, up to 20 years later.

And I know there's an anecdotal account in Utah of something similar from work done by a Jeff Smith in Utah where a territory was not used by ferruginous hawks but was reoccupied after several years. So those would be -- that would just be a brief synopsis of -- kind of a cursory review of that information. There may be more out there.

Q And you mentioned Mark. What was Mark's last name?

A Vekasy V-e-k-a-s-y.

Q Okay. I've got another terminology question.

A Sure.

Q Sorry. Is there a difference in the term breeding range and home range?

A And I don't know how I used that term. Breeding range would probably be a descriptive term more for the distribution of the species overall, where the context of the home range is one pair of birds nesting.

Q   Okay. So the breeding range is where you would expect to see a home --

A   That's correct. We might describe the breeding range as Eastern Washington for the species in Washington; however, others might use that term to describe the range of a pair of birds but.

Q   Before we go onto the next exhibit, do you need a water break?

A   No.

Q   Okay. One more exhibit then we can take an actual break.

A   Okay.

Q   For those online, I'm going to be asking about Mr. Watson's author on the contrasting -- article on the contrasting home-range characteristics, which was included in the email. Okay. You have Exhibit 3 in front of you now.

(Deposition Exhibit No. 3 was marked for identification.)

A   Yes.

Q   What is Exhibit 3?

A   This is a document -- really a summation of a lot of things we talked about regarding the research on range use, home-range size, home-range needs of ferruginous hawks and other raptors as well.

Q And how are you familiar with this document?

A I wrote -- I'm a senior author on this document.

Q Okay.

MS. PERLMUTTER: Mr. Watson, if you can keep your voice up, that would be awesome. Thank you.

Q [BY: MS. VOELCKERS] We touched on this earlier but fair to say that the findings contained within Exhibit 3 indicate that the home range and core-use areas for the ferruginous hawk in the Columbia Plateau ecoregion are larger than previously estimated?

A That's correct, yes.

Q Should this new understanding, relatively new understanding, of range use and size be incorporated in siting design decisions regarding renewable energy projects?

A Yes.

Q And why do you believe that?

A Because it's the best available science.

Q Should this new understanding of range use and size also be incorporated in designing mitigation plans for renewable energy projects?

A Yes.

Q Is it correct to say that the findings reported in Exhibit 3 also indicate that the major prey species of

ferruginous hawks in the Columbia Basin may now be the northern pocket gopher?

A Yes. Could I qualify that? That would be certainly demonstrated within the area for which the prey were collected, which we believe is representative of other areas within the Columbia Basin; that's correct.

Q Understood. In your professional opinion, are the findings and conclusions in Exhibit 3 important for EFSEC to understand before permitting new wind turbine development?

A Yes.

Q And why is that?

A Best available science. And if -- do you want...

Q I want your opinion on why you answered yes.

A Why I answered yes. A key consideration when we talk about wind power development is spacial use of the birds that will be affected, potentially, by the development, and this document is the best science available to understanding the spacial use that these birds need for successful nesting.

MS. VOELCKERS: If we could take a break now, I want to move onto another exhibit, but I'm now concerned and want to make sure that that got emailed to everyone. So if we could take a break a little bit early, if that's okay with you?

THE WITNESS: Sure.

MS. VOELCKERS: And then come back. How much time would you like? Ten minutes okay?

THE WITNESS: Ten minutes is great.

MS. VOELCKERS: Does that work for everyone online, a ten-minute break? Hearing no objection --

MS. PERLMUTTER: Yeah.

MS. VOELCKERS: Okay. We'll reconvene at 10:05.

Thank you.

[Off record at 9:57 a.m.]

[On record at 10:07 a.m.]

BY MS. VOELCKERS:

Q Okay. Mr. Watson, you have now in front of you what has been marked as Exhibit 4. Are you familiar with this document?

(Deposition Exhibit No. 4 was marked for identification.)

A Yes, I am.

MS. PERLMUTTER: What is it?

Q [BY: MS. VOELCKERS] And can you please say what this document is?

A This document is --

MS. PERLMUTTER: Wait, wait, wait. Hang on. What is that document?

MS. VOELCKERS: I was going to let Mr. Watson say this, but it's the long-term changes and population of nesting raptors.

MS. PERLMUTTER: Is that something you previously provided us?

MS. VOELCKERS: Yes.

MR. PENA: It's a PDF of the PowerPoint, it looks like.

MS. PERLMUTTER: Got it. My apologies.

Q [BY: MS. VOELCKERS] Okay.

What is this document?

A Yes, this is the PowerPoint presentation from earlier this year, I believe, that was given at the Oregon Chapter of the Wildlife Society, and it -- it's based on research that we did in Southern Washington/Northern Oregon at a large wind power development area that we've been studying for years.

Q How many years have you been studying the area?

A We've been working down there since the early 2000s. This particular project, however, was an accumulation of the information that we collected years ago and had been provided years ago to a more -- in a more recent survey effort that we did down there back in - 2 years, 2021, lost track - 2021, something like that.

So it's a long-term project. This particular project covers 18 years of wind power development down in that area.

Q Would you characterize 18 years as long-term monitoring?

A I would. It's based on longevity of a typical pair, in this case, of ferruginous hawks, we were interested in largely, and also golden eagles. So you're looking at the long-term nesting bond of a pair of birds and how long that will last, you know, 10, 12, 15 years. So that would turn over after that time.

So when you're looking at 18 years, you're looking well with -- with, you know, encompassing a pair of -- initial pair of nesting birds during one construction and then those that would follow or be recruited in. That's the key point here. Long-term has to do with: What happens on those areas after a long time? Are they perpetuated? Can we maintain habitat? That's the critical question.

Q Is it fair to say that long-term monitoring of raptor populations provides more accurate information regarding the potential impacts of wind power development than short-term monitoring?

A Mixed question. Answer would be yes and no. This type of study is not going to be beneficial -- in our initial questioning, you asked about impacts. One of those impacts was direct mortality. This -- that --

that's one type of impact that is not necessarily addressed through long-term monitoring. It can be addressed through short-term monitoring.

However, that is a short -- that's a very shortsighted assessment of impacts if we only look at direct mortality, and that's the key to this study. It's only through long-term monitoring do we understand perpetuation of habitat for a species that is in decline or endangered such that - long answer here - such that we can maintain habitat for reoccupying that habitat overtime.

In a nutshell, the fish and wildlife service terms this type of habitat as critical habitat. We don't have a designation for it, but, to explain, they, in order to recover an endangered species, would maintain -- designate and maintain habitat that is unoccupied such that the species can recover by reoccupying that habitat. So it's critical to maintain the quality of that habitat that is unoccupied such that the population can be recovered.

This study is the best effort, to date, to do that, to understand the changes in population over a long term to see how wind power has affected the potential recruitment of new individuals into habitats in order to perpetuate the species.

Q In your opinion, are the results of this long-term

monitoring effort important for EFSEC to understand before permitting new wind power development?

A I were to argue yes. Now, this particular research is in review in The Journal of Wildlife Management presently, and so it's actually getting ready to be published. But the critical component for ferruginous hawks that we learned from this study is that ferruginous hawks are impacted both in long term by wind power but also the other effects that we mentioned earlier - loss of ground squirrels and other effects.

So they're kind of getting a full impact on populations as we go through times, but wind power certainly was shown in this study to be an effect on long-term viability of ferruginous hawk territories.

Q And so while the paper on this is being reviewed, if you were able to give a presentation similar to the one in Exhibit 4 directly to EFSEC, do you think that would help them understand WDFW's most recent science regarding impacts on ferruginous hawks from wind power development?

A I think it puts the exclamation point on it. If you recall, my earlier point was the two effects -- long-term effects of wind power on ferruginous hawks are habitat alteration or habitat loss. These birds are not adapted to change or tolerant of change but also, then, the change in the raptor guild and raven guild. You bring

in species that are going to compete and prey on
ferruginous hawks, potentially.
        This study -- this long-term study, then, is,
well, what really happened overtime in the landscape where
we had -- did that really take place? Did we lose nesting
ferruginous hawks overtime? And the answer to that would
be, yes, we did on wind power areas, but we found the
impacts were also related to all of the other things
affecting ferruginous hawks in the landscape.

Q   So this PowerPoint represents the most recent
research that supports your other published materials?

A   That would be correct, yes.

Q   I'd like to shift gears now and talk about the
project itself for a bit.
**   When did you first become aware of the project?**

A   I believe it was early 2021.

Q   And how did you become aware of the project?

A   Maybe '22. I deal with a lot of projects.
        Mike Ritter contacted me about the project.

Q   Have you communicated directly with the applicant
or their consultant during the project?

MS. PERLMUTTER: I'm sorry. I didn't hear that.

Q   [BY: MS. VOELCKERS] Have you communicated directly
with the applicant or their consultants on the project?

A   Outside of our communications via Zoom, no, not

personally, if that's the question.
Q It sounds like, though, you've communicated directly via Zoom?
A Correct, I've been a participant in meetings that we've had with EFSEC and the proponents.
Q What were the general purposes of those meetings?
A The purpose of those meetings was to discuss the project in general terms. Obviously several different meetings but first in general terms, get an idea as to what might be impacted by the project, and then later on as the project developed, my participation was to just be a consultant in regard for Mike, specifically, working through Mike Ritter. I'm not the management biologist; I'm the bird spokesperson.
But to address the specific questions related to ferruginous hawks particularly and impacts from the project.
Q Aside from those meetings, have you been contacted directly by the project applicant?
A I don't recall. I would say no but I'd qualify that with I don't recall.
Q As you sit here today, you don't recall --
A No.
Q -- being contacted?
Have you been contacted directly by the

applicant's consultants?

A   Yes. Eric Jansen would be the biologist that I've been contacted, just concerning questions regarding ferruginous hawks and information.

Q   You and Eric Jansen have communicated directly about the project and the ferruginous hawks?

A   That would be correct. More the ecological side and aspects of the ecology.

Q   Is that normally part of your role as research scientist, to speak directly with applicant consultants?

A   Only when I'm requested to through Mike Ritter. That would be, note, pretty atypical. And the fact is I'm not a management biologist or a negotiator; I'm obviously a researcher. So it's really consulting and providing information to -- through my -- through Mike Ritter. But obviously other biologists would call. One of my roles is consulting with people that need information on species.

Q   Since you first learned of the project and its general design, have you had concerns about potential impacts to wildlife species?

A   In my focus, I would say yes, but specifically my focus would be on ferruginous hawks and potential impacts to ferruginous hawks.

Q   To concern about other impacts, any other species?

A   My original questions, again, would be in regard to burrowing owls and prairie falcons, those species peripherally. But, again, my focus would be raptors strictly in that arena.

Q Have you had concerns about potential impacts to prey species for the ferruginous hawk?

A Yes, there are always concerns with these types of projects, particularly locations of ground squirrel colonies where the birds might be still foraging on ground squirrels that are available, so yes.

Q To your knowledge, has the applicant conducted any surveys that note the presence or absence of northern pocket gophers within the project footprint?

A I'm unaware of those.

Q Would such information aid in identifying potential foraging sites for ferruginous hawks?

A Potentially, yes.

Q To your knowledge, has the applicant conducted any surveys that note the presence or absence or relative abundance of ground squirrels within the project footprint?

A I believe they have, but that's, again, qualified. I think so.

Q Have you reviewed any surveys of ground squirrels within the project footprint?

A No.

Q Would such information aid in identifying potential foraging sites for ferruginous hawks?

A Yes.

Q How so?

A And you use the word potential. That's a big, big question mark. When we're looking at where birds are foraging, they do some crazy things. These birds, unless we had birds that were radioed out there that we were tracking, may actually forage, you know, 3 miles in a ground squirrel colony way off the project.

But certainly those within the project would be the most -- have the highest probability of being used. So again "potential" is a -- it's hard to know for sure.

Q You would need more information?

A Yes.

Q But it would be helpful to have that survey information?

A Yes.

Q Based upon what you know about the project and your professional opinion, is the project as it's currently designed, is it designed to avoid negative impacts to ferruginous hawks?

A Can I ask a question? Is the current design as of the draft environmental impact statement? I'm not sure what the current design -- if that's changed since I've...

Q Yeah, let's unpack that. When is the last time you reviewed the project design?

A It would be the -- probably the draft environmental impact statement and what was contained within that document as well as proposed or.

Q Did you review the application itself or just the draft EIS?

A I reviewed the draft EIS.

Q So you've reviewed the project design in terms of where the micrositing corridors are for the wind turbines; is that correct?

A I believe I have, yes.

Q So just as you sit here today, based upon your recollection of that design -- I'll represent that the micrositing corridors have not moved from December. So based upon your recollection of those -- location of those micrositing corridors within the project design, is it your professional opinion that the project itself is designed to avoid negative impacts to the ferruginous hawks?

A Yes and no. There's some contained within that document that would potentially address what are termed "active nest sites," I believe, which, again, is terminology I wouldn't use. But presumably those are territories occupied by ferruginous hawks that would potentially allow the development of turbines within the 2-mile core areas and then would address potential impacts from those turbines related to direct mortality by maybe turbine shutdowns or some effect like that.

So when I say it's a "yes," there is some potential consideration for only territories that are occupied for potentially protecting birds through some means during seasons in which they nest.

However, I want to take a step back because there's a missing ingredient here. Number one, that plan, the EIS only addresses what's in the core areas, and we've initially made the decision, based on the document we looked at earlier, home-range size, these birds use extensive home ranges. And if you recall, home range is a concept that defines all of the elements that are important for these birds to nest successfully.

Because these ranges are so huge in the research we've done, we made the decision that we've got to really focus in on the core areas because use of a home-range template in this type of project 10 kilometers out from the nest would be prohibited. There's nothing that could go on.

And I point that out because we've already made the decision that we're cutting away or we're reducing the probability of nesting success already by simply going down to the core-area concept as being the unit for which we will try to minimize impacts on ferruginous hawks from wind power.

So we've already really said, well, ferruginous hawks, we're going to say this isn't important out here and just try to maintain what's within the core area. But then we're not even looking at historical habitats only, which we've already explained are important to maintain quality because of the fact you have birds that are not tolerant of habitat loss and change, and we introduced -- we potentially introduce species that compete and predate these bird.

So having said that, the answer to your question is, yes, the attempt to put -- allow turbines within the core area on only active territories is some element -- may afford some element of protection for birds that are nesting, but it's short-sighted. That's the bottom line here. It's not addressing the longer term aspects that we've discussed at length of maintaining quality of habitats that birds we know used at one time, that we need to maintain in order to recover the species that is taking a nose dive.

And so that hasn't been addressed would be my point. So the answer is yes and no to your question.

Q Okay. There was a lot to -- to that answer, so

I'm going to try to unpack it a little bit because this has been a point that could really use some clarification in the proceeding.

So the -- is it correct that the recommendation from WDFW to the applicant was to not site any wind turbines within core-use areas of historic territories?

A   Yes.

Q   And does the project as it's currently designed follow that recommendation?

A   No.

Q   Okay. And the recommendation not -- to not site any turbines within the core-use areas was a -- is it fair to say that that was a compromise, because the best thing for the species would be to not site any wind turbines within 10 kilometers?

A   That's correct, yes.

Q   So WDFW made a recommendation that was already a compromise?

A   Yes.

Q   And the applicant has rejected that recommendation?

A   Yes.

Q   Based on best available science, is it your opinion that the project as it is currently designed could potentially contribute to decreasing the viability of

ferruginous hawks?

A Yes.

Q Why is that?

A Number one, the project, as I understand it, does not even completely protect habitat for those birds that are occupying territories. Those birds would actually be subject to turbines being built on their territories with potential shutdowns. Or some means of protecting those birds from direct mortality.

That doesn't even address the fact they're changing and altering habitats, as we've discussed at length, the two implications of that. So that was striking to me.

But again, the long-term perspective for a species that is declining so rapidly is we need to have unoccupied areas that are protected -- not just protected but even improved the quality, that needs to be maintained and improved in order to have those territories reoccupied to be able to recover the species.

Q The applicant has maintained throughout the proceeding that the project design complies with WDFW guidance; do you agree?

A I can't answer that because I don't know what guidance they're referring to or you're referring to.

Q The applicant has maintained throughout the

proceeding that the project design complies with best available science; do you agree?

A No.

Q Why not?

A I think we've demonstrated the best available science is -- you know, has just been published, and some of the work we've done has demonstrated these birds need more than is being offered by the project.

Q Is it fair to say that WDFW has been providing best available science in recent years that is being ignored?

A That's correct. We've been very consistent, I believe, with our recommendations on this project.

Q Is it your professional opinion that the April 2009 WDFW Wind and Power Guidelines provide sufficient guidance to prevent negative impacts from wind development on the ferruginous hawk?

A No.

Q And why not?

A They're badly outdated. In 2009 when those were developed -- and, again, they're guidelines from our agency; they're very general. I would go back and look at those, but I don't believe there's anything specifically addressing ferruginous hawks. I could be wrong.

But obviously the science specifically related to, for example, ferruginous hawks and wind power development, specifically in ten years, was going from infancy to, you know, graduate school. So it's -- it -- the best available science was not available. We were operating on best available science perhaps back in 2009, but today there's better information.

Q In general, best available science improves overtime?

A That's correct, yes.

Q Can you mark this exhibit, please?

I'm going to be using a memo from Tetra Tech, which was included in the email this morning. You have now what has been marked as Exhibit 5.

Do you recognize this document?

(Deposition Exhibit No. 5 was marked for identification.)

A Yes, I believe I've seen this before. Actually, maybe I can refresh -- I'm not sure I've seen this before.

Q We can come back to that. I'd like you to look at another exhibit first.

A Okay.

Q For those online, I've handed Mr. Watson a January 11, 2022 letter. You're now holding what's been marked as Exhibit 6. Do you recognize this document?

(Deposition Exhibit No. 6 was marked for identification.)

A   Yes, I do.

Q   The third line of this -- the second line of this document says that "We thought we should make a formal comment on the November 23rd, 2021 memo."

So this is not responding to Exhibit 5, but do you remember what this was responding to?

A   No, I can't say that I do. To explain, I'm not privy, necessarily, to all the media documents. Those actually go through Mike Ritter. So a lot of times, even if a document was sent to WDFW, I might not be privy to it.

Q   Okay. Do you recall contributing to this document?

A   This?

Q   Exhibit 6.

A   This document, yes.

Q   Okay. Okay. If we could turn back to Exhibit 5, and I'll represent to you that this was provided in Mr. Ritter's deposition.

Do you see that it's dated January 20th, 2022?

A   Yes.

Q   After the -- after Exhibit 6; is that correct?

A   Yes.

Q   Understanding that you might not have been privy

to this document, I would like to direct your attention to line 3. It says "The project has been developed to avoid, minimize, or mitigate potential effects to avian species consistent with" and then it lists a number of different guidelines, including the 2009 wind power guidelines.

A Yes.

Q I'm going to give you a minute to read that.

A Okay.

Q Do you agree with this statement, that the project has been developed to avoid, minimize, or mitigate potential effects to avian species?

A I guess I answer no because I qualified on the best available information -- best available science was not used based on the document at least they state here.

Q As we've just previously discussed?

A Yeah, the 2009 guidelines were not the best available science from our agency.

Q Later on that page, at the bottom of the second paragraph, that last sentence reads "At no time during this multi-year coordination effort did WDFW suggest that alternative analyses or buffers, other than those described by Larsen, et al. (2004), be used to minimize effects to ferruginous hawk or their habitats."

Do you see that there?

A I do see that.

Q Do you agree with that statement?

A Well, I'm looking above, and if -- it looks like the consultation for the meetings on the fourth line was September 19, 2017 to -- and January 28, 2020, so I don't believe I was on board with this project at that time. So I don't know what went on as far as discussions and buffers, discussions before I came on board.

Q So it's possible that the recommendations that you've made regarding siting of turbines outside of core-use areas based upon best available science was not the initial recommendation made by WDFW to the project applicant?

A That's correct. It looks like they used a document, Larsen, et al., 2004, PHS guidelines -- very outdated -- very outdated in their initial assessment, which I, again, wasn't part of. But that was the basis for their saying those are the buffers we were working from, it looks like.

Q Are you familiar with the 2004 Larsen, et al. guidelines?

A Yes.

Q And why do you consider them outdated?

A As I recall, I've written a couple sections - probably golden eagles, maybe ferruginous hawks and those - in the past, but, again, they're based -- when they're published in 2004, they're based on information that predates that by a considerable amount of time. So we're talking field data that is dating back to the 90s that is actually pre-wind-power-guidelines, the pre-wind-power-development period, right.

Q So I'm not going to ask you to read through this, but I'll represent to you that it contains arguments by the applicant's consultant that EFSEC should not use WDFW's more recently recommended exclusionary zones for siting because they've not been formalized through agency guidance.

As of today, has WDFW issued formal guidance regarding the appropriate exclusionary zones for wind turbine siting within territories of ferruginous hawks?

A I have no idea how you define official guidance when we're talking about best available science because that has to be put into an official guidance format, and what defines that, I don't know, when we're talking about guidelines.

When we're talking about science, science is a slow process, and so I would argue that the best available guidelines can be verbal guidelines developed from research that has been published as the best available information that should be heeded.

Having said that, the PHS guidelines, we've been working in a frenzy to -- those are actually -- a new draft form is being developed, which, I believe, the document was available, that is just in review right now, that will include this new information. But, again, what is official? That's the question, I guess.

Q Okay. I will return to asking you about that draft guidelines after our next break.

A Okay.

Q So I can email that out to the group.

How are you using the term "formal guidance"?

A Formal guidance can be verbal. Again, as a scientist, if we waited for scientific information to be in some official form before it became usable and applied, in the wildlife world things would go extinct every day, because we need to provide information as it's synthesized and published - as soon as it's published - both verbally and presentations and meetings and other places.

So official is a business term that it's really difficult to apply in what we're talking about here.

Q And when you say that guidance could be provided verbally, did I hear you right earlier, though, that it should still be based upon studies?

A Has to be based on good science that's peer reviewed is ideal. Other -- other -- your peers have looked at it and said, yeah, this is good stuff and it's

going in the right direction. That's correct.
Q In the absence of what -- sorry. Retract that.
In the absence of what I'll call formal guidance, updated turbine -- wind power guidelines.
A Right.
Q In the absence of that being issued under WDFW's seal, should EFSEC still require the applicant to comply with WDFW's recommended offset of wind turbines from core-use areas?
A If EFSEC is applying best available science, yes.
Q Do you think that the recommendations made by yourself and others at WDFW in the absence of formal guidance has created or added to the applicant's incentive to push the project through EFSEC's review process as quickly as possible?
A I couldn't answer that question.
Q Mr. Watson now has in his hands Exhibit 7 which was emailed to those online as the population viability analysis. Are you familiar with this document?
(Deposition Exhibit No. 7 was marked for identification.)
A No.
Q Do you know the existence of this document?
A I knew that this was a proposed study from our discussions, our Zoom meetings, but that's the extent of

what I know about it.

Q Who proposed this study during your discussions?

A The proponents. I believe perhaps it was Eric on one of our Zoom meetings was suggesting that -- or suggesting that as an option for additional research.

Q So this document wasn't created at WDFW's request?

A No.

Q You haven't reviewed the contents of it?

A No.

Q Are you aware of any peer-reviewed studies provided by the applicant's consultant regarding the ferruginous hawk?

A No.

Q In your professional opinion, is it important for EFSEC to take Exhibit 7 into account before permitting the Horse Heaven Hills project?

A No.

Q Why not?

A I believe the 40 years of our study of ferruginous hawks population dynamics in Washington that are synthesized in the status review in terms of the population decline and the critical nature of it - obviously listing the species now as endangered - is a demonstration of the fact that a population viability study is somewhat irrelevant at this point in the -- in

the bird's population dynamics.
We're at a critical point where we're looking at saving what is left and what we can maintain. This study might have been beneficial, you know, 30/40 years ago when we were starting to study the species and knew it was a sensitive species.
Q Have you reviewed the habitat mitigation plan for the project?
A Hard question to answer because we've had discussions concerning in the EIS -- the draft EIS proposed habitat mitigation, I believe, but I don't know if there's a document I've seen that actually described that.
Q Okay. So you haven't reviewed the habitat mitigation plan that's attached to the application itself?
A That was attached to the application, no, but I've seen -- I know what's in the draft EIS, if that would be...
Q No, that's okay.
A If I'm getting at the right --
Q Nope. No, I just wanted to know if you reviewed the mitigation plan itself.
A I understand what is proposed for ferruginous hawk mitigation for -- regarding habitat loss, I believe. Offsetting habitat mitigation, I believe, was proposed --

in other words, if territories -- ultimately, we have 16 territories involved in this project. Ultimately, if those are all lost, the idea would be, well, we have offsetting habitat that is acquired to offset that loss.

Q So you're familiar with the proposed mitigation for -- specific to the ferruginous hawk for the project?

A That's correct.

Q And are you familiar through conversations with Mr. Ritter and --

A That -- that would be largely correct. And, again, we may have discussed some of this in our Zoom meetings with EFSEC and the proponent, but those would not be the details that we're talking about here.

Q But you've discussed proposed mitigation measures with both internal WDFW staff as well as the project applicant?

A That's correct.

MS. VOELCKERS: We're a little bit early for our break, but I think if we take a break now, I can wrap us up a little bit sooner before our lunch.

THE WITNESS: Okay.

MS. VOELCKERS: For my questions. So if that's okay with the group, I'd like to break now.

[Off record at 10:49 a.m.]

[On record at 11:05 a.m.]

BY MS. VOELCKERS:

Q So we have been talking so far this morning about siting the turbines. I do want to spend a little bit of time talking about mitigation measures for the project.

A Right.

Q Understanding that you've discussed those in multiple meetings with the applicant as well as other WDFW staff, correct?

A That's correct, yes.

Q One of the mitigation measures that is included in Section 3.4.3 of the application - which we don't have in front of us today, but I'll represent to you - includes setbacks of turbines within a 1/4 mile of occupied ferruginous hawk nests.

I believe you touched on this earlier, but as a mitigation measure rather than a siting measure, is this setback for only occupied nests consistent with the recommendations that you've made?

A No.

Q And why not?

A Well, and you didn't -- I need some qualification because I assume they're looking at some sort of means of shutting down turbines even on occupied, or as they say, "active territories." Is that -- do you follow what I'm saying here?

Q I --

A If I'm assuming that, there is still issues.

Q Okay. I do want to discuss them separately. But even assuming there would be curtailment, potentially, within proximity to nests, is the siting of a turbine within a 1/4 mile of an occupied nest as mitigation, is that consistent with best available science?

A No.

Q And is it consistent with recommendations that you've made?

A No.

Q The mitigation plan also discusses limiting construction activities within a 1/4 mile of an occupied nest. Is that consistent with best available science?

A No, I would -- limiting during the nesting season -- let me -- let me give -- say that -- ask that one again.

MS. PERLMUTTER: I'm sorry. I'm having trouble hearing you again.

THE WITNESS: Okay. I asked -- I'm going to have her ask -- repeat the question.

MS. VOELCKERS: If the court reporter could repeat it, please.

COURT REPORTER: Question: The mitigation plan also discusses limiting construction activities within a 1/4 mile of an occupied nest. Is that consistent with best available science?

A   I would say no.

Q   [BY: MS. VOELCKERS] And why not?

A   Up to a 1/4 mile is not -- for this species that's endangered, we would look at no construction at all during -- in an occupied -- at an occupied territory, no construction at all during the nesting season, which --

Q   Would then --

A   Essentially from, you know, beginning as early as late March through the end of July.

Q   No construction within the core-use area?

A   Which is -- that's correct.

Q   The mitigation plan for the project also includes two years of standardized post-construction fatality monitoring to assess impacts of turbine operation on birds and bats. Based upon your research, will the standardized post-construction fatality monitoring be sufficient to assess all impacts to the ferruginous hawk from the project?

A   No.

Q   And why not?

A   We're dealing with a species that's so limited in number, we're dealing with individuals. And so a two-year study essentially will actually capture, potentially, fatalities of a few individual ferruginous hawks, but the issue is actually the long-term monitoring, as we demonstrated in the research, and what happens in the long-term perspective on these territories to ferruginous hawks that would attempt to nest and be recruited on these territories.

So short-term monitoring provides a perspective on predictive fatalities but not a long-term perspective on viability of nesting territories.

Q Do you know why the applicant has not yet put forward final designs for its specific location of wind turbines within the micrositing corridors?

A No.

Q In your opinion, would a delay in identifying specific turbine locations until after permitting increase the risk of inadequate mitigation for impacts?

A Repeat one more time. Sorry.

MS. VOELCKERS: Can you repeat it, please?

COURT REPORTER: Question: In your opinion, would a delay in identifying specific turbine locations until after permitting increase the risk of inadequate mitigation for impacts?

A Yes.

Q [BY: MS. VOELCKERS] Why is that?

A The best information needs to be used upfront in the planning of these projects - having dealt with several - to understand the biology and work with the biology as far as the best siting for locations, as we have demonstrated consistently, the best siting.

And we identified -- just to regress a moment, I believe we called, at one point in our discussions, "mutually consolidated areas," maybe four areas of these 3.2 kilometer/2-mile zones, four different ones, excluding a couple territories that are off of this main project area.

But we consolidated those zones, four zones, based on 3.2 kilometer core areas to say, these are the areas, which, you know -- and going -- and I went through specifically each territory, matching nests within the territories, to identify a collective zone or zones for which we would propose that the best available science suggests that's what needs to be done to protect these birds in the long term.

Q The applicant is also proposing to voluntarily construct additional artificial nesting platforms. Based upon your research, will construction of artificial nesting platforms provide meaningful mitigation for the project's impacts to ferruginous hawk?

A No.

Q And why not?

A I'll regress a moment. Use of artificial nest platforms has become, in ferruginous hawk world, kind of the cure-all for saving ferruginous hawks under what I believe are some -- some really misplaced notions based on work done in the 1970s and 80s in Alberta in which habitat you have a lot of ground squirrels but very few nesting structure. It's open prairie.

So a study was done by a fellow ferruginous hawk researcher. Joe Shmutz, at that time, put out a lot of ferruginous hawk platforms, and there was successful netting. From that study, a lot of states took the impetus, including Washington, I believe, in the 1980s, to just go out and erect platforms, ferruginous hawk artificial nest structures, across the landscape with the belief that we can increase ferruginous hawk nesting.

Well, lo and behold, the reality was, in Washington we had very few of those used overtime because the need isn't nesting platforms. The need is for ground squirrels. And so you have -- limited nest structure is not the issue related to most ferruginous hawk nesting territories. And I say "most."

On territories -- and we're currently engaged in some of this work with our field folks about being very specific. When we would attempt to erect platforms on territories is when there has been a direct knowledge of a loss of nest structure or no nest structure on existing territories that we might benefit, such as a lone nest tree that's been used for years that falls down and there's no structure within the core area; that would be an ideal site perhaps to put a nest platform up.

The issue is when you broadcast nest platforms across the landscape without a specific knowledge of territories, they're going to introduce some of these other species that we mentioned, such as ravens and great-horned owls, potentially, as well as red-tailed hawks and Swainson's hawks, potentially, in some areas.

So what you're essentially doing, under the guise of creating habitat for ferruginous hawks and improving habitat, is you're creating habitat for their competitors. So it's kind of a double whammy for the ferruginous hawks.

So in a nutshell, a very, very strategic effort to understand individual territories and whether they're limited by nest structure may benefit ferruginous hawks through this type of study, but a larger project with just putting those across the landscape is not going to benefit ferruginous hawks.

Q If the current design of the project moves forward, should the mitigation plan include curtailment of turbine operation in all core-use areas during breeding season?

A Yes, absolutely. If the project moved forward putting turbines within core-use areas, depending on the technology that is used, which is currently advancing - the IdentiFlight technology is the one I'm familiar with which actually monitors, through radar, the birds' locations, at least for eagles, and then shuts down specific turbines concurrently with that activity - that would be absolutely necessary, again, to protect direct -- protect from direct turbine strikes.

However, again, it's not going to address the long-term viability of territories because of habitat loss and introduction of -- potential introduction of invasive -- or other species.

Q And you just described curtailment for detection of birds. Would it be better, though, to have seasonal curtailment during breeding season in all core-use areas?

A And that's why I was a little hedging. It depends on the technology, and the technology is not 100 proof. So, yes, for this endangered species, to put it bluntly, it would be better not to have turbines operating during the nesting season, because their problem with species identification with the current IdentiFlight technology, that radar can identify but it also misidentifies eagles occasionally flying around turbines, in which case you might have a strike that wouldn't have happened had the turbine been shutdown during that time.

Q And just so that we're clear, the main recommendation is to not site them at all within core-use areas?

A Correct, yes.

Q But if they are sited, a mitigation measure would be to have some level of curtailment?

A Yes, and -- and an important point with this is, I believe the proponent has suggested they would look at what they're terming "active territories" during a given season. And my understanding, it wasn't explained how that would be -- continue from this point on forward for year after year after year.

So it would require surveys every year such that they identified those territories they're terming active in order to, every year, shutdown -- be aware of what turbines need to be shutdown.

But I point out as well, a shutdown of turbines within core areas does not protect ferruginous hawks that may be on adjacent territories flying through those core areas. Because remember, we're talking a home range here. So these birds are moving around a much larger area than the birds that nest on specific nests.

Yes, they use core areas, but they're also flying around and in and through other areas, so they're exposed as well to operating turbines.

Q Which gets back to the importance to protect the entire home range.

A Is that a question?

Q That's my question. Isn't --

A That's correct.

Q -- that getting back to --

A That -- yes.

Q What is your understanding of the importance of shrubsteppe habitat cumulatively in Washington?

A Cumulatively it's an important native habitat because of the association with the native species that we've discussed, the preyed species, and it's declining for several reasons with ferruginous hawks.

A particularly insidious one is the large destructive fires, range fires, that we're experiencing which change -- actually removes shrubsteppe habitat and convert it to a cheap grass, which is a very poor quality habitat for maintaining ground squirrels in the long term. And so that has been a big bane.

So maintaining shrubsteppe habitat, again, is for the associated prey that's found there. Jackrabbits as well.

Q In your professional opinion, how much more shrubsteppe habitat can we afford to lose before the

species that depend upon it are unable to survive?

A   Good question. I'm not a shrubsteppe specialist, per se, but clearly the work that's been done in Washington shows that we are down to remnants of shrubsteppe amongst a sea of agricultural land in Eastern Washington.

So we're not creating new habitat, new shrubsteppe habitat. The habitat that's there has been used by ferruginous hawks for -- historically, for as -- you know, the last 40 years at least, we know. So they're not infiltrating new areas of shrubsteppe because it's simply not there.

So what's left is -- historically has been used by ferruginous hawks, and we're not -- I would say we're not creating any new habitat.

Q   So is it fair to say that every bit of shrubsteppe of habitat that remains is critical to the ferruginous hawks?

A   Yes.

Q   You're holding now what has been marked as Exhibit 8, and for those online, this is the document that I emailed half an hour ago. Are you familiar with this document?

(Deposition Exhibit No. 8 was marked for identification.)

A Yes.
Q What is this document?
A This document is an updated version of the PHS recommendations, Priority Habitats and Species guidelines that we discussed earlier. So this is a new version based on -- based on ferruginous hawk -- it's for the ferruginous hawk.
Q And can you describe the process of updating the guidelines?
A Sure.
Q The steps that that update goes through.
A Right. So we have a habitat division that is in charge of establishing these PHS guidelines. I was approached by them requesting ferruginous hawks as a model, as a new model, for an upgraded effort -- upgraded effort in the PHS guidelines because they were aware we had the good spacial information that we just published and were developing. We hadn't quite published it, but we had developed for ferruginous hawks.
The updated guidelines -- the advantage of the updated guidelines in using spacial information is the previous guidelines were largely based - and for a lot of species, still are - on point information.
So when a developer wanted information on a species as to what areas might be affected by their

development, they only had a point on a map. That is not very descriptive of the impacts, compared to if you have a spacial zone or a polygon within -- that's been mapped, that has some scientific basis; then they can look at their project relative to that two-dimensional space and say whether or not there are impacts.

So again, ferruginous hawks were a model for that development, which started over a year ago, myself working with Jeff Azerrad, in -- in -- who develops PHS guidelines, and that was the start of these guidelines.

Q And so what is the process, then, after the update has begun?

A Right. So this update was just finished. We just -- this pre-published version that we're looking at now has actually been updated and it was just about ready for review at this point. It doesn't say "draft" on here because I provided the document I had in my files.

But this is now a draft form that has been provided to our agency biologists who work with ferruginous hawks for their review, and then once they review this document, it will be sent out to -- for external review to, likely, fish and wildlife service biologists, other -- maybe Oregon Department of Fish and Wildlife, people who deal with ferruginous hawks and work with them, to get their critical review of this document.

And then it will be revised and put into an updated version of PHS guidelines.

Q So you have a version of this that has been -- that you've handed off, that you're not doing additional work on?

A That's correct. It's actually very minor changes. You can see -- actually, this is a version with the tracking on the right side and just some minor comments. So it's essentially -- this version is essentially what is out for review. I will still have the opportunity to comment on it as we get the comments back, you know. We'll be revising it.

Q It's a working draft?

A That's correct.

Q But you've sent off the first draft for review?

A Yes.

Q And okay. So I can request that updated --

A Sure, yes.

Q -- copy from your legal counsel?

After external review and comments, is there additional process internally within WDFW?

A No.

Q I'm not trying to pin you down, but would you have a guess in how much longer it would take for this to be published as "formal guidance"?

A I would like to think within four months, but that may be very -- I'm not the one actually doing -- you know, I provided the information, and Jeff Azerrad is the actual hands-on person that works in that program, so it would really be his -- up to him and his processing of the document. But once we get it in draft form and have the review comments, then it should be ready for finalizing.

Q Is there information here, to your knowledge, that's not already contained in your peer-reviewed published articles?

A No, this would be updated largely based on what we -- what we've recently published actually so.

Q So this is -- this is the --

A The synthesis.

Q -- synthesis. Thank you.

A Yes.

Q The synthesis of the best available science that WDFW has been working --

A Yes.

Q -- on over the last number of years?

A Yes.

Q Have you ever been on a site visit to the project area since learning of the project?

A No.

Q Okay. Is it true that the applicant's consultant

invited WDFW staff members to join in privately funded aerial surveys in the project areas?

A Yes.

Q In your experience, does WDFW usually join in project proponent's field work?

A No. And again, this wasn't -- to clarify, it was coming through Mike, and I think he did the responses to this. But I believe our policy would not -- WDFW internal policy wouldn't support that. We work with cooperators on a proposed project but not on -- or not a proposed project.

When we have a mutual interest working with WDFW on an area to survey, we might work with them on that, but for a project proponent, to participate with them in a survey, I don't think that's according to our policy, but that's a little out of my league so.

Q Why do you think that WDFW was invited to participate in the consultant's field surveys?

A Don't know.

Q In your professional opinion, what information is most critical for EFSEC to consider when evaluating the impacts of the project on ferruginous hawks?

A Best available science that we have in regard to spacial use, as we've discussed. The maintaining of these habitats overtime, suitable habitat, is critical for the species recovery, which is my conservation interest, professionally and personally, but that has to be done by, you know, applying these measures that we discussed.

Q I have a couple final general questions. As it is currently designed, in your professional opinion, will the project preserve and protect the quality of the environment?

A Not for ferruginous hawks.

Q As it is currently designed, will the project, in your professional opinion, enhance the public's opportunity to enjoy the aesthetic and recreational benefits of air, water, and land resources?

A I can't answer that. The public has different views about wind turbines and the landscape and how they're viewed, so it's varied.

Q As it is currently designed, in your professional opinion, will the project result in beneficial changes in the environment?

A No.

Q Why not?

A It's potentially contributing to the long-term loss of a keystone species, of ferruginous hawk, and arid landscapes in Eastern Washington, so I would say no.

Q Do you believe that it is important for EFSEC to hear directly from WDFW when considering the project's

design?

A Yes.

Q Do you believe that it is important for EFSEC to hear directly from WDFW when considering the project's mitigation plan?

A Yes.

MS. VOELCKERS: At this time, I would like to see if other counsel have questions. I may have follow-up questions depending on what is asked.

THE WITNESS: Did you want to come over here so you can see who's asking?

MS. VOELCKERS: No, I can listen. I can't see if anyone has unmuted themselves, but I would turn first to the county and see if they have any questions.

MS. FOSTER: Good afternoon, Mr. Watson. The county does not have any questions for you today.

THE WITNESS: Okay.

MS. VOELCKERS: I would next ask if Sarah Reyneveld has any questions.

MS. REYNEVELD: I do not have any questions. Thank you.

MS. VOELCKERS: Does Stoel Rives have any questions for Mr. Watson?

MS. PERLMUTTER: Yes, I do, but I would suggest -- could we take about a 15-minute break so that we can do this all in one fell swoop? Which might be a burden but I'm not sure.

MS. VOELCKERS: That's up to Mr. Watson. I thought we just took a break so we would be able to get done before lunch, but it's up to him.

THE WITNESS: I don't need another break, but if she needs a break for some reason.

MS. PERLMUTTER: I would appreciate a break, and I still think we can get done before lunch.

MS. VOELCKERS: Okay. We can go off the record.

[Off record at 11:31 a.m.]

[On record at 11:40 a.m.]

EXAMINATION

BY MS. PERLMUTTER:

Q Good morning, Mr. Watson.

A Good morning.

Q I'm Willa Perlmutter, and I'm a lawyer that represents the applicant in this case; I'm with Stoel Rives. And not surprisingly, I'm going to have some questions for you, and I apologize in advance if I'm going to be jumping around a fair amount. I'll try and keep this as short and sweet as I can.

First of all, can I ask you, what did you do to prepare for your deposition today?

A I didn't really prepare other than continually looking at my literature regarding ferruginous hawks and study work. That's the extent of my preparation.

Q Did you meet with anybody to talk about your testimony?

A No.

Q Did you review any documents other than the ones that were provided as exhibits today?

A Well, the ones that were requested for the exhibits, yeah, I provided. Obviously I have more documents that are unrelated to what was requested.

Q Did you review other documents other than the ones that were requested?

A Yeah, I mean, I had a records request which is standard procedure, you know, to go through my records and provide the ones that I did have in my possession.

Q Did you review any other publically available materials in anticipation of your deposition?

A Not that were outside of what I have in my files.

Q Okay. Did you review any documents that were published by any other sources besides the folks at WDFW?

A No.

Q And as I say, I'm going to jump around for a whole bunch of things. Does greenhouse gas -- do greenhouse gasses or the effects of climate change on greenhouse gasses, do those have an impact on ferruginous hawks?

A We anticipate they will be -- the effects of climate change will be affecting ferruginous hawks by a distributional shift in their populations, probably northward, because conditions will be too hot for a lot of ground squirrel colonies, prairie dog colonies in the southern distribution, such that those will become unavailable to ferruginous hawks.

So the distribution may shift northward which will also affect migration periods for hawks. They'll tend to migrate earlier, potentially, capture ground squirrels earlier, those kinds of things.

So there will be some effect as well as, obviously, the ultimate will be a loss of range is one of the predictions. As you lose ground squirrel habitat and foraging habitat, shrubsteppe, with climate change, there's going to be a range constriction, ultimately.

Q When you say northward, can you be a little more specific about that, what we're talking about?

A Yeah, we're not talking about a large-scale -- like these birds all moving to Canada. We're talking within the range of Washington. They'll be pushing northward within, potentially -- you know, ground squirrels move, and that's the condition -- or the speculation: Do ground squirrels move to any remaining native shrubsteppe that might be in the north -- northern part of the Columbia Basin, for example, if there is any there?

Q And you've said in the course of your testimony this morning that direct mortality - and I think you mean the turbine strikes - direct mortality is less of a concern for the ferruginous hawks when you compare the impacts of habitat alteration; am I right?

A I would -- if I said that, I probably need some clarification.

Q I'd say I would ask you to clarify, please.

A Yeah, so direct turbine strikes are obviously a big concern because adults face additive mortality. So anytime you take an adult hawk or eagle out of the population, it's not -- it's a big loss because it's taken a lot of hawks or eagles -- young hawks and eagles to actually get an adult -- to where you have an adult that's nesting.

So ultimately the direct turbine -- I wasn't trying to minimize direct turbine strikes as being absolutely critical to everything we're talking about here. You need to minimize those strikes. But what my emphasis was on the neglect or short-sightedness of looking at that as the only issue facing ferruginous hawks, in that passive displacement from territories or long-term loss of the quality of habitat is going to reduce the opportunity for those areas to be reoccupied at some future point, which is critical to maintaining a species in the next 50 years-plus. We need to keep habitats that are suitable for re-occupancy.

Q   Understood. And you talked about the ferruginous hawks, prairie falcon, and burrowing owls as the species most susceptible to renewable energy development because they're the most sensitive to human activities; am I getting that right?

A   That would be within the project we're discussing. Obviously there are other species in other projects that may have some interactions, but the context was -- for those three species was -- within this HHH project, those would be the three species. Immediately when I heard about the project, I'm thinking ferruginous hawks, burrowing owls, and prairie falcons. Yeah.

Q   So are there other human activities that have the potential to impact those species within the Horse Heaven Hills?

A   There certainly have been overtime. When you talk about maybe a hunting -- somebody coming in and shooting a bird, and we're talking about post "changes in the actual habitat" from -- you know, going from a native habitat to an agricultural base has been obviously the main change that took place.

And whether or not that continues to change up there, you know, I'm not familiar enough and don't -- it's just one of the main areas that I look at with my work. I don't keep on top of that specific area to know how agricultural "encrosion" is -- you know, continues to impact those birds. So that would be certainly a concern.

Also residential development may be - down below on some of that area - a potential issue, but the critical one, again, is the agricultural change that took place years ago and, you know, we see the results of right now.

Q And is that a continuing impact, that agricultural change?

A Is it -- say again?

Q Well, let me ask, is agricultural development increasing? Is it continuing to become -- to be an issue?

A It is if, in fact, it is removing the native habitats that we're interested in that may contain ground squirrels, for mainly prey items would be the issue. So in that area, again, I'm -- I don't keep up on the, you know, whether -- how many projects or how much plowing of shrubsteppe continues, but I'm assuming it does in certain areas.

Q And would it be fair to say that this footprint of that agricultural use is expanding in the area?

A Again, I would presume at least at a very small level that may be the case, but essentially what is left there, largely, I think is the BLM land and lands that were un-developable as far as agricultural because they're topographically unfavorable for plowing, and that's been, really, probably the best -- the best saving grace for ferruginous hawks in that whole area is the topography has been such that agricultural couldn't infringe on it overtime, and, you know, you can't drive a tractor down those hills.

And so the ferruginous hawks that are there have continued to maintain a livelihood, you know, by eating -- eating critters on slopes and edges of fields where they probably fly long distances to eat ground squirrels. But a lot of that is unknown.

Q Would it be fair to say, then, that your testimony is that all of the agricultural impact of -- all the impacts on the ferruginous hawk habitat by agricultural areas that sort of -- by agricultural development, that that is already taking place and won't expand any further?

A I think -- I think to a large degree that's probably true. Again, there are minor areas. There are small areas that are continually -- you know, someone may have a small field that they've kept and haven't plowed under for years, that economics forced them to do that.

But essentially I would say that's probably a true statement.

Q Okay. And can you tell me, do you know how many ferruginous hawk fatalities there have been documented as a result of wind facilities in Washington state?

A My last count -- and I keep a -- this is an informal count because I'm -- the fish and wildlife service, because this species isn't listed by them, their reporting system isn't as it is with golden eagles, for example, where I receive the information.

But to my best recollection, since 2001 there have been eight reported -- from wind companies, eight reported ferruginous hawk fatalities. Eight to ten.

Q And over what period is that?

A Since 2001, I would believe. I'd have to look at my records, but that would be approximate.

Q So within roughly the last 22 years or so?

A That's correct.

Q Okay. And let's look at your -- let's look back at that PowerPoint that was introduced, Exhibit 4, I think.

A Yes.

Q Do you have that?

A And if you could look at slide 16, please. I don't know that mine are numbered. I'm looking at the statement "The degree to which wind power contributed to

changes was unclear." See if I can find the Bates number.
MS. VOELCKERS: Bates number 366.
Q [BY: MS. PERLMUTTER] Thanks so much.
Again, I'm looking at page -- at WATSON-000366.
A Correct.
Q You stated here -- this is your -- you authored this document, correct?
A Yes.
Q And you indicate here in your summary that it's not clear how much wind power contributed to changes in the nesting raptor guild; am I right?
A That's correct.
Q Okay.
A But this, I want to point out this document is an early presentation of an oral presentation - and early of this particular study. From this time, we've actually submitted a document that's currently in review in The Journal of Wildlife Management that did a reanalysis to address that specific point so we could identify what factors were influencing ferruginous hawk changes in nest occupancy during this study.
And so this is actually an outdated slide here, obviously provided because it was requested, but just to point that out.
Q But as of the time of this document, you

acknowledge that the degree to which wind power contributed to changes in the nesting raptor guild, that was -- as opposed to the other factors, you said, as of time of this document, that you couldn't reach a conclusion?

A Right, it wasn't -- we couldn't reach a conclusion. It was impacting, but we couldn't -- but the idea was relative to everything that's taking place, this -- the analysis we had done to this point didn't differentiate between that which was connected to wind power versus other factors.

Just immediately after this, we were completing our analysis -- and that's the problem with draft studies. And this is actually a presentation, oral presentation. We actually completed the document to define that information.

Q And that's the document that you say is currently being peer reviewed?

A Yes, that's correct.

Q But that's -- that review hasn't been completed?

A No, that's correct.

Q Okay.

A It's not published.

Q And -- and so there could be changes or there could be disagreements that come out of that peer review,

right?

A Unlikely but, yes, until the paper is published, yeah.

Q While it's being peer reviewed, it's still vulnerable to attack?

A Correct.

Q Okay. When you were talking about the habitat for pocket gopher population, pocket gophers are a prey of ferruginous hawks, right?

A Yes.

Q And you've indicated that that -- that that prey would not be favored by large monotypic stands of agricultural?

A Yes.

Q Okay. So that's what we were talking about earlier. And as a layperson, so that I understand, people were farming in the area; that's messing up the habitats for these pocket gophers; and as a result, that's depriving the ferruginous hawks of some of food that they need for sustenance?

A That's close. Actually, monotypic stands are plowed up every year. So there's nothing -- no prey essentially there once they plow at that native habitat and put it into monoculture. Where you find pocket gophers would be on the fringes of that habitat. So

initially there may have been ground squirrels, for example, nesting before they put in these plowed fields.
They plow them up every year. There's nothing that -- there's no -- I say "ground squirrels nesting." They don't nest. They do nest. But -- but after that, then, you wouldn't expect any substantial prey out in these fields, these large agricultural fields.
Q And in fact, if the gophers were showing up in these monotypic stands, the farmers would be mighty furious, right?
A Yeah, they probably would, but -- and I'm not -- I'm not a pocket gopher expert, but all I know is we do have evidence from, you know, my observations, other studies, that hawks will fly to these agricultural fields - the edges of some irrigated, some nonirrigated - where you get these slopes, and you'll have pocket gopher colonies that are obviously related to these fields, and the hawks are using those.
Q Okay. You indicated that -- again, just to make sure that I understand. When you were talking about the 2019 report on migration factors and you were talking about that pairs of birds returning to where they formally nested, but if they don't, there would be recruitment on those territories to insure future reproduction of the ferruginous hawks; is that right?

A Almost correct. The only reason they don't return is if -- because if they die and don't come back.

Q Okay.

A So we've done some extensive work with nomadism with this species and repeatability and migration routes, and these birds are much more faithful to their home base, their home range, and their nests - as long as they survive - than we initially thought years ago.

Q But if they don't survive, then - again, looking at these territories where birds -- had the birds survived, you would have expected them to return to those territories but for whatever reason, their mortality, they don't return - there would be an effort to get other birds to colonize those areas?

A Yeah, so what happens, typically both adults won't die at the same time; occasionally that happens. So in a given winter, say, you had two adults that migrated to California; one of them died and one of them didn't. The other bird comes back and it comes back to the territory. It will go through the motions to attract a new mate, and obviously these would be recruitable adults; birds that have -- are old enough, two years-plus, to actually breed.

And so they'll be flying around and looking for a place to set up shop, and, you know, through the solicitation of that individual bird, whether it's male or female, they'll join them on that territory. So that's laymen's terms for what takes place.

Q You said that you've been contacted directly with questions about the project, and I'm looking to see -- it sounds like you were contacted directly by the applicant's consultant, by Mr. Jansen, regarding questions about the ferruginous hawks and the project, and you said that was more on the ecological side.

What does that mean?

A Yeah, I think Eric, for example, recently contacted us, sent a message about where ferruginous hawk platforms were located in Washington, those questions about some of the platform, probably in preparation for maybe what's been proposed as studies.

So not specific -- my point was not specific to what is being proposed as the project and how I relate to that. It's more just as Eric, as a biologist, talking about, you know, this is where we have hawks and -- and those are very limited in communications. There may only be a couple emails that that happened on so.

Q And so when you talk about the ecological side, what do you mean specifically? Can you define that?

A Well, that -- that specifically. I'm not talking about mitigation for projects. When I talk about ecology, I'm talking about the nesting of the birds, the nesting season of the birds, where they go, where we find them, what they eat. Those are ecology issues.

Q Okay. And you testified, and -- I'm sorry. I can't put my hands quickly on this document, but you talked about -- there was a statement that -- that the project adheres to WDFW guidance, and you said you weren't sure if that was true because you didn't know which guidance it was referring to?

A Right.

Q There was about --

A Right.

Q Okay. And so let's talk about guidance for a minute because then you talked about this guidance could be done, you said, verbally. I take it you mean orally; that not all guidance has to be written down?

A Correct.

Q Okay. And you said it has to be -- the guidance has to be based on good science.

A Yes.

Q And you used the phrase a bunch of times, what best -- you referred to the phrase "best available science."

A Yes.

Q Who decides -- tell me what you mean by best available science.

A In the arena I work in, in research division, best available science is science that's peer reviewed, that has gone through the process of others looking at it saying this is useful information, and it's scientifically credible.

Q Well, I'd like to tease that out a little bit because I think we're talking about two different concepts. I understand the concept of peer review; we talked about that a little bit. But when you talk about best available science, that wouldn't necessarily entail a component of peer reviewed, would it? I mean, it could be great science that just hasn't yet been peer reviewed.

A If it's available, I guess -- let me think about that question. Obviously before it's peer reviewed, it could be the best available science. Is that...

Q That's exactly my question.

A I guess I would agree.

Q Okay. And so who decides what's the best available science?

A It's a -- it's a -- the experts. I'm not sure how to answer that question.

Q Okay. And in fact, just to -- the updated study you've talked about, the one that's in peer review, that hasn't yet been peer reviewed. So by your definition, that's not yet the best available science; is that right?

A It is -- it is the best available science. That would be my definition. But I said earlier that it's got to go through peer review, and, you know, we went back on that a little bit. I believe -- I believe it's the best available science. Obviously through peer review, then my colleagues will agree that it's the best available science. So I guess it's a matter of perspective of who that's coming from.

Q So would it be fair to say they're related concepts but they're not -- they don't overlap vertically?

A It's a hard subject. The best available science is just the best science that has been -- the best research that's been done, and if it's published, it's published, and that would be, at that time, that which scores the best on this particular topic. It's -- you're asking a really -- a question I can't really answer, I guess.

Q That's why I went to law school and I'm not a scientist.

A Yeah.

Q So let me give you a hypothetical and you tell me if I understand this right. You go out and you do a study on habitats for the ferruginous hawks, a survey, let's say, and I go out and do my own survey. You might -- and neither one of them is peer reviewed. Mine might be

actually the best available science; is that right?

A I think it has to be passed, in that case, through the experts to determine because they're the -- they would be the avenue, best avenue, through which to determine best available science.

Q Okay. So would it be fair -- and I don't mean to beat this horse, but -- but the experts might think that my science is better than your science?

A But the problem is, in the scientific arena, we're talking about expertise built on years of -- you know, I've studied ferruginous hawks almost 50 years here, plus-50 years. I'm considered one of the nation's experts on these species. So I think going -- and I'm not saying that to boast. But going through those channels to understand what's the best available science would be the logical thing.

If somebody brought a study into me that's not built on 50 years of expertise, they would say "What do you think of this?" And I would say, "Well, that's not good science because of this, that, and the other," even though that's not peer reviewed. So it's -- again, the scientific field is -- it's -- it's hard to -- hard to grasp.

Q Okay. I think mine is the best available science for the record, just because.

And you indicated that every bit - again, I'm jumping around - that every bit of shrubsteppe habitat that remains is critical to the ferruginous hawk; is that right?

A I agreed with that, and that was in the concept of that which is, you know, important for ferruginous hawks. I mean, certainly every bit of shrubsteppe is important because it's such a limited habitat for a lot of species in the broader context, if I made that clear.

Q Is residential development, is that having an impact on the shrubsteppe habitat?

A It certainly can in certain places.

Q And you indicated wild fires also have an impact on that -- on that habitat?

A That's correct.

Q Okay. Are there other factors that would have an impact?

A Those are some of the main ones.

Q Okay.

A I mean, if --

Q And --

A And if we're talking about the exclusion of wind power as being that type of impact as a -- those are some of the -- those would be probably the three I would list as being really pressing on ferruginous hawk habitats at this present time.

Q Okay. You said that there would be -- we were talking about this first draft of the -- of the survey, the recommendations, the ferruginous hawk recommendation. You said that's been sent off, the first draft has been sent off for review, and that you were expecting external review and comments, right?

A Right.

Q And that will then be developed into formal guidance, and you said - and I understand that this was your hope - that it would be formalized within four months or so?

A Yeah, that's out of my arena because I'm actually just the consultant on that providing the ecological information. So it all depends on the reviewer times but, yes, that's essentially the process.

Q So the formal guidance that's in place now, that's the guidance that the project is in compliance with; is that right?

A I really don't know.

Q How old is the guidance that's in place?

A How long what? Excuse me.

Q This guidance that's in place, the formal guidance that's currently in place, when was that put into place?

A I think the reference was 2009, maybe, I believe.

Q Okay.

A That was the first wind-power guideline -- or wind-power-associated guidelines, I think that...

Q You -- this is -- now I'd like to just talk briefly about Exhibit 2 which is the periodic status review that you authored.

A All right.

Q Okay. And you noted in that -- in that report, you noted a decline in the ferruginous hawk population. Can you tell when that decline began?

A I would have to go exactly to the graph, but we're talking in the last 30 years, 20-plus years.

Q And could you talk about the specific causes that led to that decline?

A Again, loss of shrubsteppe habitat associated with the loss of ground squirrels, so the conversion of habitats largely; mortality of individual birds; a lot of those effects that we discussed.

Q And I know we've talked about the ferruginous hawks as a migratory species. What does that mean, a migratory species?

A That means the bird leaves its breeding area at the end of breeding to move over an extensive area, typically several hundred kilometers away, to find habitat in which it has prey to basically be rejuvenated during the winter and then be able to return to nest again the next nesting season.

Q And so is that -- so those areas that they go to, is that what we call "wintering grounds"?

A That would be correct. This bird also has summering grounds because it's gone for such a long period at the end of summer. So it'll actually migrate a couple times.

Q And so could conditions of wintering grounds, could those be contributing to a decline in population?

A Potentially. One of the things we're looking at is actually a longer term -- a study to look at survival throughout the breeding year. So one of the things we believe, a combination of factors, changes on breeding areas, as well as mortality outside the breeding season could be contributing to this decline. So a variety of factors potentially.

Q And when you talk about summering grounds, is that something other than this project area that we're talking about?

A Summering would be just a, for example, habitat in Southern Alberta. These birds leave immediately after nesting to go to Southern Alberta, perhaps the Great Plains, where they feed on ground squirrels and prairie dogs, and then they'll fly to California in the winter --

Q And so --

A -- where they spend the winter.

Q My apologies.

A No.

Q So could conditions in Southern Alberta, could those also be contributing to the decline in population?

A Very unlikely based on, you know, prey levels and what we know about ferruginous hawks but -- yeah.

Q "Yeah" what?

A I was going to say, in Colorado and other places, other factors such as residential development are taking place. Certainly, in ferruginous hawk winter habitats that may be affecting, ultimately, the survival of birds and whether or not they return, or at least diminishing their health to the degree that they don't nest, but those are all unknowns. Those are very hypothetical situations that we can think about.

Q And do -- could just the loss of migratory routes, could they be contributing to the decline in population?

A Of course, but generally these birds, you know, have certain stopover areas which are the key to whether or not they survive or not, so it's those summering areas, wintering areas. But they can get shot, for example, in some of these migratory areas. A lot of things can happen.

Q   And as part of what you do as a biologist, have you identified the ferruginous hawk nests that are close to this project?

A   Yes.

Q   And how many -- how many nests have you identified in proximity to this project?

A   If you're asking about specific nests, I would have to look that up. It's probably 50-some nests that historically have been there. There are 16 nesting territories; those are the critical factor. Again, we don't manage this species based on number of nests. Since birds have alternate nests on territories, we manage them on the territory basis. And each -- the reproductive unit is essentially one pair of birds on a territory; that's what we're interested in maintaining.

And so there's 16 territories, historically, that we've identified associated with the project.

Q   And can there be more than one active nest within a territory?

A   No.

Q   Okay. Is that -- in fact, am I missing the point? Is that -- that's how you define the territory is where the active nests are?

A   We don't use the term active nest. It would be a used nest on an occupied territory. So the territory is the score that gets the occupant, and that's what we're concerned about - occupied territory, used nests and unused nests on that occupied territory - because these birds can have more than one nest.

So some years they'll use this nest; some years that nest. And that's why the term active nest, I think, has been coined, but it actually should be used nest, unused nest, or used-alternative nest on an occupied territory; that's the proper terminology.

Q So am I hearing correctly that there can be more than one used nest within an occupied territory?

A No.

Q Okay.

A Not in a given nesting season. You have -- the birds are territorial, so they would not allow another pair of birds within their home -- or within their -- that zone that includes an alternative nest to be using a nest.

Now, territories can change a little bit overtime, the boundaries. So we're talking in relative terms. I mean, there can be, you know, some things that, over 20/30 years, there can be some slight shifts. But you're not going to have two birds nesting in close proximity, generally.

Q Do you monitor the unused nests in a given territory?

A We monitor those only when -- and I don't monitor those personally. Our management biologist would fly over and look at those and actually record those during surveys. So they're looking for the used nests, and if the unused nests are -- if they don't find a nest that's being used on that territory, they'll look at the unused nests to see if they're in use. So that's kind of their process.

Generally, if they find a used nest, they will -- you know, they'll be done with the survey at that point because they've located the pair of birds that are -- that the territory is occupied; that's how we approach it.

Q So I just want to go back with some of this. You talked about anthropogenic impacts to the ferruginous hawk population. And so what do you mean when you talk about anthropogenic impact?

A Yeah, ferruginous hawks are what I would consider more of a wilderness species than -- and we're talking about arid-land species. I mentioned the spotted owl, so we think of -- we know a lot about spotted owls. They're native to large trees, uncut virgin forests.

Ferruginous hawks are similar in that they're a species that is associated with undeveloped land, wide-open arid land. They use large spaces. They're a species specialist when it comes to prey. And once those -- and those species are very specific. The prey is the key to all raptors. Once you -- once you remove that prey that they're very specialized in, you're creating all sorts of havoc for these birds because they have to find other things to feed on.

Now, what happens, then, when you alter habitat anthropogenically - a couple things - one, you may be removing their key prey, so they're forced to subsist -- persist on other types of prey.

Secondarily, with ferruginous hawks, this species historically and even now has been -- seem to be very sensitive to close human activity. So we're talking about alterations that are unnatural in that landscape, that, you know, would not be present had it not been for people, whether it's people driving out in an area with ATVs or whether it's, you know, plowing up certain fields. So it can be altered habitat or actually human activities and altered habitat, both of these things.

So this species is not just subject to being a specialist with diets that are affected by those anthropogenic activities that may change the habitat and availability of prey, but they're also sensitive to those actual activities that are taking place that are more than other hawks.

For example, osprey, a good example, we all see osprey nesting along our river and on a pole that may be right next to human activity and they're basically tolerant of it or indifferent towards it. It doesn't affect them, and they're feeding out in the water, which is, again, a key. So it doesn't affect their ability to nest and be successful.

But that's simply not the case with ferruginous hawks. By their nature, they're a specialist, a sensitive species that uses large areas in the type of landscapes they inhabit.

Q So in the last 20 years, say - and let's just talk about Washington state - can you tell me how many fatalities to ferruginous hawks there have been from collisions with vehicles?

A That would be a really -- I wouldn't have that information. And the reason I wouldn't is because it's not recorded, generally. There's no -- fish and wildlife service doesn't keep -- they would have the record base for that. And outside of wind turbine, the incidental information I've mentioned that I've kind of kept track of that's not even comprehensive, I don't know of anybody that really tracks ferruginous hawk fatalities.

Q Would it be fair to say you'd expect to see fatalities as a result of collisions with vehicles?

A Yes.

Q And what about collisions with buildings? Same story?

A No, no buildings. These birds wouldn't run into buildings.

Q Okay. What about electrocution on power lines?

A Sure.

Q And what about poisoning? I know in some of your materials you reference incidental poisoning as a result of poisoning of their prey.

A Yeah, unlikely with this species. They're not associated with some of the present uses of rodenticides and others that are more typically in human activity areas. Like red-tailed hawks, barn owls would be poisoned from rodenticides, for example, because that's where people place them. Well, these hawks nest out in landscapes that are devoid of those types of poisons. So poisoning is generally not a concern.

Q What about poisoning of pocket gophers?

A Probably not pocket gophers. Prairie dogs, for example, might be a concern, but it all -- it depends on the types of poisons, and that's -- that's kind of a big unknown, but it has been demonstrated that poison of, you know, those kinds of rodents could lead to some ferruginous hawk fatality.

Q And what about squirrels?

A   Ground squirrels, same thing.

Q   Yeah.

A   Up in -- up in Alberta, for example, yeah.

Q   And how about wild fires? Do we -- do ferruginous hawks die in wild fires?

A   Sure, nestlings would, of course. If you have birds that are preflight on nests, they could die in wild fires.

Q   And you indicated, if I understand correctly - and this came as a surprise to me during your testimony - that ravens are a predator of ferruginous hawks?

A   They are, and I probably -- to clarify, predator of eggs and nestlings. Big predators of not just ferruginous hawks but pretty much everything else.

Q   And are there other -- do the ferruginous hawks have other predators as well?

A   They do and probably the worst are great horned owls. Great horned owls are probably the worst -- one of the worst things that were ever invented as far as ferruginous hawks. And again, they're an --

Q   And so --

A   They're a favorite of species that moves in after people move in so.

Q   And presumably there are fatalities associated, then, with that kind of predation?

A   Definitely. They'll kill adults. They'll kill eagles as well.

Q   And reduced nest occupancies, those are -- that's also, in some cases, attributable to human impacts, right?

A   Potentially, yes.

Q   Okay. So drought might be a factor on nest occupancy?

A   Yeah, drought would be in relation to prey, if it's -- if prey is affected, certainly drought could affect.

Q   And the same with disease as regard to prey?

A   Specifically, I'm not sure what disease -- you said "disease of prey"?

Q   Well, yeah, I mean, I'm just thinking about the things that could also have an impact on nest occupancy.

A   Oh, yeah. I mean, if you were to go to Colorado and there was a bubonic plague outbreak in a huge prairie dog town, obviously if the birds are feeding on prairie dogs, that -- potential disease.

Q   Okay.

A   I mean.

Q   Okay. And we talked about agricultural. What about overgrazing?

A   Grazing, grazing can be good. Historically Bison graze, and that was actually a good thing probably for ferruginous hawks in that it reduced vegetation heights. So these birds are going to get, you know, their best capturing of rodents and having rodents, if, you know, vegetation is 10 centimeters high or so. So it needs to be clipped off, but then if you reduce the vegetation down to 0, that's not a good thing for maintaining rodents.

So it's really -- grazing is a -- it needs an explanation as far as the level of grazing and what might be benefit or be detrimental to ferruginous hawks and other species.

Q And what about climate change?

A I mentioned climate change as being a potential future affect on reducing -- on range constriction for ferruginous hawks, based on, you know, effects on prey.

Q And am I correct that there's already been residential development in Horse Heaven Hills?

A That's a really tough question. I was thinking of, actually, a site probably adjacent to Horse Heaven Hills on a slope that had houses on it; that I recall back in -- 20 years ago they were still building a few houses.

But in terms of large-scale residential development, I'm unsure of any -- that there'd be anyplace for that to take place. So residential development, I was thinking, again, an individual lot maybe being developed on an area that's already been developed.

Q Well, what about the County Heights development in the Badger Canyon territory; are you familiar with that?

A Yeah, I'm familiar with Badger Canyon but not that development at all.

Q Okay. What about the Clodfelter and Glenn Miller Prairie Development?

A No.

Q Are you aware of any new construction in the Sheep Canyon territory?

A No. I mean, I'm familiar with all of those territories but obviously I don't work as a district biologist that's on top of what's taking place in terms of the specific developments there so.

Q So in other words, there could be large-scale development, but you just wouldn't necessarily be aware of it?

A Personally. The biologist there would be, yeah.

Q Okay. Would you expect construction -- residential development construction to have impacts on the use of nests?

A All depends on where the nests are in proximity to the development.

Q Okay. And certainly it might -- construction -- active construction could lead to nest abandonment in the proximity?

A Well, if we're talking about a nest that's in use and you have a house that's built within, you know, a couple miles of the nest, you could have people that are certainly disturbing the birds. So it all depends on proximity and the nature of the activities, you know.

Q So the hypothetical that you just talked about, where there's a house built within a couple miles of a nest, that could lead to a nest abandonment?

A Potentially.

Q Okay.

A But it could also lead to loss of -- excuse me -- of habitat. That's the --

Q Understood.

A Yeah.

Q Do you know, has WDFW taken any action to protect the ferruginous hawk population against impacts from residential development?

A That's part of the -- part of the development of these PHS Guidelines, or redevelopment, to provide, proactively, this information to potential developments and residential development. So that would be the extent of my knowledge as to how that process works.

Again, you're speaking in an arena that's kind of outside of my forte so really kind of difficult to address. But I do know these PHS guidelines we talked about are the -- you know, a critical part of that.

Q Thanks. So let me ask -- I want to talk about a couple of other wind energy projects. Are you familiar with the Columbia Gorge Wind Resource Area?

A I don't know if that's -- I may be familiar with it, but, you know, people use different terms and names change. So if you could describe the area, is that -- can you describe the project area?

Q You know, actually I -- I actually can't. That's the information that I have is the Columbia Gorge WRA. But let me ask, are you familiar with Stateline?

A Yes.

Q Okay. And am I right that there -- historically there have been 10 nests within 10 kilometers of that area; is that --

A Yeah, that --

Q I'm sorry?

A I'd have to look that up, but that could be accurate.

Q And if I told you there were four nests that were inside -- inside 3.2 kilometers of that area, would that make sense to you too?

A I would -- again, I would have to look all that up.

Q Well, do you know whether WDFW has required or

recommended any mitigation resources -- any mitigation measures to protect the resources there?

A At Stateline?

Q Yeah.

A That would be, you know, prior to my working with this. And, again, operating under different guidelines, that was a 2001 project. So that's -- that was the first project -- first wind project, essentially, affecting ferruginous hawks. So it's very early on in what we're -- you know, when we -- and well-before I got involved, so I really couldn't say.

Q What about the Rattlesnake Flat Area; are you familiar with that?

A That -- yeah, let me think. Rattlesnake Flat, I'm blanking out on the location. I'd -- yeah.

Q Okay. So you're not familiar with that, necessarily, specifically?

A No. Yeah, I'm trying to think. If it's got ferruginous hawks associated with it, I'm probably -- probably familiar with it, but I'm trying to think of the location but drawing a blank.

Q I want to talk briefly about these artificial nesting platforms that you talked about during your testimony.

A Okay.

Q And I think you indicated that there's been a change of policy on the use of these artificial nesting platforms as a way of supporting nesting ferruginous hawks; did I get that right?

A There's not really a policy, per se. It's just advice within our agency and our biologists based on what's developed as far as our understanding as to how these birds use those. So there's not really a policy, per se.

Q Well, is the state continuing to build them?

A I -- the state, we don't really build those. We have -- right now there's a project. One of our biologists, Mark Vekasy who I mentioned, who has a cooperative project with the Department of Transportation, and Mark is very much attuned to his -- he's a raptor biologist -- attuned to ferruginous hawks and the territories he has.

So it's been a great opportunity to look at how we can, through an understanding of potential sites that have gone downhill, that have lost nesting structure, can be improved by putting platforms up. But, again, that's a very measured process. It's not a policy -- and it's -- that we, you know, allow platforms going up everywhere in general. We're very specific as to when those need to be used and not used.

Q So that process is still underway, if I'm hearing you correctly?

A That's correct.

Q Okay. And does the state monitor the platforms?

A We only do through our regular surveys that are conducted, and we don't, in general -- like the last time we surveyed - probably it was 2016 - we actually went through and eliminated roughly 50 platforms that had historically been placed in the landscape that have never been used by ferruginous hawks.

So we only monitor those that have ever been used or would be considered to be ferruginous hawk nests by virtue of having ferruginous hawks confirmed nesting at that location, at those locations.

Q Why were the other platforms removed?

A Why were they what?

Q Why were they removed?

A Because they were never used for 40 years. We didn't really remove them. We just don't survey them. They were just never used. They fall into disrepair and they fall over.

Q Okay. I'm very close to the end. I just have a couple of last questions for you.

When we talked -- we talked, probably at more length than you want to, about peer review. When you talk

about peer review of your materials, is that only within WDFW or is that -- or does that take input from external sources as well?

A   No. So when I say peer reviewed, I'm talking about external sources exclusively. I mean -- I'll rephrase that because we did talk about peer review of the PHS document; so that's the exception. But when I talk about, in my -- my resume, for example, what I would provide as peer-reviewed documents, those are all external reviews through journals, you know, through my peers; whereas internal reports are reviewed internally, largely, but they go through internal review.

The exception would be these PHS guidelines which are obviously going to be impacting a larger group of people and have more application. They would go -- you know, it would be internal, plus we would send out for external review. And, again, all of that's outside my arena as to those processes and who decides those so.

Q   Sure. So only a couple more things.

You mentioned that there were 16 territories that overlap the project area. Are any of these occupied territories or are they all considered historical?

A   They're based on information that -- we know there are at least a couple that have been recently occupied. So historical is a relative term. Does that go back to

1990 or does that go back to 2020? Does that -- so --
Whoa, are we still here?
Q I'm here.
A Right. Historical, for some people, would mean it wasn't used last year, but that wouldn't be our definition. Our definition would really focus on currently occupied, being used previously, as kind of -- so when I'm using the term "historical," is that your question?
Q Well, and it seems that maybe I need to ask you to define it.
A Yeah.
Q Can you just tell me -- go ahead.
A Yeah, I'm sorry. Historical would be a ferruginous hawk territory that has been occupied definitively, that is confirmed definitively, at some point in our monitoring history. From day X when we first monitor until now, at some year, at least one year, it has been occupied and used by nesting ferruginous hawks.
Q So 16 territories, could you quantify how many are currently occupied?
A This year, I haven't flown over them, so I couldn't tell you. We're right in the middle of a nesting season, so I really don't know.
Q Do you know from last year?

A No, that's not my job to survey those. That would be the district biologist. So, again, I'm just -- it's outside of my -- I know it's hard to say that because we're talking about ferruginous hawks, but I don't go out and monitor every nest every year because I'm dealing with golden eagles and prairie hawks and everything else in the state. So I -- last year, from what I've heard, there were two or three or four territories occupied; I don't really know.

MS. PERLMUTTER: Okay. So if we could take a two-minute break, I think I'm done, but I want to just make sure that none of my colleagues have any questions. So if we could go off the record. It's -- I've got 12:36. If we come back at 12:40, and I am within seconds of wrapping up. So let's take a minute. Okay?

[Off record at 12:36 p.m.]

[On record at 12:39 p.m.]

BY MS. PERLMUTTER:

Q Mr. Watson, did you review the applicant's survey reports from the last couple of years before your deposition?

A No, I -- no.

Q Okay. And when you said -- we were talking about the number of occupied nests, and I asked you about last year, and I just want to make sure. You said you weren't

sure, that it could be two, three, or four, but you really didn't know.

A As I -- as I best recall, I think it was two or three last year. So obviously I'd been conveyed that information, maybe in our Zoom meetings or wherever.

Q But if I told you that the number was zero, would you have any basis for disagreeing with me?

A No, I didn't survey them, so I was -- no.

MS. PERLMUTTER: I have nothing further.

MS. VOELCKERS: I have a few concluding questions, unless the other parties have follow-up questions? Okay. Hearing none.

EXAMINATION

BY MS. VOELCKERS:

Q Mr. Watson, have you ever affirmatively declined to review any materials authored by the applicant's consultant that you were asked to review?

A No.

Q Are there any specific details regarding the project site surveys from the last couple years that, if you were to review them, would change your recommendation to exclude all turbines from core-use areas of identified ferruginous hawk territories?

A If I was to review the proposal?

Q Any survey details that you were to review from

the last couple years' surveys that would change your recommendation to --

A No, our recommendation has been consistent with that core area being off limits to turbines.

Q And that's because your recommendation is based upon historic territory identification?

A That's correct, yes.

Q Were your answers to Ms. Perlmutter earlier regarding the current extent of agricultural growth in the Horse Heaven Hills anecdotal?

A Yes.

Q And I apologize, but I do want to return to this discussion of best available science one more time. I understand it's a nebulous term, maybe, for those of us that aren't in the field. So to be clear, can scientific information be considered best available science before it's been peer reviewed?

A Yes.

Q And why is that?

A Because science is a process, and so the best available science, that term is relative to what has been studied or researched, and it may not -- it's never going to be perfect. Science is based on probability.

The idea, though, is, as it goes up through this process, the reliability of it may increase but it's still the best available science at anyplace in the process. But obviously the most preferred step is that last step of the peer-reviewed process.

Q And as an expert in your field, are there certain methods or standards that you would look for in assessing the reliability of science that hasn't been peer reviewed?

A Again, it's looking at the experts who understand that the process would be -- if a project has been developed or has been reported on, that information, the process for reliability for understanding how valid the science is, is to put it through the experts that understand that particular system or species and can evaluate that.

Q And then there was some reference to guidelines earlier when discussing Exhibit 7. So I want to be really clear. Is Exhibit 7 an update to the 2004 PHS guidelines?

Oh, I'm sorry.

A Not Exhibit 7.

Q I misspoke. Not Exhibit 7. Exhibit 8.

A Yes. Yes.

Q Okay. That's an update to the 2004 PHS guidelines?

A That's correct.

Q Not the 2009 wind turbine guidelines?

A A little bit of explanation. Again, this would be a question posed for our energy section, but I believe the idea in our last discussions was to consolidate energy recommendations within PHI -- PHS guidelines more formally, which it wasn't done in 2004 because we didn't -- wind power wasn't an issue.

So the current discussion was, yes, let's include wind power recommendations within these guidelines. So I think that answers your question.

Q Is it fair to say that WDFW is working hard to update both guidance documents as soon as possible?

A Yes.

MS. VOELCKERS: Okay. I don't have any other further questions.

MS. PERLMUTTER: I don't have anything further.

[By agreement of counsel and deponent, signature was reserved.]

[Deposition concluded at 12:45 p.m.]

STATE OF WASHINGTON)
) SS: C E R T I F I C A T E
COUNTY OF WHATCOM)

I, DANIELLE SCHEMM, a Certified Court Reporter within and for the State of Washington do hereby certify;

That the witness, James Watson, whose testimony appears in the foregoing deposition was duly sworn by me;

That the testimony of said witness was taken by me to the best of my ability and thereafter reduced to typewriting under my direction and is contained in Pages 1 through 127;

That I am neither counsel for, related to, nor employed by any of the parties to the action in which this deposition was taken;

And further that I am not a relative or employee of any attorney or counsel employed by the parties thereto, nor financially or otherwise interested in the outcome of the action;

This transcript and invoice have been prepared and submitted for final production and delivery in accordance with all Washington State laws, rules and regulations, including WAC-308-14-130, WAC-308-14-135, RCW 18-145, and applicable court rules regulating formatting and equal terms requirements;

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Signed and dated this 19th day of July 2023.

DANIELLE SCHEMM
CERTIFIED COURT REPORTER
IN AND FOR THE STATE OF
WASHINGTON, RESIDING AT
BELLINGHAM. LICENSE EXPIRES
JULY 16, 2024

ERRATA SHEET

I declare under penalty of perjury that I have read the foregoing ________ pages of my testimony, taken on ____________________________ (date) at _____________________(city), ____________________(state),

and that the same is a true record of the testimony given by me at the time and place herein above set forth, with the following exceptions:

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EDUCATION

M.S. Fish and Wildlife Management - Montana State University, 1984
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PROFESSIONAL EXPERIENCE

- **Research Scientist**, Washington Department of Fish and Wildlife, Olympia, WA 1997-present
- **Wildlife Research Biologist**, Washington Department of Fish and Wildlife, Olympia, WA 1992-1997
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- **Biological Aide**, U.S. Fish and Wildlife Service, Denver, CO, 1979
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LICENSES AND CERTIFICATIONS

Master permit 24133, U.S.G.S. Bird Banding Laboratory
Migratory Bird Scientific Collection Permit MB182337, U.S. Fish and Wildlife Service

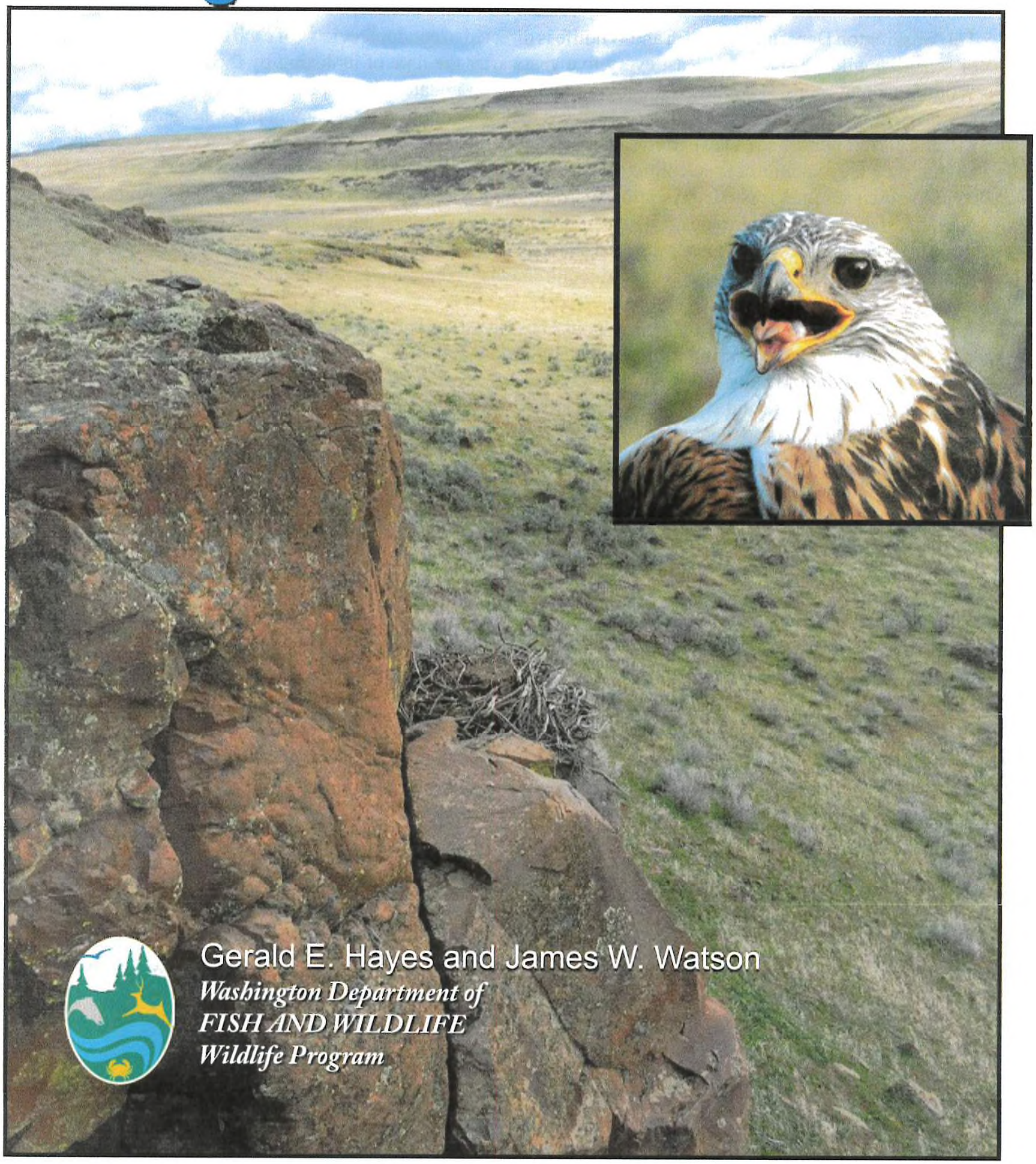
PROFESSIONAL SOCIETIES

Raptor Research Foundation

STATE OF WASHINGTON

August 2021

Periodic Status Review for the Ferruginous Hawk



Gerald E. Hayes and James W. Watson
Washington Department of
FISH AND WILDLIFE
Wildlife Program

The Washington Department of Fish and Wildlife maintains a list of endangered, threatened, and sensitive species (Washington Administrative Codes 220-610-010 and 220-200-100). In 1990, the Washington Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 220-610-110). These procedures include how species listings will be initiated, criteria for listing and delisting, a requirement for public review, the development of recovery or management plans, and the periodic review of listed species.

The Washington Department of Fish and Wildlife is directed to conduct reviews of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing by the Washington Fish and Wildlife Commission. These periodic reviews include an update on the species status to determine whether the species warrants its current listing or deserves reclassification. The agency notifies the general public and specific parties interested in the periodic status review, at least one year prior to the end of the five-year period, so that they may submit new scientific data to be included in the review. The agency notifies the public of its recommendation at least 30 days prior to presenting the findings to the Fish and Wildlife Commission. In addition, if the agency determines that new information suggests that the classification of a species be changed from its present state, the Department prepares documents to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act.

This periodic status review for the Ferruginous Hawk was reviewed by species experts and was available for a 90-day public comment period from 12 January to 12 April 2021. All comments received were considered during the preparation of this final periodic status review. The Department presented the results of this periodic status review to the Fish and Wildlife Commission at a meeting on 6 August 2021, and the Commission voted to uplist the species to endangered on 27 August.

This report should be cited as:

Hayes, G.E. and J.W. Watson. 2021. Periodic Status Review for the Ferruginous Hawk. Washington Department of Fish and Wildlife, Olympia, Washington. 30+iii pp.

On the cover: Photos of Ferruginous Hawk and nest by Jim Watson

This work was supported in part by personalized and endangered species license plates

Periodic Status Review for the Ferruginous Hawk in Washington

Prepared by
Gerald E. Hayes and James W. Watson

Washington Department of Fish and Wildlife
Wildlife Program
600 Capitol Way North
Olympia, Washington 98501-1091

August 2021

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LIST OF FIGURES AND TABLES

EXECUTIVE SUMMARY

The Ferruginous Hawk (*Buteo regalis*), was listed as state threatened by Department of Game policy in 1983, and in 1990 the Washington Wildlife Commission maintained the species on the state list of threatened species. North America's largest buteo, the Ferruginous Hawk, occurs in low numbers in shrubsteppe and grassland regions of several eastern Washington counties, however, early accounts suggest they were once relatively abundant in the state. An average of 55 breeding pairs per year nested in the state between 1992 and 1995. More than 60% of the nesting territories are concentrated in Franklin and Benton counties, which are considered the core breeding range in the state.

The Ferruginous Hawk is largely restricted to grasslands and shrubsteppe. Conversion of native grasslands and arid shrublands to agriculture, urbanization, and the degradation of rangelands have contributed to the loss of nesting and foraging habitat on its breeding range in Washington. Degradation of fall and winter ranges frequented by Washington's hawks in migration and the nonbreeding period has been documented through satellite monitoring. Reductions in prey base on the breeding range and depressed prey populations encountered during migration on fall and winter ranges are likely a significant factor in the decline of Washington's breeding population of Ferruginous Hawks.

The breeding population of Ferruginous Hawks in Washington is in sustained decline. Between 1974 and 2016, there have been significant declines in nesting territory occupancy, nest success, and productivity. Additionally, the percentage of surveyed nesting territories supporting breeding pairs has significantly declined in the core breeding range of the species in Benton and Franklin counties. The distribution of breeding pairs statewide also appears to have contracted since the 1990s. There has been no improvement in habitat conditions or amelioration of primary threats, and therefore the recommendation is to reclassify the Ferruginous Hawk from threatened to endangered status in Washington.

ACKNOWLEDGMENTS

This periodic status report was improved after reviews by Hannah Anderson, Michael Atamian, Stefanie Bergh, Joseph Buchanan, Steve Desimone, Jason Fidorra, Patrick Kolar, Michael Kuttel, Jr., Jason Lowe, Heidi Newsome, Janet Ng, John Nugent, Mike Ritter, Ella Rowan, Matt Stauber, Derek Stinson, Jessica Stocking, Mark Vekasy, Kevin White, and Justin Wilde. Syntheses of WDFW survey data on the status of nesting territories, including occupancy, number of breeding pairs, reproductive success, and distribution of breeding pairs by recovery zones were provided by Gretchen Blatz (WDFW, WSDM database). We wish to thank numerous participants and supporters of nest survey efforts that produced the data presented in this report. Survey participants included staff from the Bureau of Land Management, U.S. Department of Energy Hanford Site (Mission Support Alliance contractor), U.S. Fish and Wildlife Service, Yakima Training Center, Yakima Audubon Society, Lower Columbia Basin Audubon Society, Woodland Park Zoo, WDFW regional wildlife biologists, and numerous other volunteers. Cover photograph provided by Jesse Watson, with permission.

INTRODUCTION

This document summarizes the historic and current distribution and abundance of the Ferruginous Hawk (*Buteo regalis*) in Washington and describes factors affecting the population and its habitat. It updates the species' status since 1995 (WDFW 1996), as per WAC 220-610-110. This document is intended to review information pertinent to Washington State classification and not serve as a comprehensive literature review for the species.

LEGAL STATUS AND DESCRIPTION

In Washington, the Ferruginous Hawk was listed as state threatened by Department of Game policy in 1983 and in 1990 the Washington Wildlife Commission maintained the Ferruginous Hawk on the state list of threatened species (WAC 220-200-100). It retains the classification of state threatened today. The Ferruginous Hawk was petitioned for listing under the federal Endangered Species Act in 1983 and 1991 and found to be not warranted (USFWS 1992). The Ferruginous Hawk is a Species of Greatest Conservation Need (SGCN) in State Wildlife Action Plans (SWAPs updated 2015) in 14 of 17 states in the U.S. where breeding occurs.

The Ferruginous Hawk is a member of the order Accipitriformes and the family Accipitridae. The genus *Buteo* includes nine species that breed in mainland North America. The species was first described by G. R. Gray in 1844, who named it *Archibuteo regalis* (AOU 1998). No subspecies are recognized (Ng et al. 2017). Common names include Squirrel Hawk and Ferruginous Rough-legged Buzzard (Jewett et al. 1953). The Ferruginous Hawk is the largest North American buteo. Adults measure 56-69 cm from the top of the head to tail tip, have a wingspan of nearly 1.5 m, and a body mass of 977-2,074 g, with females being larger than males (Ng et al. 2017). Both light and dark morph plumages occur with the light morph plumage more characteristic of our Washington birds (Bowles and Decker 1931). Underparts are starkly white at a distance and make the reddish leggings and black "commas" at the wrist of the wing very apparent (Figs. 1, 2). The head is brown with rufous or creamy streaking. From above, the back and upper-wing feathers are rufous, contrasting with the grayish flight feathers and white "window" on the outer primary feathers. The tail is white, rufous, gray, or a mixture of these. Sexes are similar in plumage (Dunne et al. 1988, Ng et al. 2017).

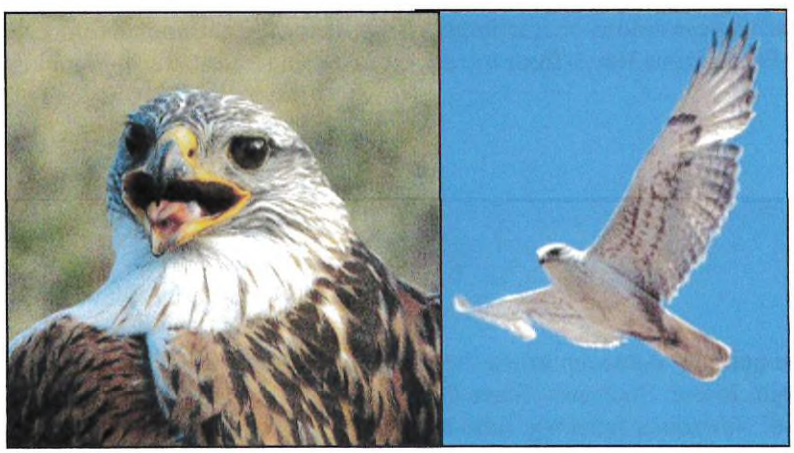

Figure 1-2. Ferruginous Hawk (photos, left to right, by Jim Watson,and Jerry Liguori)

DISTRIBUTION

The Ferruginous Hawk breeds from the Canadian Prairies south through northern Arizona and New Mexico and winters from central Mexico north to California, Colorado, and western Kansas (Ng et al. 2017; Fig. 3). In Washington, Ferruginous Hawks are restricted to the arid shrubsteppe region of southeastern Washington. Most hawks migrate from their breeding ranges in Washington with only a small percentage (6%) overwintering on their breeding territories in the state (Watson et al. 2018*a*). Breeding activity has been confirmed in 11 eastern Washington counties (Fig. 3) with most nesting territories concentrated in Benton and Franklin counties. Most hawks from Washington's breeding population migrate and overwinter in the Central Valley of California (Watson and Pierce 2003, Watson et al. 2018*a*).

Figure 3. Breeding and winter range of Ferruginous Hawks in North America (*left*; source: Ng et al. 2017). Distribution of Ferruginous Hawk nesting territories (first reported 1978–2019) in Washington (*right*; Source: WDFW database).

NATURAL HISTORY

Habitat requirements. The Ferruginous Hawk is an open country species that inhabits grasslands, shrubsteppe, and deserts of North America (Ng et al. 2017). Habitat in the breeding range is flat and rolling terrain in grassland or shrubsteppe regions where sparse riparian forests, canyons with rock outcrops, and isolated trees and small groves of trees provide suitable nest sites (Ng et al. 2017). In Washington, breeding habitat is shrubsteppe and juniper savanna where basalt rock outcrops or isolated trees, primarily juniper (*Juniperus occidentalis*), provide suitable nest sites (Bowles and Decker 1931, Bechard et al. 1990, WDFW 1996). In Oregon, breeding habitat occurs in grasslands and shrubsteppe where rock outcrops, trees, and the ground provide nest sites (Lardy 1980, Cottrell 1981, Kolar 2013).

During migration, Ferruginous Hawks use shrubsteppe, grasslands, and agricultural edges as foraging habitat (Ng et al. 2017). Winter habitat is open terrain from grassland to desert (Ng et al. 2017). East of the Rocky Mountains, the hawk primarily uses grasslands, especially where prairie dogs (*Cynomys* spp.) are abundant. West of the Rocky Mountains, grasslands and arid areas are used, especially where ground squirrels (*Urocitellus* spp.), prairie dogs (*Cynomys* spp.), lagomorphs, or pocket gophers (*Thomomys* spp.) are abundant (Ng et al. 2017). Ferruginous Hawks from Washington's breeding population use grasslands, shrubsteppe, pasture, and croplands on summer and fall ranges in the Great Basin, along the east slope of the Rocky Mountains, and Northern Great Plains, and use grasslands and oak savannah interspersed with croplands on winter range in the Central Valley of California (Watson and Pierce 2003, Watson et al. 2018*a*).

Diet. The Ferruginous Hawk preys primarily on small to medium size mammals, including rabbits (*Sylvilagus* spp.), hares (*Lepus* spp.), ground squirrels, prairie dogs, and pocket gophers (Olendorff 1993, Ng et al. 2017). Primary prey varies by region with ground squirrels and prairie dogs utilized east of the Continental Divide, while jackrabbits and cottontails are mainly utilized west of the Continental Divide (Ng et al. 2017). On the breeding range in shrubsteppe, diet is comprised mostly of jackrabbits in Utah (Smith and Murphy 1978) and southern Idaho (Thurow et al. 1980), with ground squirrels and pocket gophers replacing rabbits as primary prey in Washington (Fitzner et al. 1977), Oregon (Lardy 1980, Cottrell 1981), and southwestern Idaho (Steenhof and Kochert 1985).

Ferruginous Hawks in Washington appear to have undergone a dietary shift since the 1920s. Anecdotal accounts from that time suggest jackrabbits were critical to the state breeding population (Bowles and Decker 1931), but subsequent declines in jackrabbits (Couch 1928, Larrison 1976), Washington ground squirrels (*Urocitellus washingtoni*) (Betts 1990, Betts 1999) and Townsend's ground squirrel (*U. townsendii*) may have contributed to dietary shifts of Ferruginous Hawks to small mammals, snakes, insects, and gulls (*Larus* spp.) (Fitzner et al. 1977, Leary et al. 1996, Richardson et al. 2001). In some parts of the state, Ferruginous Hawks may be nearly dependent on northern pocket gophers, which are small and nocturnal, indicating that their traditional, higher quality prey species may no longer be available (Richardson et al. 2001).

During migration and on their winter range, Ferruginous Hawks prey on lagomorphs, ground squirrels, pocket gophers, and prairie dogs (Jones 1989, Allison et al. 1995, Plumpton and Anderson 1997, Plumpton and Anderson 1998, Watson and Pierce 2003, Smith and Lomolino 2004). After the breeding season has ended, Washington's Ferruginous Hawks migrate to exploit small to medium-sized mammalian prey that includes Richardson's ground squirrels (*U. richardsoni*), California ground squirrels (*U. beecheyi*), prairie dogs, and pocket gophers on late summer, fall and winter ranges (Watson and Pierce 2003, Watson et al. 2018*a*).

Home range and movements. During the breeding season raptor pairs establish a territory overlapping with suitable habitat resources, such as prey and nesting substrates, which they defend from conspecifics (Newton 1979). Raptors demonstrate strong territory fidelity and nest-site fidelity, especially *Buteo* species such as Ferruginous Hawks (Newton 1979, Watson and Pierce 2003, Watson and Keren 2019). Nesting territories typically contain one to multiple nests that are reused for many years (Houston 1995, Ng et al. 2017). Nests act as the loci around which resource use is centered during the breeding season (Bechard et al. 1990). The size of the adult home range and distance from the nest to foraging areas during the breeding season is largely determined by food availability (Newton 1979). Adults may range over small areas where prey is locally abundant or range over larger areas where prey is generally scarce or far away. Breeding hawk pairs that do not reproduce or fail in their nesting attempts may expand their home range or abandon their territory for the remainder of the season (Steenhof and Newton 2007).

In Washington, average home range size (95% minimum convex polygon) for seven radio-marked adult males was 79 km^2 (range 8.9 – 136.4 km^2), and core activity areas (85% adaptive kernel) averaged 30.8 km^2 (Leary et al. 1998). In southwestern Idaho, average home range size (95% minimum convex polygon) for seven radio-marked adult males was 7.6 km^2 (range 4.8 – 14.1 km^2), and core activity areas (50% harmonic mean) averaged 2.2 km^2 (0.46 – 5.5 km^2) (McAnnis 1990). The relatively larger home ranges and core activity areas used by hawks in the Washington study (Leary 1996) was attributed, in part, to some adult males traveling more than 10 km from their nests to hunt northern pocket gophers in irrigated agricultural fields. This indicated that prey may have been less available in habitats around nest sites and more available in the irrigated agricultural fields. In contrast, prey may have been more abundant near nests in the Idaho study. Core activity areas were centered on the nests and most foraging attempts occurred within one kilometer of the nests site (McAnnis 1990). In a study using GPS telemetry and more advanced analytical methods, home ranges averaged 315.9 km^2 (Browian Bridge 95% isopleths) and 32.3 km^2 (50% isopleths) for seventeen breeding pairs in southcentral Washington and northcentral Oregon from 2007 to 2014 (J. Watson, WDFW, *unpubl. data*).

The majority of Ferruginous Hawks from Washington migrate and are away from breeding territories for two-thirds of the year (Watson and Pierce 2003, Watson et al. 2018*a*). Changes in population sizes of migratory birds can be influenced by conditions on migration and wintering areas, in addition to conditions on breeding areas (Newton 2004, Newton 2006). In general, Washington's adult hawks follow a migration pattern (Fig. 4) of migrating across the Continental Divide to ranges in late summer, then migrate in the fall back across the Continental Divide to winter ranges, and migrate in the spring back to breeding ranges (Watson and Pierce 2003, Watson et al. 2018*a*). Adult hawks from Pacific Northwest breeding populations depart breeding territories in late July and migrate northeast or southeast to summer ranges (occupied in September and October) in the southern Canadian provinces, northwest Montana, and the Northern and Central Plains, then migrate westward to the Central Valley of California where the majority (78%) of their winter ranges (occupied in November through February) are located (Watson et al. 2018*a*). In late February, adult hawks depart winter ranges in California for breeding ranges in Washington. Adult hawks demonstrate high breeding and winter range fidelity but are nomadic in late summer when they migrate to fall ranges (Watson and Keren 2019). While away from breeding ranges, adult hawks from Pacific Northwest breeding populations migrate an average of 2,679 km (Watson et al. 2018*a*). Juveniles migrate independently of their parents. Juvenile hawks hatched in Washington and Oregon migrate northeast in late summer to ranges in the northern grasslands and to winter ranges in California and the Great Plains. During their first year, juveniles travel about three times farther (6,079 km) and twice as long (89 vs. 40 days) as adults during annual migrations (Watson et al. 2019).

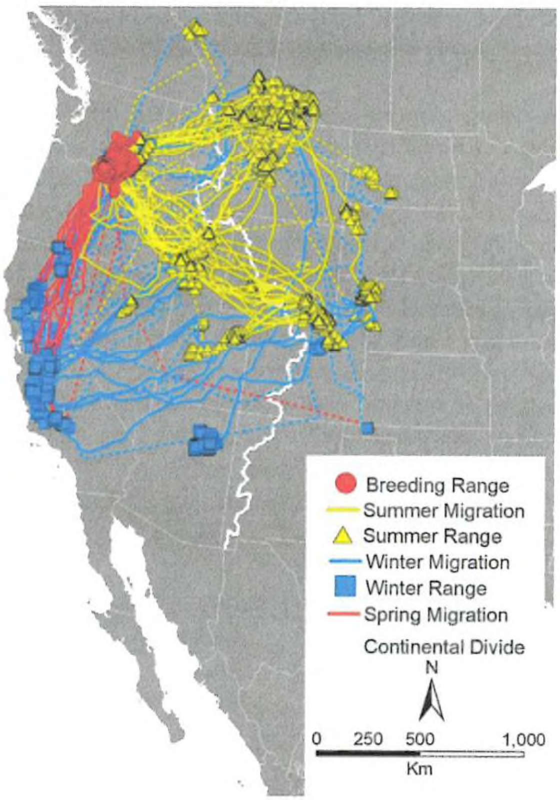

Figure 4. Year-round migration patterns of adult Ferruginous Hawks breeding in shrubsteppe west of the Continental Divide and tracked ≤6yr with satellite telemetry.

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Reproduction. Ferruginous Hawks first breed at two to three years of age (Wheeler 2003, Ng et al. 2017). Adults return to nesting territories in Washington during late February and early March (Watson and Pierce 2003, Watson et al 2018*a*) and typically reoccupy the same nesting territories each year (Watson and Pierce 2003, Watson and Keren 2019). Adults engage in display flights and vocalizations, nest building, food transfers, and copulation that aid in establishing and renewing pair bonds (Palmer 1988, Ng et al. 2017). Nests are typically large in diameter (61–107 cm) and constructed of old sagebrush stems. An average clutch of 2–4 eggs is laid in 2-day intervals each and incubated for 32– 33 days, resulting in asynchronous hatching (Ng et al. 2017). Young fledge in 38–50 days (Palmer 1988, Pope 1999, Ng et al. 2017). If the first nesting attempt fails, re-nesting is apparently rare (Palmer 1988). In Washington, on average, incubation begins about mid-April, hatching begins in mid-May, and nestlings begin to fledge by late June (J. Watson, unpublished data) with one to two fledglings being the most common. After leaving the nest, the young continue to depend on the parents for food as they develop flight, hunting and social skills while remaining in the adult home range. The post-fledging dependency period averages 27 days (range = 16–34 days) with a mean departure date from natal ranges of 27 July (Pope 1999, Watson and Keren 2019).

Survival. Among raptor species, adult survival tends to increase with body mass and pre-breeders have lower survival than adult breeders (Newton et al. 2016). The population growth rate of many raptor populations is more sensitive to changes in adult survival rates than it is to reproductive parameters (Stahl and Oli 2006, Sergio et al. 2011). Identifying factors and processes that affect age- or life-stage specific survival rates is important for understanding population dynamics and implementation of conservation actions (e.g., Todd et al. 2003, Klaassen et al. 2014). Estimates of age-specific survival rates of Ferruginous Hawks are highly variable (Table 1) and likely reflect spatial and temporal variability in prey abundance and other factors across the species' range. Age- and life-stage specific survival rates for Ferruginous Hawks suggest a mortality bottleneck early in life before reaching sexual maturity. This pattern of survival may be influenced by factors occurring on breeding areas and after dispersal from natal areas as they learn to hunt and make long-distance migratory movements (Schmutz and Fyfe 1987, Harmata et al. 2001, Watson and Pierce 2003, Watson et al. 2019). Maximum potential longevity for Ferruginous Hawks is 20 years (Ng et al. 2017), but most do not survive longer than 6 years (Harmata et al. 2001).

Table 1. Age- and stage-specific survival rates of Ferruginous Hawks.

Period	Survival	*n*	Study type[c]	Location	Source
Hatching to dispersal	0.42[a]	202	VT	Utah	Ward and Conover 2013
Pre-fledge	0.93[a]	54	ST	Range-wide	Watson et al. 2019
Fledge to dispersal	0.62[a]	50	ST	Range-wide	Watson et al. 2019
Fledge to dispersal	0.85[b]	29	VT	Montana	Zelenak 1996
Nestling to 1 yr	0.55[b]	6,6 87	B	Canada	Schmutz et al. 2008
Fledge to 1 yr	0.43[b]	15	ST	Washington	Watson and Pierce 2003
Nestling to 1.5 yr	0.05[a]	233	B and VT	Montana	Harmata et al. 2001
Adult (≥ 1 yr)	0.70[b]	115	B	Canada	Schmutz et al. 2008
Adult	0.76	13	ST	Washington	Watson and Pierce 2003

[a]Relative survival; [b]Estimated survival rate; [c]B = banding; VT=VHF telemetry; ST=satellite telemetry

Causes of Ferruginous Hawk mortality are mostly based on encounters with banded birds and include collisions, shootings, electrocution, and predation (Harmata 1981, Schmutz and Fyfe 1987, Gilmer et al. 1985, Gossett 1993, Harmata et al. 2001, Ng et al. 2017). American crow (*Corvus brachyrhynchos*) and Common Raven (*Corvus corax*) prey on eggs and nestlings. Great Horned Owl (*Bubo virginianus*), Golden Eagle (*Aquila chrysaetos*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), American badger (*Taxidea taxus*), and foxes (*Vulpes* spp.) are predators of nestlings and fledglings (Zelenak 1996, Keough 2006, Ward and Conover 2013, Nordell et al. 2017, Ng et al. 2017). Golden Eagles may kill adults (Buhler et al. 2000). Sources of direct mortality of wintering Ferruginous Hawks include shooting, electrocution, and collisions with vehicles (Allison et al. 1995, Cartron et al. 2000, Bak et al. 2001, Harmata et al. 2001, Cartron et al. 2006). Indirect sources of mortality likely affect overall health and survival of hawks and include factors such as loss and fragmentation of breeding and wintering habitat and associated loss of prey (Plumpton and Andersen 1998). Ferruginous Hawks are at risk to secondary poisoning from scavenging carcasses of ground squirrels and prairie dogs exposed to rodenticides (Schmutz et al. 1989, Proulx 2011, Vyas et al. 2017) or those shot with lead ammunition (Chesser 1979, Knopper et al. 2006, Pauli and Buskirk 2007, Stephens et al. 2008). Other sources of mortality include electrocution at power lines (Cartron et al. 2000, Harness and Wilson 2001, APLIC 2006, Cartron et al. 2006, Lehman et al. 2010, Kemper et al. 2013, Dwyer et al. 2015) and collisions with wind turbines (Kolar and Bechard 2016, Watson et al. 2018*b*).

POPULATION AND HABITAT STATUS

North America. The estimated population of Ferruginous Hawks in the United States and Canada was 2,921 to 5,665 nesting pairs in 1992 (Olendorff 1993). There are no recent and reliable population estimates for the U.S. population of Ferruginous Hawks. In Canada, the latest population estimates are 865 pairs in Alberta (2015), 278-500 pairs in Saskatchewan (2006), and 42 pairs in Manitoba (2006) (COSEWIC 2008, Redman 2016).

The species is thought to be declining in several areas of its breeding range, but data are largely lacking to quantify percent declines (Ng et al. 2017). The best documentation of earlier declines is from the northern edge of its range in Alberta, Saskatchewan, and Manitoba (Ng et al. 2017). Apparent declines also occurred in the core of its range during the 1980s, as suggested by vacancies of many historic nests (Ng et al. 2017). Between 1979 and 1992, breeding populations were stable in Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, North Dakota, South Dakota, Texas, Washington and Saskatchewan. During this same time period, apparent population increases occurred in Oregon, Wyoming, Alberta and Manitoba, whereas declines were confirmed only in northern Utah and eastern Nevada (Olendorff 1993). Alberta has the largest Ferruginous Hawk population in North America (Olendorf 1993). Long-term population monitoring in Alberta began in 1982 and repeated surveys documented a steep decline between 1992 and 2000. Since 2005 the population has stabilized, but at lower numbers relative to its population peak in the late 1980s and early 1990s (Redman 2016, Ng et al. 2017). The breeding range has contracted by 40% in Alberta and 50% in Canada (Downey 2006, COSEWIC 2008).

Washington: Past. Early accounts suggest that Ferruginous Hawks were once abundant in the state. Decker and Bowles (1926) observed that the hawks must have been formerly "very plentiful" based on the number of old nests they found in the area around Kiona, Benton County. Bowles and Decker (1931) described the center of abundance for this species as shrubsteppe in proximity to the Columbia and Yakima Rivers where they were "not at all rare" during the breeding season.

Fitzner et al. (1977) conducted the first state-wide survey of the species in 1974–1975 over 12 counties in southeastern Washington. They documented at least 15 territorial pairs of hawks and estimated the state population to be about 20 pairs. The Washington Department of Game conducted a statewide survey in 1978 and found 26 territorial pairs (WDG 1978). Friesz and Allen (1981) documented 31 territorial pairs over 10 counties in 1981 and estimated the statewide population to be about 40 pairs.

Studies of reproductive rates in raptors can be useful in decisions to list or reclassify an endangered raptor species (Steenhof and Newton 2007). Territory occupancy, nest success and productivity are indices that may be used to assess the overall health and status of raptor populations (USFWS 2003). A minimum of two visits to each nesting territory during the breeding season is required to determine the number of potential breeders and to count the number of young raised; both are required to calculate reproductive success (Postupalsky 1974). The purpose of the first check of nesting territories is to locate nests and determine whether they are being used by adult birds. The timing of the first nest check (early season survey) occurs when all birds are either incubating or about to lay eggs. The purpose of the second nest check, later in the breeding season (late season survey), is to count the number of young raised. The best time for the second nest check is just prior to the earliest known fledging dates (Postupalsky 1974). The *nesting territory* refers to an area that contains, or historically contained, one or more nests within the home range of a pair of mated birds (Postupalsky 1974). A *nesting territory* can also be described as a confined locality where nests are found, usually in successive years, and where no more than one pair has bred at one time. The territory *occupancy rate* is defined as the percentage of the total known territories where activity patterns indicate the presence of a mated, territorial pair of potential breeders (Postupalsky 1974). *Nest success* is defined as the percentage of occupied territories which produce one or more young to an advanced stage of development (Postupalsky 1974, USFWS 2003, Steenhof and Newton 2007). *Productivity* is another measure of reproductive success and is defined as the number of young (fledging or advanced age of development) per occupied nest (Postupalsky 1974, Steenhof and Newton 2007). In general, WDFW conducted nest surveys at known nesting territories based on a first visit in April and early May to determine occupancy and a visit in June or July to determine productivity.

Coordinated efforts to survey all known nesting territories and to search for new sites were undertaken by WDFW in 1987 and in 1992-1995 (WDFW 1996). By 1995, an average of 55 breeding pairs (1992–1995) nested in the state across 12 Washington counties (WDFW 1996).

Washington: Present. The last statewide surveys conducted in 2016 recorded 47 occupied nests and 32 breeding pairs. As of 2020, WDFW maintains a database of 284 known nesting territories of Ferruginous Hawks. While the number of known nesting territories in the WDFW database has steadily increased over time, most new nesting territories were added to the database during a period of intensive annual surveys for this hawk in the late 1970s, 1980s and 1990s (Fig. 5). Moreover, not all 284 known nesting territories in the WDFW database are based on documented breeding activity (i.e., evidence eggs were laid) at some time in their history. The percentage of known nesting territories with no prior breeding activity observed has increased from 14% in 1990 to 28% in 2016. As of 2016, 216 nesting territories in the WDFW database have had breeding activity (i.e, eggs laid) documented, 16 territories had only been observed occupied by one or more adult hawks with no evidence of breeding activity, and 52 nesting territories have never been observed with an adult in attendance. These data indicate that the trend of an increasing number of nesting territories overtime, and especially since the mid-1990s, is not reflective of an increasing breeding population, but rather the discovery of "old" Ferruginous Hawk nests on the landscape that have long been vacant.

The number of nesting territories surveyed by WDFW and its partners has varied over the years. Greater survey effort (≥70% of nesting territories surveyed) occurred in 1978, 1981, 1986, 1987, 1992–1997, 2002–2003, 2010, and 2016 (Fig. 5, Table 2). Most of these surveys were intended to assess comprehensive, statewide status of all nesting territories systematically, but were <100% due to access limitation, limited staff capacity, weather factors, or other conditions. Nest surveys were not based on a random selection of preselected nesting territories prior to the survey season, due in part to the small size of the population and incomplete knowledge of the distribution of nesting territories as the Department added new nesting territories to its raptor database.

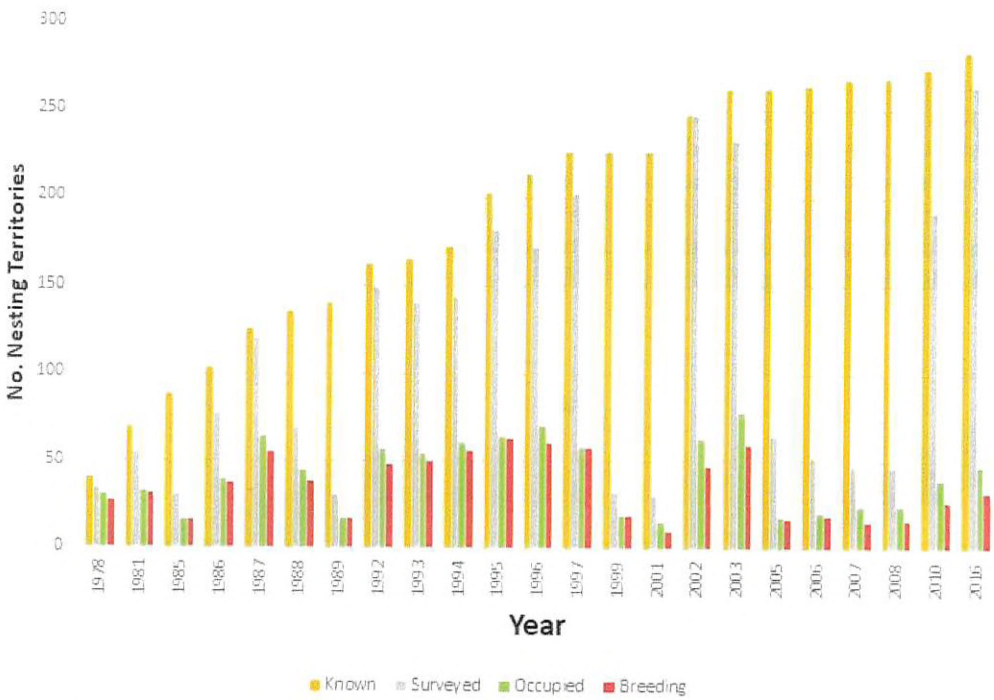

Figure 5. Number of Ferruginous Hawk nesting territories surveyed that were occupied and that supported breeding activity by survey year (1978-2016). Data displayed are only those years when ≥30 nesting territories were surveyed.

Table 2. Occupancy and reproductive success at Ferruginous Hawks nesting territories in Washington, 1978-2016. Data reported are for years when >70% of known nesting territories were surveyed.

	Nesting territories					Nesting Territories Occupied					Number of Young[c]	
	Known	Surveyed		Occupied[a]		Known Outcome		Successful[b]		Observed	/Occupied Known	/Successful Nesting Attempt
Year	(n)	(n)	%	(n)	%	(n)	%	(n)	%	(n)	Outcome	(brood size)
1978	40	34	85	30	88	18	60	18	100	56	3.11	3.11
1981	69	55	80	32	58	25	78	25	100	70	2.8	2.80
1986	103	75	73	39	52	25	64	22	88	58	2.32	2.64
1987	125	119	95	64	54	49	77	38	78	121	2.47	3.18
1992	162	148	91	57	39	46	82	38	83	88	1.91	2.32
1993	165	140	85	54	39	47	87	42	89	83	1.77	1.98
1994	172	143	83	60	42	48	80	42	88	92	1.92	2.19
1995	202	181	90	64	35	28	44	14	50	22	0.79	1.57
1996	214	173	81	70	40	55	79	45	82	115	2.09	2.56
1997	226	201	89	58	29	48	83	42	88	94	1.96	2.24
2002	247	246	100	63	26	45	71	29	64	56	1.24	1.93
2003	262	230	88	78	34	55	71	39	71	92	1.67	2.36
2010	274	192	70	39	20	18	46	12	67	26	1.44	2.17
2016	284	263	93	47	18	26	55	21	81	53	2.04	2.52

[a] Nest sites (territories) where at least one adult Ferruginous Hawk was observed at or near a nest; one adult was observed sitting low in a nest, presumably incubating; eggs were laid; or young were raised.

[b] Number of occupied nesting territories from which at least one young fledged or at least one young was raised to an advanced stage of development (i.e., near fledging age; 33 days). Estimates are inflated because they are usually based on the number of chicks seen during a single survey, regardless of their age, some of which may not survive to fledging.

[c] Productivity estimates are inflated because they are usually based on the number of chicks seen during a single survey, regardless of their age. Young chicks included in productivity estimates may not survive to fledging.

For survey data collected systematically, we used linear regression to test for trends in occupancy, nest success, and productivity among survey years. To eliminate potential bias associated with incidental survey results we excluded from analysis survey years when <70% of territories were surveyed. Incidental surveys may have favored more easily accessible or active territories. We weighted the number of territories surveyed by the proportion of known territories in each year. There were significant declines in territory occupancy ($P < 0.001$, $F_{(1,12)} = 50.01$, $r^2 = 0.81$), and the fitted regression line showed a decline in occupancy of >40% to the lowest recent levels of about 20% statewide (Fig. 6a). Productivity also declined significantly ($P = 0.023$, $F_{(1,12)} = 6.75$, $r^2 = 0.36$) during the study period (1978-

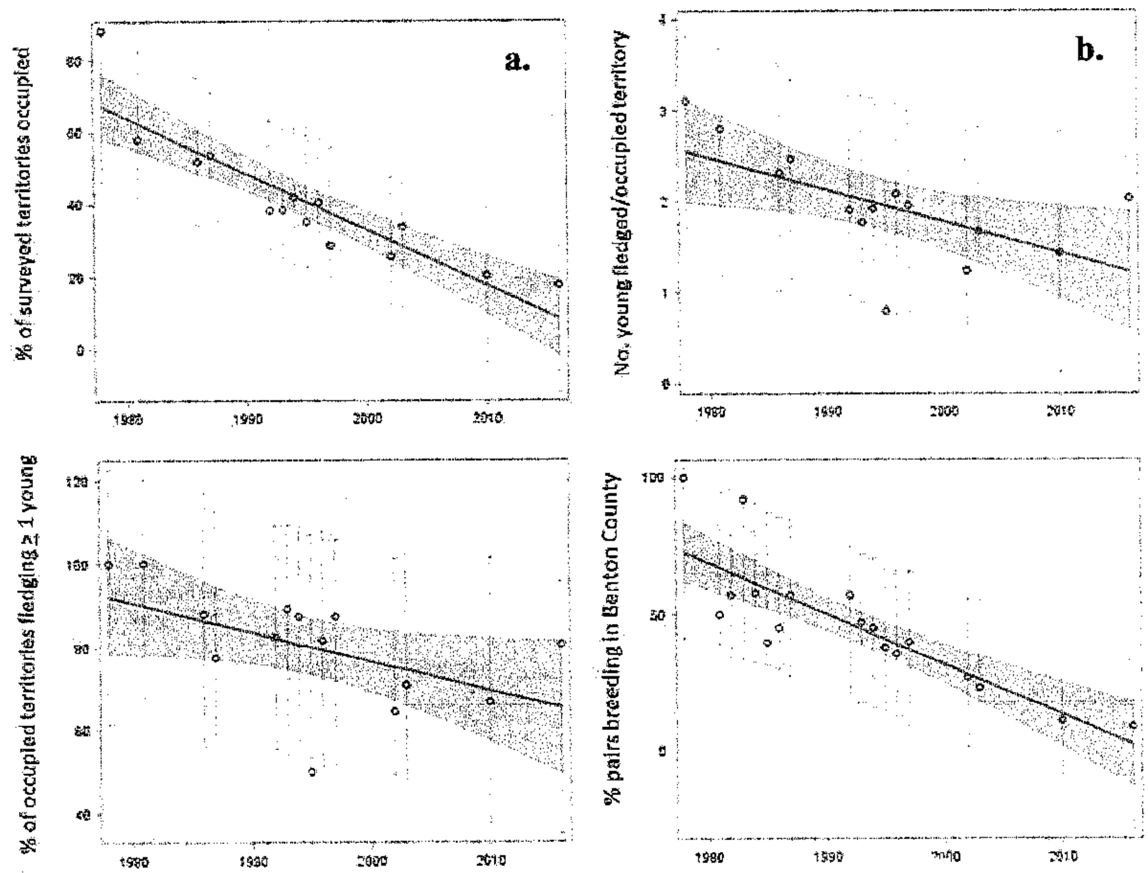

Figure 6 a-d. Productivity of Ferruginous Hawks in Washington, 1978-2016. Blue line is the fitted linear trend and blue band is the 95% confidence interval of the trend (WDFW data). Data are restricted to only those years when ≥70% of all known nesting territories were surveyed and analyses incorporate a weighting factor to account for uneven survey effort among years. a. Proportion of surveyed nesting territories occupied; b. Number of young fledged per occupied nesting territory; c. Proportion of occupied territories that fledged at least one young during the breeding season; d. Percentage of surveyed nesting territories in Benton County where breeding was confirmed.

2016) resulting in reduction of about one young/occupied territory over that time (Fig. 6b). There was a similar, but marginal decline in nest success ($P = 0.052$, $F_{(1,12)} = 4.65$, $r^2 = 0.28$), biologically resulting in about 20% fewer occupied territories producing young (Fig. 6c). In the core breeding range, there were significant declines in the percentage of surveyed nesting territories supporting breeding pairs in Benton County ($P < 0.001$, $F_{(1, 16)} = 38.66$, $r^2 = 0.69$; Fig. 6d) and Franklin County ($P < 0.001$, $F_{(1, 11)} = 36.12$, $r^2 = 0.75$; Fig. 7) during the same period, and the statewide distribution of breeding pairs showed a corresponding contraction from the north and west since the 1990s (Fig. 8).

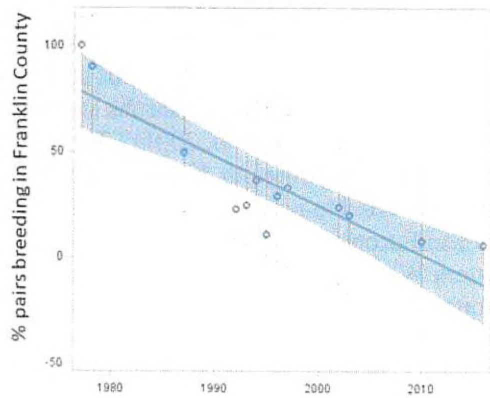

Figure 7. Percentage of surveyed nesting territories in Franklin County, Washington where Ferruginous Hawk breeding was

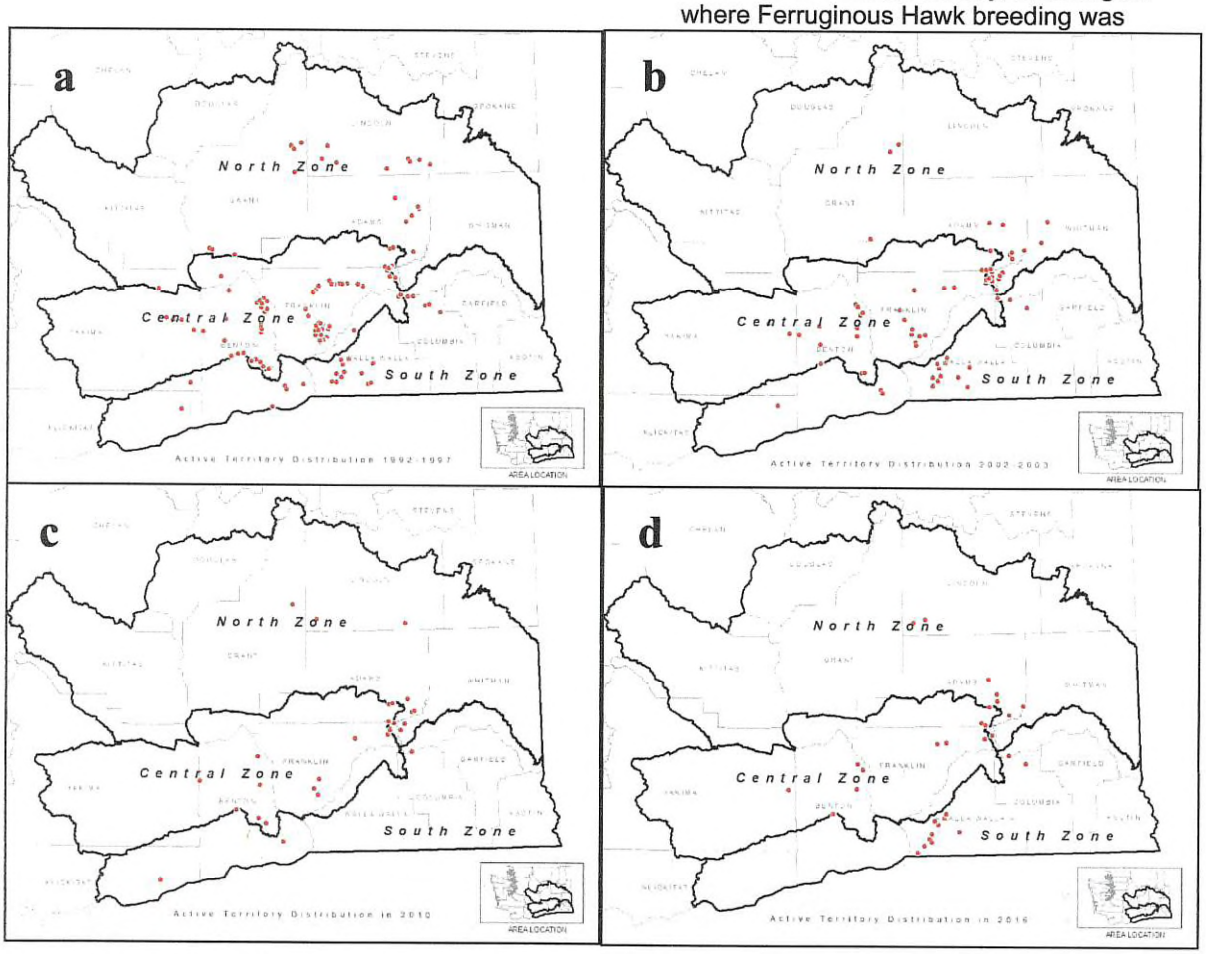

Figure 8. Ferruginous Hawk nesting territories in eastern Washington where breeding activity has been confirmed: a) 1992-1997, b) 2002-2003, c) 2010, and d) 2016. Data include only those survey years since 1992 (last status update; WDFW 1996) when >70% of nesting territories were surveyed.

Habitat status - breeding range. Breeding habitat of the Ferruginous Hawk occurs in shrubsteppe and grasslands in Washington and Oregon (Bowles and Decker 1931, Fitzner et a. 1977, Lardy 1980, Cottrell 1981, Bechard et al. 1990). Much of eastern Washington is a large arid to semi-arid region of shrublands and grasslands dominated by shrubs and herbaceous (grasses and forbs) vegetation (Franklin and Dyrness 1988, Vander Haegen et al. 2001). The majority of grasslands occurred on the Palouse Prairie in southeastern Washington. Much of the native vegetation in these shrubland and grassland habitats has been converted to cropland (Dobler et al. 1996, Quigley and Arbelbide 1997, McDonald and Reese 1998). Prior to European settlement an estimated 4.2 million ha (10.4 million acres) of shrubsteppe existed in eastern Washington (Dobler et al. 1996) and by 1986 over half of Washington's original shrubsteppe habitat was converted to agricultural lands resulting in high fragmentation of extant habitat (Dobler et al. 1996, Vander Haegen et al. 2001) and disproportionate loss of deep-soil shrubsteppe communities (Vander Haegen et al. 2000). Remaining shrublands are influenced by a legacy of excessive livestock grazing that facilitated invasion by exotic vegetation, especially cheatgrass (*Bromus tectorum*) (Mack 1981). Invasion of exotic annuals has changed both the fire regime and successional patterns in sagebrush resulting in more frequent fires and conversion of shrublands to exotic annual grasslands (D'Antonio and Vitousek 1992, Vander Haegen et al. 2001).

Impacts of wildfires on nesting raptors are not well studied, particularly in shrubsteppe and low elevation sagebrush habitats. Indirect effects of wildfire on nesting raptors include short- and long-term loss of prey (Groves and Steenhof 1988, Yensen et al. 1992), potentially leading to longer-term dietary shifts (Heath and Kochert 2016) and reduced nest success (Kochert et al. 1999). Loss of shrubsteppe and invasion of cheatgrass and other exotic grasses after hot, expansive wildfires, and the population changes in ground squirrels and other small mammals is a current topic of intense research because of the difficulty of regenerating native grasses and shrubs (Knick et al. 2003, Holbrook et al. 2016, Holmes and Robinson 2016). Spatial extent of wildfires in eastern Washington since 1995 (earliest year of fire perimeter data) have overlapped nest locations of Ferruginous Hawks based on an analysis of fire boundary layers (National Interagency Fire Center, https://data-nifc.opendata.arcgis.com/) and nest locations from the Wildlife Program data base (WDFW). Shrubsteppe in west Benton and Yakima counties has been particularly impacted by wildfires and where fire perimeters overlap many nesting territories (Appendix A). Many of these large, hot fires have burned in the past 20 years resulting in conversion to monocultures of cheatgrass. Since 1995, wildfires affected 15 nesting territories in 2010, 7 in 2015, and 5 in 2020.

Agriculture, urbanization, infrastructure placement (e.g., power lines, roads) and energy development have fragmented sagebrush ecosystems (Leu et al. 2008) and provide resource subsidies (e.g. food, perch sites) to the Common Raven, a generalist avian predator (Coates et al. 2014, Howe et al. 2014). Human activities provide ravens access to beneficial resource subsidies (e.g., food, perch sites) that have been associated with agriculture and anthropogenic development. Additive effects of anthropogenic structures and fragmentation of sagebrush ecosystems have led to a dramatic expansion and abundance of the Common Raven into sagebrush ecosystems (Coates et al. 2014, 2020; Howe et al. 2014). In the early 1990s observers conducting nest surveys of the Ferruginous Hawk in Juniper Dunes reported Common Ravens as "uncommon" but they are now much more abundant in this area (J, Lowe, BLM, personal communication). Similarly, on the Hanford Site, the number of Common Raven nests has increased from 9-11 in the 1970s to a peak of 70 nests in 2014, with most nests located on transmission towers or utility poles (Nugent 2016). Common Ravens are known to prey on eggs and nestlings of Ferruginous Hawks (Ng et al. 2017) and may compete with hawks for nest sites (J, Lowe, BLM, personal communication).

Despite the widespread loss of Ferruginous Hawk nesting habitat, agricultural lands enrolled in the USDA's Conservation Reserve Program (CRP) have the potential to provide nesting and foraging habitat for Ferruginous Hawks. The State Acres for Wildlife Enhancement (SAFE) program is an initiative under the Conservation Reserve Program (CRP) that started under the Farm Bill nationwide in January 2008. The program is a partnership between the U.S. Department of Agriculture (USDA) and state fish and wildlife agencies to develop quality wildlife habitat with an emphasis on restoration of native vegetation and associated wildlife benefits. The Ferruginous Hawk SAFE is available to agricultural producers in portions of Adams, Benton, Franklin, and Walla Walla counties. The goal of this initiative is to enhance foraging habitat around Ferruginous Hawk nests by establishing shrubs, grasses and broadleaf forbs on cropland. Therefore, this initiative is restricted to lands near recently occupied nest sites. There are 415 Ferruginous Hawk nests associated with 171 nesting territories within the program boundary (Fig. 9) where agreements may be negotiated. However, enrolled acres may not occur within the home ranges of the hawks and are not permanent. As of November 2019, there were 14,647 acres enrolled out of 20,000 acres allocated to the FEHA SAFE program in Washington (Mike Kuttel, Jr., WDFW, personal communication).

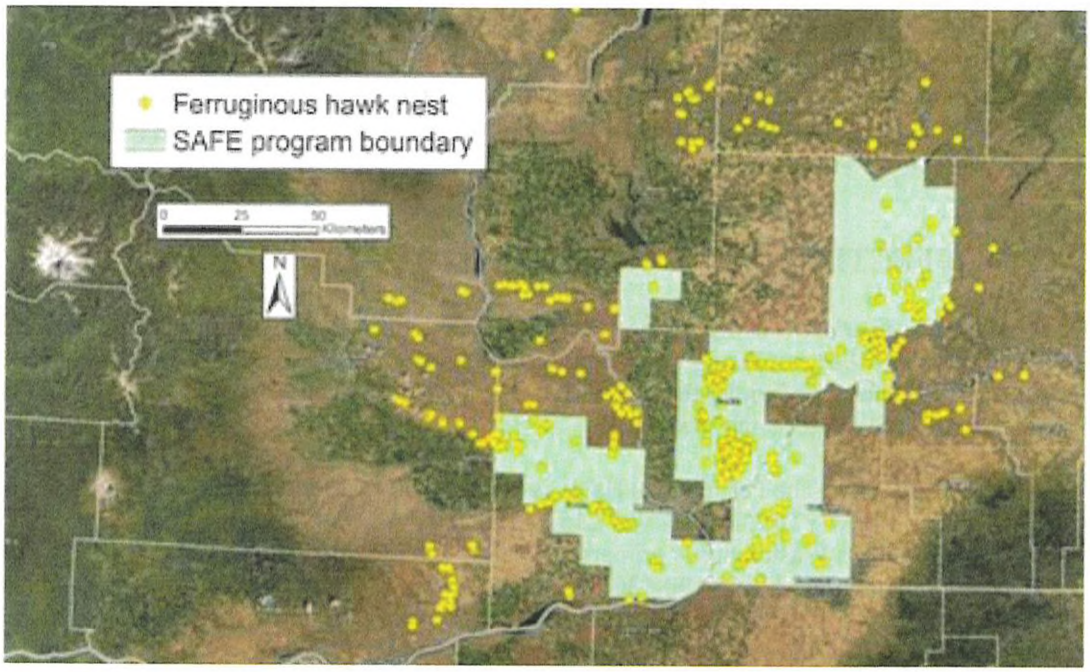

Figure 9. Boundaries of State Acres for Wildlife Enhancement (SAFE) program for Ferruginous Hawk in Adams, Benton, Franklin, and Walla Walla counties, Washington. Boundaries as of June 2020.

Habitat status - nonbreeding range. Winter habitat of the Ferruginous Hawk includes shrubsteppe, grasslands, desert, and edges of agricultural areas that support an abundance of pocket gophers and prairie dogs (Ng et al. 2017). Washington's migratory Ferruginous Hawks spend most of the year (63%) on nonbreeding ranges, most importantly the Great Plains region, from late summer through fall, and the Central Valley of California during winter (Watson et al. 2018*a*). Sagebrush and grasslands are among the most imperiled ecosystems in North America (Samson and Knopf 1994, Noss et al. 1995, White et al.

2000, Wisdom and Rowland 2007). Although the sagebrush ecosystem remains large, it has been substantially reduced in area and quality. Approximately 50-60% of remaining native sagebrush steppe now has either exotic annual grasses in the understory or has been converted completely to non-native annual grasslands (West 2000). Land-use practices that have caused the loss, degradation, and fragmentation of sagebrush ecosystems include historically excessive livestock grazing, agriculture and urbanization, and energy development (Knick et al. 2003, Connelly et al. 2004, Knick et al. 2011). Invasion of exotic annuals has changed both the fire regime and successional patterns in sagebrush resulting in more frequent fires and conversion of shrublands to exotic annual grasslands (D'Antonio and Vitousek 1992). In the Great Plains, the tall-grass prairie has decreased by nearly 98%, mixed-grass prairie has declined by 64% and the short-grass prairie decreased by nearly 66% (Mac et al. 1998, White et al. 2000). Land-use practices that have caused the loss, degradation, and fragmentation of central North American grasslands include agriculture, urbanization, desertification, fire, grazing of domestic livestock, and introduction of non-native plant species (White et al. 2000, Gauthier et al. 2003). Reduced prey and quality of nonbreeding habitats experienced by Washington's hawks on wintering areas and during migration could adversely affect Washington's breeding population (Newton 2006, Watson et al. 2018*a*). Specifically, because the nonbreeding season is the period during which hawks restore body condition diminished during nesting, reduced prey abundance or quality on winter ranges potentially impacts survival and subsequent breeding performance. Although these effects are difficult to quantify, the exposure of Washington's migratory Ferruginous Hawk population to documented loss of habitat and prey on nonbreeding ranges, as well as documented, substantial mortality during the nonbreeding period (J. Watson, unpublished data), suggest these factors are contributing to reduced breeding performance of the population (e.g., nest occupancy).

FACTORS AFFECTING CONTINUED EXISTENCE

Federal regulatory protection. The Ferruginous Hawk was petitioned for listing under the Endangered Species Act in 1983 and 1991 but listing was determined to be unwarranted (USFWS 1992). In Canada, the species is listed as threatened under the federal Species at Risk Act (COSEWIC 2008). The Migratory Bird Treaty Act currently protects the species.

State regulatory protection. The Ferruginous Hawk is protected from 'take' as a threatened species by Washington state law (RCW 77.12.020, RCW 77.15.130). On non-federal lands, the Growth Management Act (GMA) is Washington's primary regulatory tool to protect rare and threatened species from development impacts (WAC 365-190-130). Consistent with provisions of GMA, many counties use the federal and state lists of endangered, threatened, and sensitive species, and require review and mitigation before issuing permits for projects that would impact habitat. WDFW provides Priority Habitat and Species (PHS) information to counties, local jurisdictions, agencies, landowners, and consultants for land use planning and permit evaluation purposes; this includes maps and management recommendations (https://wdfw.wa.gov/species-habitats/at-risk/phs Richardson et al. 1999, Azerrad et al. 2011). County critical area ordinances provide some protection of its habitat through environmental review and habitat management plans for development proposals that affect state-listed species. Although the nature of protections varies, the counties of Adams, Asotin, Columbia, Douglas, Franklin, Garfield, Grant, Kittitas, Klickitat, Lincoln, Spokane, Walla Walla, Whitman, and Yakima include Ferruginous Hawk in their critical area ordinances.

Habitat loss, degradation, and fragmentation. Conversion of native grasslands and shrublands to crops and urbanization is usually permanent and results in direct loss and fragmentation of breeding and wintering habitat. Conversion of native habitats to cultivated croplands and urban development eliminates nest sites, removes or reduces prey species, and increases human disturbance and potential predators. In Washington, over half of the original shrubsteppe habitat has been converted to croplands resulting in high fragmentation of extant habitat (Dobler et al. 1996, Vander Haegen et al. 2001) and disproportionate loss of deep-soil shrubsteppe communities (Vander Haegen et al. 2000) that are important habitat for prey species, such as ground squirrels (Vander Haegen et al. 2001).

Compared to agriculture and urbanization that eliminate and often fragment habitat, rangelands can provide nesting and foraging habitat for Ferruginous Hawks, but over-grazing practices may negatively affect populations through habitat degradation. Grazing can affect raptors by 1) altering nest site availability; 2) changing prey diversity, abundance and composition; and 3) influencing prey vulnerability (Kochert 1989). In Washington, historical overgrazing has degraded remaining shrubsteppe communities. Native perennial grasses in shrubsteppe are not adapted to grazing by large herds of large ungulates (Mack and Thompson 1982), several of the major shrub species are fire sensitive and can be eliminated from the site by burning, and exotic annual grasses are well-adapted to invade and increase under excessive grazing pressure (Daubenmire 1988, Franklin and Dyrness 1988). Sagebrush systems used for grazing livestock were historically overgrazed or cleared of sagebrush to increase production of grasses and forbs as forage for livestock (Franklin and Dyrness 1988, Harris 1991). These grazing practices often led to loss of perennial native grasses and forbs and contributed to invasions of annual grasses, such as cheatgrass (Franklin and Dyrness 1988, Harris 1991, Knick et al. 2003, Knick et al. 2011) that adversely impact prey species of Ferruginous Hawks (*see below Reductions in prey base*).

Invasions of annual grasses, particularly cheatgrass, provide fine fuels that facilitate fire spread and result in more frequent fires in cheatgrass-dominated sagebrush communities (Miller et al. 2011). Moreover, big sagebrush is easily killed by fire, and when it occurs at increased frequency, big sagebrush can be eliminated from the vegetation assemblage (Daubenmire 1988, Franklin and Dyrness 1988, Miller et al. 2011). Cheatgrass invasion has altered fire regimes resulting in shorter fire return intervals, larger burned areas, and increased probability of fire (Miller et al. 2011, Balch et al. 2013). Invasion by cheatgrass has led to a grass-fire cycle in which increasing cheatgrass promotes larger fires that allow cheatgrass to increase further, thereby eroding and fragmenting remaining stands of sagebrush and converting native sagebrush to exotic annual grasslands (Whisenant 1990, Knick and Rotenberry 1997, Knick 1999). Degradation of sagebrush systems due to a legacy of historical overgrazing and associated habitat alterations are widespread across the Intermountain West (Young 1999, Knick et al. 2003) and likely reduce foraging habitat of Washington's migratory Ferruginous Hawks encountered on nonbreeding ranges (Watson et al. 2018*a*). Washington's Ferruginous Hawks depend on grasslands in the Great Plains and in the Central Valley of California as critical foraging habitat during the nonbreeding period (Watson et al. 2018*a*).

Reductions in prey base. The Ferruginous Hawk is stenophagus (Ng et al. 2017), a dietary specialist that targets specific small mammal prey. Primary historical prey species of the Ferruginous Hawk that nest in Washington, namely ground squirrels and jackrabbits (Ng et al. 2017), have become scarce in Washington and greatly reduced in numbers and distribution in other parts of their range that are frequented by Washington's hawks during the nonbreeding period. In Washington, the Townsend's ground squirrel, Washington ground squirrel, white-tailed jackrabbit, and black-tailed jackrabbit are state candidate species. In Oregon, the Washington ground squirrel is state endangered. At the federal level, the Washington ground squirrel was petitioned for listing under the Endangered Species Act but found to be not warranted (USFWS 2016). Washington's breeding population of Ferruginous Hawks prey on ground squirrels and rabbits, as well as prairie dogs when they are away from their breeding ranges for up to two-thirds of the year (Watson et al. 2018*a*). In North America, many prey species of ground squirrels, especially those associated with shrubsteppe, are of conservation concern (Hafner et al. 1998, Yensen and Sherman 2003). Additionally, all five species of prairie dog: black-tailed (*C. ludovicianus*), Gunnison's (*C. gunnisoni*), Mexican (*C. mexicanus*), Utah (*C. parvidans*), and white-tailed (*C. leucurus*) are now rare (Hoogland 2006). The Utah prairie dog is federally listed as threatened under the Endangered Species Act (USFWS 2012) and the Mexican prairie dog is federally listed as endangered (Hoogland 2003). The black-tailed, Gunnison's, and white-tailed prairie dogs were petitioned for listing under the federal Endangered Species Act and found not warranted (USFWS 2004, USFWS 2006, USFWS 2010). The black-tailed prairie dog currently occupies <2% of its former range (Miller et al. 2000).

Distribution and abundance of ground squirrels, prairie dogs, and jackrabbits have sharply declined across their range as a result of habitat loss, degradation and fragmentation of native shrublands and grasslands, as well as decades of persecution from shooting and poisoning, and disease (Flinders and Chapman 2003, Hoogland 2003, Yensen and Sherman 2003, Simes et al. 2015). In Washington, expansion of irrigation into sagebrush areas for agriculture, overgrazing of bunchgrasses in sagebrush and bunchgrass areas by livestock, and conversion of bunchgrass areas to dry-land wheat farming are likely major factors that resulted in the reduction and current rarity of white-tailed jackrabbits (Dice 1916, Couch 1927a, Svihla and Svihla 1940, Dalquest 1948). Livestock grazing, cultivation, and fire in the shrubsteppe have reduced the area and distribution of native vegetation to small, isolated remnant patches (Vander Haegen et al. 2000, Vander Haegen et al. 2001), thereby reducing the protective cover and food plants that are important components of habitat to black-tailed jackrabbits (Uresk 1978, Johnson and Anderson 1984, Anderson and Shumar 1986, Nydegger and Smith 1986, Knick and Dyer 1997, Simes et al. 2015) and ground squirrels (Rogers and Gano 1980, Nydegger and Smith 1986, Betts 1990, Yensen and Quinney 1992, Yensen et al. 1992, Van Horne et al. 1997, Van Horne et al. 1998, Lohr et al. 2013).

Often perceived as "pests" by ranchers and farmers, prairie dogs, ground squirrels, and jackrabbits have been the targets of intensive eradication programs across their range and controlled by trapping, shooting and poisoning (Flinders and Chapman 2003, Hoogland 2003, Yensen and Sherman 2003, Forrest and Luchsinger 2006). Extensive poisoning and shooting of prairie dogs in North America during the past century are largely responsible for the 98% decline in their populations (Miller et al. 1994, Hoogland 2006). Recreational shooting of prairie dogs is estimated to kill nearly 2 million prairie dogs per year (Reeve and Vosburgh 2006). As a result of poisoning programs, prairie dog colonies are now scattered and more isolated. Colonies of prairie dogs that have become isolated due to habitat fragmentation are more susceptible to extirpation due to genetic effects, demographic and environmental stochastic events, and disease, especially sylvatic plague (Miller et al. 1994, Miller and Reading 2012). In Washington, ground squirrels were poisoned because of damage to agricultural crops (Foster 1911, Shaw 1916, Couch 1927*b*). Efforts to eradicate primary prey species of Ferruginous Hawks also increase risk to these hawks due to lead toxicosis from recreational shooting of prairie dogs and ground squirrels (Herring et al. 2016) and exposure to rodenticides (Vyas et al. 2017).

Plague is a disease relevant to Ferruginous Hawk populations because of its effect on its prey base. Plague is a flea-borne zoonotic disease caused by the bacterium *Yersinia pestis* that is maintained in the wild through transmission between blood-feeding adult fleas and certain rodent hosts, and occasionally lagomorphs (Gage and Kosoy 2005). Plague was likely introduced to North America via ship-borne rats and their fleas early in the 20th century and gained its initial foothold in California around 1900 (Link 1955, Gage and Kosoy 2006). Afterward, plague spread rapidly eastward in the 1930s and 1940s in several rodent species, including ground squirrels and prairie dogs, (Svihla 1939, Cully and Williams 2001). Dramatic reductions in numbers and distribution of ground squirrels attributed to plague occurred in Washington and Utah beginning in 1936 and shortly thereafter in Nevada (Svihla 1939, Hansen 1955). By 1950 the current distribution of plague was established near its current range limit that comprises 17 western states (Cully and Williams 2001, Gage and Kosoy 2006). In Washington, evidence suggests incidents of epizootic plague have occurred among ground squirrel populations in eastern Washington as early as 1896 and "die-offs" among ground squirrels were reported from 1914 through 1938 in seven counties (Klickitat, Benton, Garfield, Columbia, Adams, Lincoln and Spokane) (Svilha 1939, WDOH 2009). All four species of prairie dogs in the U.S. are highly susceptible to plague with high mortality reported during epizootics (Biggins and Kosoy 2001*a*, Biggins and Kosoy 2001*b*, Cully and Williams 2001).

Changes in the abundance, distribution, and composition of available prey species influence breeding populations of Ferruginous Hawks. In areas where jackrabbits are its primary prey, the number of hawks occupying nesting territories and laying eggs and the number of young produced is positively correlated with the abundance of jackrabbits (Howard and Wolfe 1976, Smith and Murphy 1978, Thurow et al. 1980, Smith et al. 1981, Woffinden and Murphy 1989). The response of hawk populations to changes in jackrabbit abundance suggest that jackrabbits as food are a potentially limiting factor to hawk reproduction (Smith et al. 1981). When jackrabbits are abundant, the breeding population and reproductive success of hawks increases, whereas pairs appear to refrain from breeding or have lower reproductive success when jackrabbits are scarce (Smith and Murphy 1978, Smith et al. 1981). A similar relationship has been reported between occupancy of nesting territories and reproductive success of Ferruginous Hawks and ground squirrel abundance (Steenhof and Kochert 1985, Schmutz and Hungle 1989, Houston and Zazelenchuk 2005, Schmutz et al. 2008, Wallace et al. 2016). Some Ferruginous Hawk breeding populations that experienced a decline following a crash in their primary prey failed to increase as their primary prey subsequently increased. This is cause for concern and perhaps is due to low production and increased mortality rates of hawks (Woffinden and Murphy 1989) or other factors that influence recruitment. Given that both nesting populations and productivity of Ferruginous Hawks are known to be negatively affected by declines in abundance of primary prey, it is likely that the apparent drastic reductions in jackrabbits and ground squirrels in Washington have played a role in reducing the nesting population of Ferruginous Hawks in the state.

Wind turbines. Wind energy is one of the fastest growing renewable energy sources in the U.S. (USDOE 2017), and there are concerns for potential direct and indirect impacts of wind energy facilities on wildlife populations, particularly raptors (Watson et al. 2018*c*). Direct impacts are primarily collision fatalities and indirect impacts include habitat loss, fragmentation, and behavioral changes that result in avoidance (Arnett et al. 2007, Kuvlesky et al. 2007). Ferruginous Hawks have been considered at risk of collision with wind turbines based on observed diurnal flight heights within the rotor swept zone at planned wind facilities (Wulff et al. 2016, Watson et al. 2018*b*). While the Golden Eagle has been the focus of much concern about wind energy development, a recent analysis identified both Ferruginous Hawk and Golden Eagle at equally high risk of experiencing population declines from wind energy in the U.S. (Beston et al. 2016).

In Washington, wind turbines occur in proximity to Ferruginous Hawk nesting territories in Klickitat, Benton, Walla Walla, and Columbia Counties. Five Ferruginous Hawk fatalities, due to turbine strikes, have been documented along the Columbia River in Oregon and Washington between 2003 and 2012 (J. Watson, unpublished data.) and likely underestimate the potential impact from this source of mortality since post-construction fatality monitoring is only required up to two years after projects are completed. In north-central Oregon, greater wind turbine densities were related to decreased nest success and lower post-fledging survival of Ferruginous Hawks (Kolar and Bechard 2016). While the specific mechanisms for these relationships were unclear, the researchers speculated that a combination of breeding adults being killed from turbine collisions and disturbance or displacement from portions of their home range by activities associated with wind energy development in the area were likely responsible (Kolar and Bechard 2016). However, Watson et al. (2018*b*) found no evidence of behavioral displacement of adult hawks by turbines in the same study area, although recent research has documented long-term declines in Ferruginous Hawk nesting on or near wind turbine projects (J. Watson, unpublished data).

Climate change. During the past century temperatures have been increasing across the Great Basin and Columbia Plateau, both annually and seasonally, but changes in precipitation have been minor with no clear trends (Kunkel et al. 2013, Snyder et al. 2019). The Great Basin and Columbia Plateau are becoming more arid and this trend will likely continue resulting in more frequent droughts that last longer, expanded occurrence of invasive annual grasses, and increased duration and severity of wildfire seasons (Snyder et al. 2019). Climate projections for 2020-2050, indicate that temperatures will continue to increase but precipitation estimates are more uncertain (Snyder et al. 2019). More frequent droughts and expansion of invasive annual grass/fire cycles may result in continued conversion of native shrubsteppe to exotic annual grasslands that lead to an increasingly unstable prey base for Ferruginous Hawks (Smith and Johnson 1985, Yensen and Quinney 1992, Yensen et al. 1992, Van Horne et al. 1997, Van Horne et al. 1998). Increased frequency of droughts due to climate change may increase the frequency of widespread epizootics of plague among primary prey species, including prairie dogs in the grasslands of western North America (Eads and Hoogland 2016, Eads et al. 2016, Eads and Hoogland 2017) and ground squirrels. While predicting how Ferruginous Hawks will respond to these conditions is uncertain, the implications of changing climate to Ferruginous Hawks may result in changes in disease incidence, breeding asynchrony with respect to availability of fossorial prey, increased nestling mortality from exposure and nest collapse, and changes in prey numbers and hunting success (Shank and Bayne 2015).

MANAGEMENT ACTIVITIES

Surveys. Coordinated efforts to survey all known Ferruginous Hawk nesting territories and to search for new territories have been undertaken periodically by WDFW and its partners (e.g., USFWS, BLM, YTC, DOE Hanford) to determine the number of territorial pairs and their reproductive status (WDFW data, Nugent 2016). A minimum of two visits are made to each nesting territory with a first visit in April and early May to determine occupancy and a second visit in June or July to determine productivity. Surveys for Washington ground squirrel have been conducted by WDFW and its partners to determine their status (Finger et al. 2007, Cranna and Nugent 2015) and population trend (WDFW data).

Artificial nest platforms. New or replacement nesting opportunities can be provided by constructing artificial nest platforms. Twelve pole platforms were installed in the Juniper Forest Management Area (Franklin County) in 1987 and 1988 and 42 were built and installed in Walla Walla County in 1993. Two additional platforms were constructed in Benton County in 1993. In 2019, WSDOT funded the design and construction of 29 nest platforms that WDFW installed in Benton (7), Franklin (1), Columbia (6), and Walla Walla (15) counties (M. Vekasy, WDFW). WDFW coordinated the placement of 15 platforms in southwest Walla Walla County in the area surrounding the planned Highway 12 re-alignment, an area that overlaps the core breeding range of the Ferruginous Hawk in the county. Although monitoring of nest platforms has been limited due to COVID-19 restrictions, all 29 platforms were monitored to some extent and successful nesting attempts were documented at two new platforms.

Habitat restoration and enhancement. The State Acres for Wildlife Enhancement (SAFE) program is an initiative under the Conservation Reserve Program (CRP) that started under the Farm Bill nationwide in January 2008. The program is a partnership between the U.S. Department of Agriculture (USDA) and state fish and wildlife agencies to develop quality wildlife habitat with an emphasis on restoration of native vegetation and associated wildlife benefits. The Ferruginous Hawk SAFE is available to agricultural producers in portions of Adams, Benton, Franklin, and Walla Walla counties. The goal of this initiative is to enhance foraging habitat and provide buffers around Ferruginous Hawk nests by establishing shrubs, grasses and broadleaf forbs on cropland and expanding upon remnant shrubsteppe and grassland habitat near nests. SAFE has the potential to increase the amount of foraging and nesting habitat available for breeding hawks, but WDFW has not evaluated the effectiveness of the program for this hawk and its primary prey species. Ferruginous Hawks may benefit from other SAFE programs in shrubsteppe.

Conservation planning. A state recovery plan for Ferruginous Hawk was completed in 1996 (WDFW 1996), with the goal of maintaining a breeding population throughout much of the species' historical range in Washington. An assessment of connectivity patterns for jackrabbits and ground squirrels in the Columbia Plateau was completed in 2012 (Ferguson and Atamian 2012*a,b*; Sato 2012*a,b*); the analysis modelled habitat areas and movement corridors. Jackrabbits and ground squirrels are focal species of conservation in the Arid Lands Initiative (Arid Lands Initiative 2014). On the Hanford Site, the Conservation Habitat Assessment and Mitigation Prioritization (CHAMP) takes a landscape approach to evaluate habitat quality of shrubsteppe and grasslands on DOE-managed lands to determine areas for conserving, restoring, mitigating, and connecting habitats. Results from this analysis will direct recovery efforts for black-tailed jackrabbits and Townsend's ground squirrels on DOE-managed lands (MSA 2019).

Research. Research on this species has been directed primarily at understanding movements by Washington's Ferruginous Hawks during the nonbreeding period, food habits, and some focus on assessing risk at wind energy sites. WDFW has led research studies to identify migration patterns, destinations and chronology (Watson and Pierce 2003, Watson et al. 2018*a*, Watson et al. 2019), estimate survival rates and associated sources of mortality (Watson and Pierce 2003), and investigated site fidelity by adults to breeding and nonbreeding (Watson and Pierce 2003, Watson and Keren 2019). Studies of food habits suggest that Washington's breeding population of Ferruginous Hawks has undergone a dietary shift since the early 1900s and appears to have lost a high quality prey component, namely jackrabbits (Richardson et al. 2001). Other research has assessed potential direct and indirect effects of wind energy development on nesting Ferruginous Hawks in the Columbia Basin in Washington and Oregon (Watson et al. 2018*b*). Researchers on the Hanford Site developed a survey method using remote cameras to document the presence and distribution of black-tailed jackrabbits (Grzyb et al. 2016).

CONCLUSIONS AND RECOMMENDATION

Early accounts suggest Ferruginous Hawks were once common in the early 1900s. Ferruginous Hawk populations likely declined concurrent with the conversion of grassland and shrubsteppe to agriculture, degradation of rangelands, and increasing fire frequency that adversely affect both nesting and foraging habitat and their primary prey. In addition to loss and degradation of habitat for primary prey species, such as jackrabbits and ground squirrels, these species were perceived as pests and were targets for eradication in the state by trapping, shooting, and poisoning. Further, sylvatic plague was confirmed in ground squirrels in 1937 in eastern Washington and likely was a significant factor in the decline of

Washington and Townsend's ground squirrel populations statewide. Loss of foraging habitat and sharp declines in abundance and distribution of ground squirrels, jackrabbits and prairie dogs throughout arid shrublands and grasslands of the western U.S. and Great Plains likely adversely affect survival, mortality, and carry-over effects on Washington's Ferruginous Hawk breeding population during the nonbreeding period when they are away from Washington for nearly two-thirds of the annual cycle.

The breeding population of Ferruginous Hawks in Washington is in sustained decline. Between 1974 and 2016, there has been significant declines in nesting territory occupancy, nest success, and productivity. Additionally, the percentage of surveyed nesting territories supporting breeding pairs has significantly declined in the core breeding range of the species in Benton and Franklin counties. The distribution of breeding pairs statewide also appears to have contracted since the early 1990s. There has been no improvement in habitat conditions or amelioration of primary threats, and therefore the recommendation is to reclassify the Ferruginous Hawk from threatened to endangered status in Washington.

LITERATURE CITED

The references cited in the *Periodic Status Review for the Ferruginous Hawk* are categorized for their level of peer review pursuant to section 34.05.271 RCW, which is the codification of Substitute House Bill 2661 that passed the Washington Legislature in 2014. A key to the review categories under section 34.05.271 RCW is provided in Table A. References were categorized by the primary author in April 2021.

Individual papers cited cover a number of topics discussed in the report, including information on: 1) the species' description, taxonomy, distribution, and biology; 2) habitat requirements; 3) population status and trends; 4) conservation status and protections; 5) research, monitoring, and restoration activities; and 6) factors affecting the continued existence of the species.

Table A. Key to 34.05.271 RCW Categories:

34.05.271(1)(c) RCW	Category Code
(i) Independent peer review: review is overseen by an independent third party.	i
(ii) Internal peer review: review by staff internal to the department of fish and wildlife.	ii
(iii) External peer review: review by persons that are external to and selected by the department of fish and wildlife.	iii
(iv) Open review: documented open public review process that is not limited to invited organizations or individuals.	iv
(v) Legal and policy document: documents related to the legal framework for the significant agency action including but not limited to: (A) federal and state statutes; (B) court and hearings board decisions; (C) federal and state administrative rules and regulations; and (D) policy and regulatory documents adopted by local governments.	v
(vi) Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under the processes described in (c)(i), (ii), (iii), and (iv) of this subsection.	vi
(vii) Records of the best professional judgment of department of fish and wildlife employees or other individuals.	vii
(viii) Other: Sources of information that do not fit into one of the categories identified in this subsection (1)(c).	viii

Reference	Category Code
Allison, P. S., A. W. Leary, and M. J. Bechard. 1995. Observations of wintering Ferruginous Hawks (*Buteo regalis*) feeding on prairie dogs (*Cynomys ludovicianus*) in the Texas Panhandle. Texas Journal of Science 47:235-237.	i
American Ornithologists' Union. 1998. Check-list of North American Birds, Seventh edition. American Ornithologists' Union, Washington, D.C.	i
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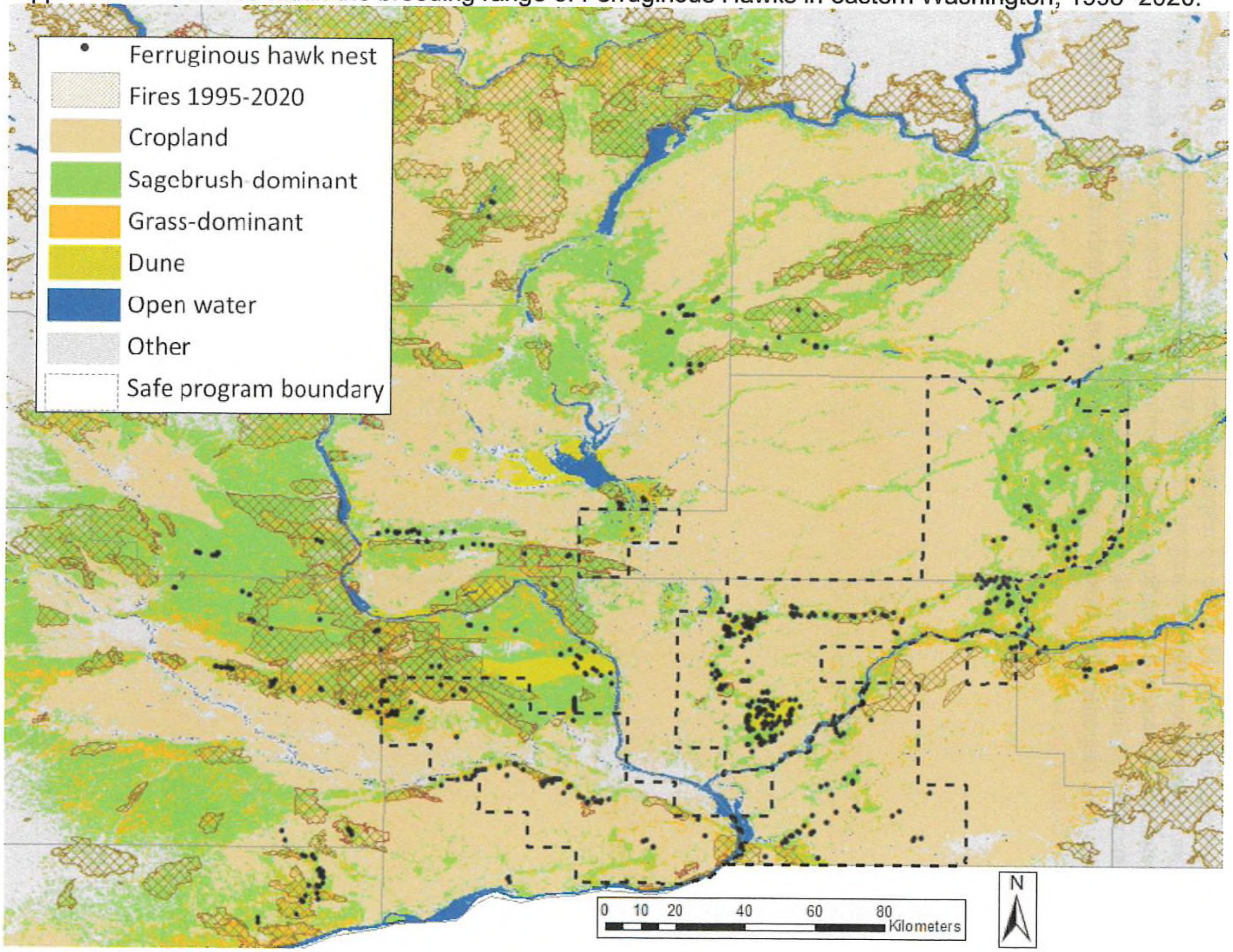
Appendix A. Wildfires within the breeding range of Ferruginous Hawks in eastern Washington, 1995–2020.



APPENDIX B. PUBLIC COMMENTS.

WDFW received public comments during the 90-day public comment period for the draft *Periodic Status Review for the Ferruginous Hawk.* WDFW received 13 individual comment letters from citizens and four comment letters from organizations; 11 of the 13 response letters from citizens and three of the four response letters from organizations indicated support for WDFW's status recommendation to reclassify the Ferruginous Hawk from threatened to endangered in Washington. One response letter from an organization and one response letter from a citizen did not comment on the recommended reclassification to endangered status. One response letter from a citizen did not support reclassification to endangered status.

Washington State Status Reports, Periodic Status Reviews, Recovery Plans, and Conservation Plans

Periodic Status Reviews

2021	Gray Whale
2021	Humpback Whale
2021	Greater Sage-grouse
2020	Mazama Pocket Gopher
2019	Tufted Puffin
2019	Oregon Silverspot
2018	Grizzly Bear
2018	Sea Otter
2018	Pygmy Rabbit
2017	Fisher
2017	Blue, Fin, Sei, North Pacific Right, and Sperm Whales
2017	Woodland Caribou
2017	Sandhill Crane
2017	Western Pond Turtle
2017	Green and Loggerhead Sea Turtles
2017	Leatherback Sea Turtle
2016	American White Pelican
2016	Canada Lynx
2016	Marbled Murrelet
2016	Peregrine Falcon
2016	Bald Eagle
2016	Taylor's Checkerspot
2016	Columbian White-tailed Deer
2016	Streaked Horned Lark
2016	Killer Whale
2016	Western Gray Squirrel
2016	Northern Spotted Owl
2016	Greater Sage-grouse
2016	Snowy Plover
2015	Steller Sea Lion

Conservation Plans

2013	Bats

Recent Status Reports

2019	Pinto Abalone
2017	Yellow-billed Cuckoo
2015	Tufted Puffin
2007	Bald Eagle
2005	Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot
2005	Aleutian Canada Goose
1999	Northern Leopard Frog
1999	Mardon Skipper
1999	Olympic Mudminnow
1998	Margined Sculpin
1998	Pygmy Whitefish
1997	Gray Whale
1997	Olive Ridley Sea Turtle
1997	Oregon Spotted Frog

Recovery Plans

2020	Mazama Pocket Gopher
2019	Tufted Puffin
2012	Columbian Sharp-tailed Grouse
2011	Gray Wolf
2011	Pygmy Rabbit: Addendum
2007	Western Gray Squirrel
2006	Fisher
2004	Sea Otter
2004	Greater Sage-Grouse
2003	Pygmy Rabbit: Addendum
2002	Sandhill Crane
2001	Lynx
1999	Western Pond Turtle
1996	Ferruginous Hawk
1995	Pygmy Rabbit
1995	Snowy Plover

Status reports and plans are available on the WDFW website at:
http://wdfw.wa.gov/publications/search.php

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CONTRASTING HOME RANGE CHARACTERISTICS AND PREY OF SYMPATRIC HAWKS (BUTEO SPP) NESTING IN THE UPPER COLUMBIA RIVER BASIN

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CONTRASTING HOME RANGE CHARACTERISTICS AND PREY OF SYMPATRIC HAWKS (*BUTEO* SPP) NESTING IN THE UPPER COLUMBIA RIVER BASIN

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ABSTRACT—Between 2007 and 2021 we monitored adult hawks (*Buteo* spp.) nesting in the upper Columbia River Basin of Washington and Oregon using global positioning system (GPS) telemetry on 17 Ferruginous Hawks (*B. regalis*), 9 Red-tailed Hawks (*B. jamaicensis*), and 14 Swainson's Hawks (*B. swainsoni*). Our main objectives were to: (1) provide contemporary home-range estimates using fixes generated by the global positioning system to better inform protective buffers on *Buteo* ranges in the Columbia River Basin; and (2) describe prey analyzed from pellets collected at 47 *Buteo* territories. Breeding home ranges (Brownian bridge movement model, 95% isopleths) of Ferruginous Hawks (*B. regalis*) were substantially larger ($\bar{x}$ = 378, s_x = 133 km^2) than those published previously, as were home ranges of Swainson's Hawks ($\bar{x}$ = 276, s_x = 146 km^2) and Red-tailed Hawks ($\bar{x}$ = 28, s_x = 12 km^2). Diets of Ferruginous Hawks on the study area were dominated (60%) by Northern Pocket Gophers (*Thomomys talpoides*), whereas Swainson's Hawks primarily (83%) ate grasshoppers (*Apote notablis* and *Melanoplus* spp.). Red-tailed Hawks ate a less-specialized diet of reptiles (40%), mammals (38%), and birds (13%). We provide models that show the probable degree of protection afforded by different-sized buffers when applied to species-specific home ranges and core areas for hawks in the Columbia River Basin.

Key words: *Buteo, Buteo jamaicensis, Buteo regalis, Buteo swainsoni,* Ferruginous Hawk, home range, Oregon, prey, Red-tailed Hawk, Swainson's Hawk, Washington

Our ability to assess the response of species to anthropogenic changes often depends on understanding the extent of their movements and degree of overlap with resources they use in that environment. An individual animal's use of space over the annual cycle is largely determined by their life stage, season, and breeding status. At a local level, an individual's regular movements between essential resources define its home range (Burt 1943). The home range can, therefore, be thought of as a snapshot of dynamic processes between an animal and its environment that it maintains as a cognitive map (Powell and Mitchell 2012). For raptors, home ranges typically encompass prey concentrations, nests, and topography promoting flight, and are often associated with relatively low human disturbance (Newton 1979). Thus, home-range size may be affected by factors like distribution of preferred prey (Marzluff and others 1997; Leary and others 1998; Peery 2000; Watson 2002) and features including perches and nest substrates (Watson 2002; Kudo and others 2005; Hamer and others 2007).

Home-range estimates may provide a useful template for predicting general spatial use and intensity of use for the same species in unstudied, similar habitats (Suter and Joness 1981; Camp and others 1997; Millar 2002). A recent review found published estimates of home-range sizes of western raptors varied dramatically owing to analytical methods and ecological context (period, age, and sex) and identified the need to systematically estimate home-range sizes for raptors in western North America to better inform protective buffers associated with

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human activities including energy development (Kocina and Aagaard 2021). A species-specific understanding of these movements and home-range dimensions is especially important in the Columbia River Basin (hereafter, "Basin") of the Pacific Northwest where large numbers of Ferruginous Hawks (*Buteo regalis*), Swainson's Hawks (*Buteo swainsoni*), and Red-tailed Hawks (*Buteo jamaicensis*) nest sympatrically (Bechard and others 1990; Kolar and Bechard 2016), and where wind power development and other types of anthropogenic activity have expanded dramatically in the past 15 y (Conley and others 2009). Home-range characteristics of these 3 raptor species were described in the Basin in past studies based on observational and VHF-monitored individuals but lacked the accuracy and completeness of current global-positioning-system (GPS) telemetry (Fitzner 1978; Leary and others 1998). Home-range size and movements of these raptors in the Basin are influenced by diets (Leary and others 1998; Janes 1984), which have shifted over time in response to land-use changes such as conversion of native vegetation to agriculture and invasive grasses (Richardson and others 2001). Thus, understanding current composition of dominant prey species for raptors nesting in the Basin near developing transportation and energy infrastructure will better inform the appropriateness of applying home-range buffers to non-radioed raptors and identification of potential foraging sites.

We evaluated home-range characteristics and document diets of sympatrically nesting Ferruginous, Red-tailed, and Swainson's Hawks with specific objectives to: (1) estimate home-range and core-area sizes of each species; (2) determine the proportion of home ranges contained within fixed-radius buffers centered on nests to inform management guidelines; and (3) identify prey of each raptor species to better understand ecology of food-web dynamics.

Methods

The study was conducted in south-central Washington and north-central Oregon, within the Columbia Plateau Ecoregion. The main study area encompassed about ≈5400 km^2 that included existing and proposed wind-development projects in Klickitat County, Washington, and Gilliam and Morrow Counties, Oregon (Fig. 1). Our targeted sample of 40 hawks was selected at nests located in both undeveloped and developed areas to reflect the range of anthropogenic change in the landscape. We included one Red-tailed Hawk we captured and tracked near a wind-power project near Vantage, Washington in Kittitas County (Fig. 1). Landscape alterations associated with wind-power development include strings of turbines that bisect all habitats but often follow ridgelines and access roads, electrical infrastructure, and low-intensity vehicle traffic associated with turbine maintenance. Grassland habitats show considerable topographic variation throughout the study area, with the steepest hillsides along the Columbia River and large tributaries that feed the river. Little flatland remains undisturbed; large sections of dry-land and irrigated agriculture are interspersed with rangeland used primarily for cattle and sheep grazing. Sagebrush (*Artemisia* spp.) is mixed with annual grasses among patches of lithosol soils (Azerrad and others 2011). Cheatgrass (*Bromus tectorum*) is prevalent in heavily grazed pastures and intensively burned areas. Large expanses of native habitats include the Boardman Conservation Area and Naval Weapons Systems Training Facility Boardman, which are managed by the Nature Conservancy (TNC) and Department of Defense (DoD), respectively.

Ferruginous Hawk nesting habitats include significant areas of shrubsteppe or native grasses, often on talus slopes and hills that are too steep for cultivation. Additional nesting habitats include relatively level landscapes between canyons in stands of Western Juniper (*Juniperus occidentalis*). Red-tailed Hawks nest in some of the same areas, but also frequent more open stands of windbreak trees in mixed cropland and native habitats. Swainson's Hawks most often nest in juniper trees, but also use exotic or native homestead trees adjacent to agricultural land.

On average, Ferruginous Hawks and Red-tailed Hawks arrive on the study area following spring migration during the last week of February and 1st week of March, respectively, whereas on average Swainson's Hawks arrive later in the last week in April (J Watson, unpubl. data). The average departure date from breeding ranges is the 3rd week in July for Ferruginous Hawks, the 1st week in August for Swainson's Hawks, and mid-September for Red-tailed Hawks (J Watson, unpubl. data).

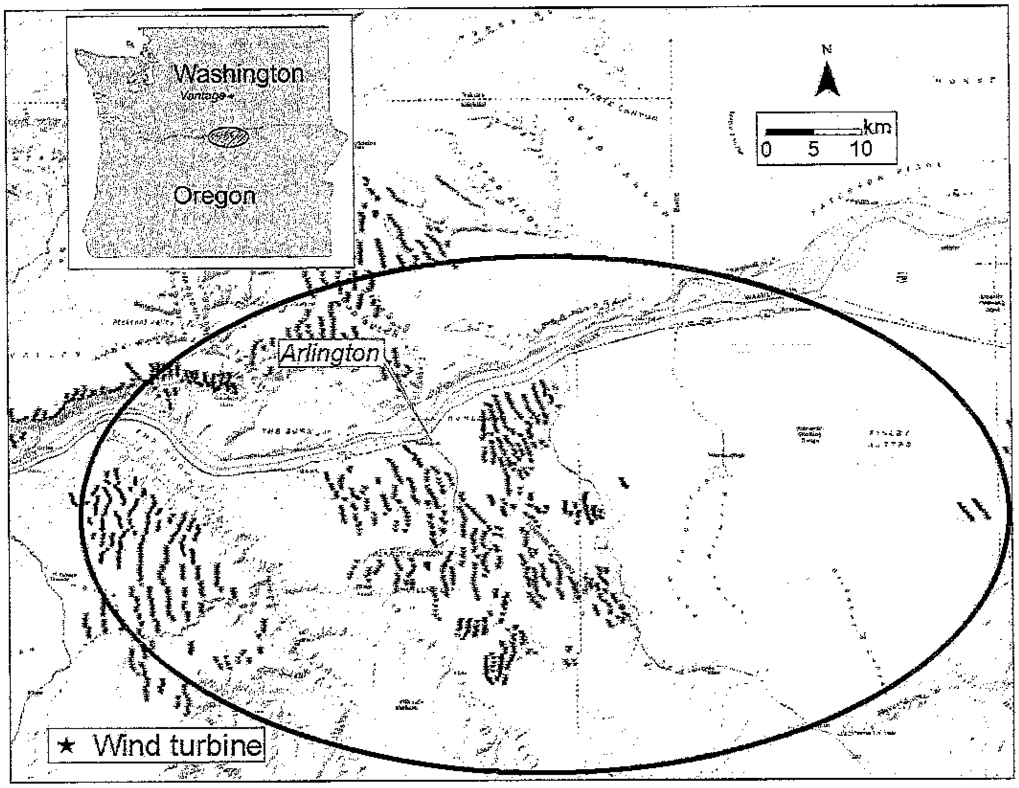

FIGURE 1. Location (oval) where 40 adult hawks were monitored with global positioning telemetry in the Columbia Plateau Ecoregion, 2007–2014. Nest locations are not provided due to data sensitivity. One study territory was in Kittitas County, Washington (upper left inset).

Hawk Capture and Telemetry

Each spring beginning in 2007, we captured and radio-tagged adult hawks near nests within historical territories using bal-chatris traps baited with mice or gerbils along nearby access roads or with break-away dho gaza nets and a live Great Horned Owl (*Bubo virginianus*) lure (Bloom and others 2007). We captured 1 adult hawk on each territory, but targeted males because they provide more movement information than females, at least during incubation and brooding periods (Collopy 1984; Howell and Chapman 1997). We attached platform transmitter terminals (PTTs), manufactured by Microwave Telemetry, Inc., to captured hawks with Teflon ribbon and "X"-configured backpacks. Thirty-gram PTTs used on most hawks were programmed for transmitting hourly locations for 21 h d^{-1}, but actual transmissions were often fewer due to less-than-optimal battery charging and perching locations of birds that negatively affected satellite-to-PTT communication. Twenty-two-gram PTTs were deployed on male Swainson's Hawks to maintain a transmitter/body mass ratio <3% and were programmed to broadcast every 4 h for 20 h d^{-1} for optimal transmission of 5 locations daily. Data retrieval was accomplished via computer access to ARGOS satellite data servers. Manufacturer specified error for GPS fixes was ±22 m (T. Rollins, Microwave Telemetry Inc., pers. comm.).

Home Range

Nesting attempts and productivity for monitored hawks were assessed annually by ground surveys between April and May, and June and July, respectively, using standard protocols (Hayes and Watson 2021). From these surveys we determined whether nesting pairs laid eggs, based on their incubation behavior, and either

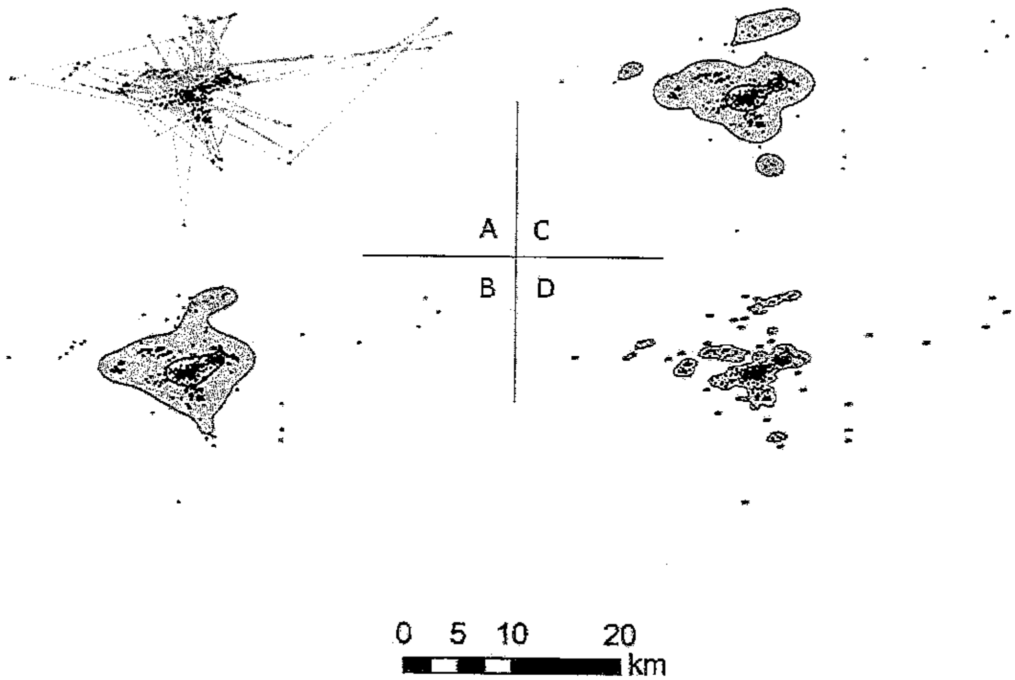

FIGURE 2. Example of 95% home-range contours (gray) and 50% core-area contours (white) determined for an adult male Ferruginous Hawk monitored between 21 May–5 July 2009 ($n = 764$ fixes). (A) Plots depict trajectories connecting consecutive fixes (star is nest location); (B) Brownian bridge movement model; (C) kernel density estimate with 10% h_{REF} bandwidth for kernel smoothing; and (D) kernel density estimate using the h_{PI} plugin bandwith selector.

failed or successfully fledged young. We estimated home-range characteristics between the spring capture date or arrival on the breeding range (for hawks monitored . 1 y) and the last fixes before post-breeding departure from the range at both successful and failed nests. We did not document early migration of monitored hawks at any failed nests. We averaged range estimates for hawks in the year they were captured after arrival with estimates from complete breeding seasons, because range size was not correlated with occupancy duration for any species (P . 0.10). Arrival on breeding ranges was abrupt and distinct for all Ferruginous Hawks and Swainson's Hawks, which were complete migrants, and most Red-tailed Hawks, which were partial migrants. Two Red-tailed Hawks that remained in the Pacific Northwest year-round dispersed locally , 5 km from their breeding ranges, whereas Red-tailed Hawks that were complete migrants departed ranges, so we defined their home-range occupancy as within the same period.

We estimated home ranges with 2 methods. First, we used the Brownian bridge movement model (BBMM) to estimate home ranges (Horne and others 2007) based on flight locations where the speed sensor was . 0 kph, and perch locations where the speed sensor was = 0 kph. This method allowed us to estimate utilization distributions (UDs) that included hawk flight paths in range estimation because it involved the probability of the bird being at any point between 2 locations based on elapsed time between fixes (Fig. 2A, Fig. 2B). Thus, it inherently addressed potential issues of fix independence among large GPS data sets (Horne and others 2007; Walter and others 2011). Hawk use of airspace was relevant to range estimates because of importance to possible wind-energy conflicts. We calculated UDs, and 50 and 95% isopleths, from consecutive locations separated by ≤ 2 h. We chose this interval to include the minimal transmission time for programmed transmitters (for example, 1 h for 30-g PTTs, 3 h for 22-g PTTs) and exclude longer periods of missed fixes.

Second, we estimated home-range sizes with the fixed-kernel density estimator (KDE) to generate 50 and 95% home ranges from pooled perch and flight locations. Fixed kernels identify areas of more intensive focal use relative to BBMMs and provided home-range comparisons to other studies. We did not subsample fixes to assure fix independence (Swihart and Slade 1985) because De Solla and others (1999) found subsampling resulted in loss of important information and did not reduce autocorrelation. Flight mobility of raptors, which allows them to quickly traverse their home ranges to preferred habitats, reduces concerns over fix independence (Andersen and Rongstad 1989; Moss and others 2014; Sandgren and others 2014). We tested the 10% reference-bandwidth (h_{REF}) and plug-in bandwidth selector (h_{PI}; Duong 2007) for kernel smoothing. We found h_{PI} under-smoothed most ranges (Fig. 2D) despite its apparent advantages (Jones and others 1996), so we report KDE estimates based on 10% h_{REF} (Fig. 2C). We conducted home-range estimation in the R statistical package (R Version 4.0.3, www.r-project.org, accessed 8 September 2021) and the ADEHABITAT package (http://cran.r-project.org/package=adehabitat, accessed 8 September 2021).

For birds monitored . 1 y, we averaged annual estimates of range size for BBMMs and KDEs and summarized range-size estimates by species with grand means and standard errors (S_x). We also summarized size of 95% BBMM isopleths for birds on territories where nesting was observed versus not observed using pooled data for all territories for all years. We did not statistically assess the effect of nesting on range size because of small samples. For BBMM ranges, we recorded the number of isolated isopleths at each level as a measure of range fragmentation (Watson and others 2014). Finally, we assessed overlap of 50% and 95% range isopleths of nesting adults with fixed, hypothetical management buffers at 0.8-km increments centered on nests (extended to 5 km for Swainson's and Red-tailed Hawks, and 10 km for Ferruginous Hawks). We plotted home-range isopleths and calculated the percent of overlap with buffer increments using geographic information system (GIS) techniques in ArcMap version 10.0 (ESRI 2011).

Prey

In 2011, we collected pellets opportunistically at the end of the season from nests and perch locations used by adults and fledglings of all 3 species at 47 territories within the study area. We sampled territories of telemetered adults and adjacent territories not selected for radio-marking. This increased sample size and allowed representation of different habitat types and levels of anthropogenic activity throughout the study area. From each sample we derived the minimum number of prey individuals to the most specific taxa possible through identification of mammal and bird skulls and jaw fragments and paired jaws of Orthopertans (Elbroch 2006). Fur, feathers, and reptile scales (Moore and others 1974; Scott and McFarland 2010) in a single pellet were considered to represent the same individual, whereas counts of pooled skulls and jaws in a single pellet allowed for identification of . 1 individual. Frequencies of prey species in diets were quantified to provide an assessment of relative use within and among *Buteo* species.

RESULTS

From 2007–2021 we captured, radioed-marked, and monitored 40 adult *Buteos* on territories, including 17 Ferruginous Hawks, 9 Red-tailed Hawks, and 14 Swainson's Hawks. Individuals were monitored an average of 2.1 y (s_x = 0.2, range = 1–6 y). Core areas (50% isopleths) and home ranges (95% isopleths) of Ferruginous Hawks were the largest of the 3 buteos, up to 37% larger than ranges of Swainson's Hawks, and 5x to 16x larger than ranges of Red-tailed Hawks for each method used (Table 1). BBMM home ranges for Ferruginous Hawks were, on average, identical in territories where hawks nested ($\bar{x}$ = 314.7 km^2, s_x = 124.6, n = 24) compared to those where no egg-laying was observed ($\bar{x}$ = 314.0 km^2, s_x = 99.7, n = 9). However, home ranges were over twice as large for Swainson's Hawks that did not nest ($\bar{x}$ = 363.9 km^2, s_x = 291.5, n = 5) compared to hawks that nested ($\bar{x}$ = 162.9 km^2, s_x = 83.3, n = 28), and over 5x larger for Red-tailed Hawks that did not nest ($\bar{x}$ = 62.0 km^2, s_x = 25.5, n = 3) than for hawks that nested ($\bar{x}$ = 12.2 km^2, s_x = 8.3, n =

TABLE 1. Home-range size (km²) and occupancy duration ($\bar{x}$ **6** s_x) of territorial hawks monitored by satellite telemetry during the breeding season in the Columbia River Basin, 2007–2014. Range isopleths (50% and 95%) were estimated using Brownian bridge movement models (BBMM) and kernel density estimation (KDE).

	Ferruginous Hawk	Swainson's Hawk	Red-tailed Hawk
No. birds	17	14	9
No. territories	33	33	16
Range isopleths			
50% BBMM	39.8 **6** 18.5	33.4 **6** 18.7	2.4 **6** 0.8
50% KDE	100.3 **6** 43.9	105.2 **6** 69.0	9.6 **6** 5.5
95% BBMM	378.1 **6** 133.4	275.7 **6** 146.4	27.7 **6** 12.1
95% KDE	636.6 **6** 249.2	554.0 **6** 317.3	96.1 **6** 61.8
No. days	100 **6** 9	87 **6** 6	197 **6** 16
No. fixes	1589 **6** 151	608 **6** 80	1904 **6** 248

11). Range fragmentation ($\bar{x}$ no. islands **6** s_x) was highest for Ferruginous Hawks (50% isopleths = 1.6 **6** 0.3, 95% isopleths = 5.1 **6** 1.6) compared to Swainson's Hawks (50% isopleths = 1.6 **6** 2.1, 95% isopleths = 1.9 **6** 0.5) and Red-tailed Hawks (50% isopleths = 1.1 **6** 0.1, 95% isopleths = 2.2 **6** 0.7).

On average, a circular buffer with a 2.4-km (1.5-mi) radius centered on the nest encompassed . 75% of 50% core areas for all 3 species (Fig. 3). A buffer with a 10-km radius encompassed 72% of 95% home ranges for Ferruginous Hawks. A buffer with a 5-km radius encompassed 75% of 95% home ranges for Swainson's Hawks, and a buffer with a 2.4-km radius encompassed 74% of 95% home ranges for Red-tailed Hawks.

Hawks monitored during multiple years (n = 17) exhibited nest-site fidelity and used the same nest or alternative nests within the same territory, with 2 exceptions. One male Ferruginous Hawk nested on a different adjacent territory during each of 5 breeding seasons. Additionally, there was one nest switch between a telemetered Ferruginous Hawk and a Swainson's Hawk in consecutive years (Fig. 4).

We identified 29 prey species or species groups in 394 whole pellets and pellet fragments from nests of 6 Ferruginous Hawks, 13 Red-tailed Hawk nests, and 28 Swainson's Hawks in

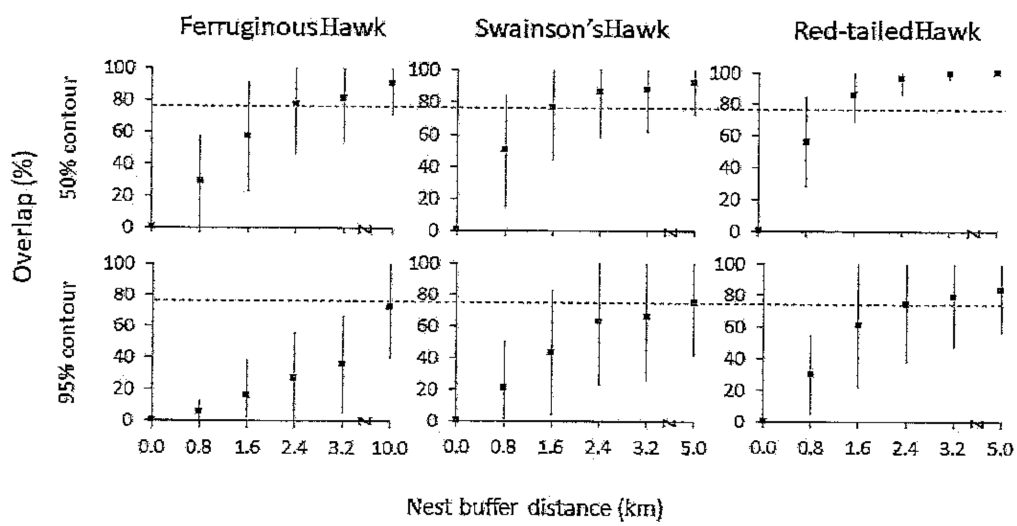

FIGURE 3. Percentage of breeding core areas and home-range contours of hawks encompassed by circular buffers at 0.8-km increments radiating from used nests. Home ranges were estimated by the Brownian movement model. Mean percentages and associated standard deviations are shown at each increment. The dotted line identifies the third quartile (75%) of range overlap.

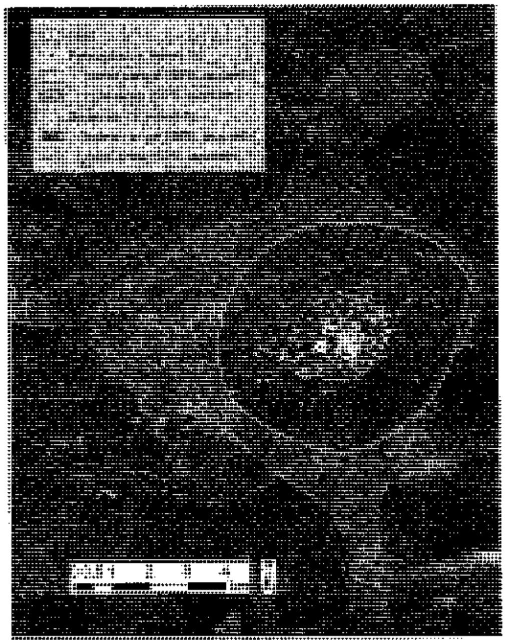

FIGURE 4. GPS fix distribution and Brownian bridge ranges for an adult male Ferruginous Hawk ($n = 766$ fixes; 21 May–6 July 2009) and adult male Swainson's Hawk ($n = 427$ fixes; 31 May–12 August 2010) using the same nest in consecutive years.

the study area (Table 2). Northern Pocket Gophers (*Thomomys talpoides*) were the most abundant prey of Ferruginous Hawks (60%), followed by snakes (21%). Frequencies of these prey items were reversed for Red-tailed Hawks (24 and 40%, respectively). Less-diverse prey were represented in Swainson's Hawk pellets, with insects, principally grasshoppers, accounting for 83% of prey by frequency.

DISCUSSION

Global positioning system technology increases transmitter fix frequency, precision, accuracy, and reduces sampling bias (Hebblewhite and Haydon 2010). Thus, as expected, our breeding home-range estimates for the three species were larger than ranges determined by pre-GPS (ground-based) telemetry studies throughout the west (Fitzner 1978; Janes 1984; Andersen and others 1990; McAnnis 1990; Babcock 1995; Leary and others 1998). Also, our estimates were larger than recent studies of GPS-monitored Ferruginous Hawks in Alberta (Watson 2020) and Wyoming (S Ramirez, pers. comm.), and Swainson's Hawks in Texas (Watson and others 2017). Increased home-range size has been correlated with increased human disturbance (Andersen and others 1990) and reduced resource availability within the landscape including habitat for preferred prey (Babcock 1995; Leary and others 1998). Anthropogenic factors included expanding wind-power development, and modified habitats consisting of mixed agriculture, ranching, and native plants. About half the raptors we studied had ranges where wind-power projects were recently developed or were in the process of being developed.

We hypothesize prey distribution was an important influence on *Buteo* home range characteristics (Marzluff and others 1997; Leary and others 1998; Watson 2002), but because our purpose was not to assess prey abundance or distribution, we could only interpret the effects of prey indirectly through our diet analysis. Ferruginous Hawk consumption of pocket gophers was not unexpected based on their predominance in regional Ferruginous Hawk diets (Richardson and others 2001). Pocket gophers are often associated with native habitats (Shaffer and others 2019) and edges of irrigated cropland (Zelenak and Rotella 1997; Leary and others 1998). Ferruginous Hawks hunted pocket gophers near cropland several kilometers distant from their nests in native habitats (Thurow and others 1980; Leary and others 1998), an association that may partly account for the relatively high degree of home-range fragmentation we observed.

Larger ranges of Ferruginous Hawks were consistent with the positive correlation between body mass and home-range size in holarctic raptors (Peery 2000). Comparatively, home ranges of Red-tailed Hawks, which averaged 12% of the size of Ferruginous Hawk ranges, may have resulted in part from their opportunistic diet of mammals, reptiles, and birds, and their social dominance in the raptor guild (Janes 1984, 1994; Restani 1991). In contrast, home-range size of Swainson's Hawks was intermediate among species and their prey was dominated by grasshoppers (Thurow and others 1980; Bechard and others 2020).

Notably, home ranges of Ferruginous Hawks in high-density ground-squirrel habitat in Canada were 20x smaller than in our study (Watson 2020). Historically, ground squirrels were impor-

TABLE 2. Diet of hawks in the wind power development study area identified from analysis of pellets collected in and around 6 Ferruginous Hawk nests (77 pellets and fragments), 13 Red-tailed Hawk nests (54 pellets and fragments), and 28 Swainson's Hawk nests (263 pellets and fragments) in 2011.

Prey Species or Group	Ferruginous Hawk		Red-tailed Hawk		Swainson's Hawk	
	No.	%	No.	%	No.	%
Northern Pocket Gopher (*Thomomys talpoides*)	73	60.3	22	23.7	110	5.9
Deer Mouse (*Peromyscus maniculatus*)	0	0.0	3	3.2	2	0.1
MontaneVole (*Microtus montanus*)	0	0.0	0	0.0	7	0.4
Jumping Mouse (*Zapus princeps*)	0	0.0	0	0.0	6	0.3
Great Basin Pocket Mouse (*Perognathus parvus*)	0	0.0	0	0.0	4	0.2
unidentified small mammal	4	3.3	8	8.6	40	2.1
Mountain Cottontail (*Sylvilagus nutallii*)	1	0.8	3	3.2	5	0.3
White-tailed Jackrabbit (*Lepus townsendii*)	1	0.8	0	0.0	0	0.0
Black-tailed Jackrabbit (*Lepus californicus*)	1	0.8	0	0.0	0	0.0
Coyote (*Canis latrans*)	1	0.8	0	0.0	0	0.0
unidentified large mammal	0	0.0	0	0.0	3	0.2
TOTAL MAMMAL	81	66.9	36	38.7	177	9.5
Black-billed Magpie (*Pica hudsonia*)	0	0.0	4	4.3	0	0.0
Stellar's Jay (*Cyanocitta Stelleri*)	0	0.0	0	0.0	1	0.1
Western Meadowlark (*Sturnella neglecta*)	3	2.5	0	0.0	2	0.1
Horned Lark (*Eremophial alpestris*)	0	0.0	0	0.0	1	0.1
Bewick's Wren (*Thryomanesbewickii*)	1	0.8	0	0.0	0	0.0
unidentified Passerine	2	1.7	7	7.5	14	0.8
Long-billed Curlew (*Numenius americanus*)	0	0.0	1	1.1	1	0.1
Killdeer (*Charadrius vociferous*)	0	0.0	0	0.0	1	0.1
Gray Partridge (*Perdix perdix*)	0	0.0	0	0.0	1	0.1
unidentified bird egg	1	0.8	0	0.0	0	0.0
TOTAL BIRD	7	5.8	12	12.9	21	1.1
Gopher Snake (*Pituofis catenifer*)	1	0.8	1	1.1	4	0.2
Racer (*Coluber constrictor*)	0	0.0	1	1.1	1	0.1
unidentified snake	24	19.8	35	37.6	43	2.3
TOTAL REPTILE	25	20.7	37	39.8	48	2.6
Burying Beetle *Nicrophorini* spp.	0	0.0	0	0.0	5	0.3
unidentified beetles Coleoptera	4	3.3	2	2.2	48	2.6
grasshopper *Apote notablis* and *Melanoplus* spp.	4	3.3	6	6.5	1558	83.4
Field Cricket (*Gryllus pennsylvanicus*)	0	0.0	0	0.0	10	0.5
Jerusalem Cricket (*Stenopelmatus fuscus*)	0	0.0	0	0.0	1	0.1
TOTAL INSECT	8	6.6	8	8.6	1602	85.7
TOTAL PREY	121	100.0	93	100.0	1868	98.9

tant prey of *Buteos* in portions of the Basin (Lardy 1980; Janes 1984), but pocket gophers have become the predominant prey in southeast Washington (Fitzner and others 1977; Leary and others 1998; Richardson and others 2001). We did not identify ground squirrels as prey of any *Buteo* (Table 2), which is consistent with the reduced range and distribution of the Washington Ground Squirrel (*Urocitellus washingtoni*) in Oregon and Washington (Betts 1999).

Home-range size was smaller for Swainson's Hawks and Red-tailed Hawks that nested compared to those that did not nest. Nest defense, brood-rearing, and provisioning are responsibilities that increase intensity of raptor use closer to the nest, whereas non-nesters may expand use away from core areas (Marzluff and others 1997; Haworth and others 2012; Watson and others 2014). We suspect that the larger home ranges of Ferruginous Hawks used by nesting and non-nesting hawks largely resulted from prey distribution in dispersed habitats (Leary and others 1998).

Our home-range estimates based on GPS fixes (Table 1) provide a starting point for understanding spatial needs of nesting *Buteos* in the Basin or in habitats with comparable anthropogenic development. Protective zones (for example, management buffers) that are smaller than these home ranges and core areas are likely to provide decreasing protection for nesting hawks (Fig. 3) and should incorporate territory-specific knowledge of prey distribution relative to nests (for example, pocket gopher and ground squirrel colonies).

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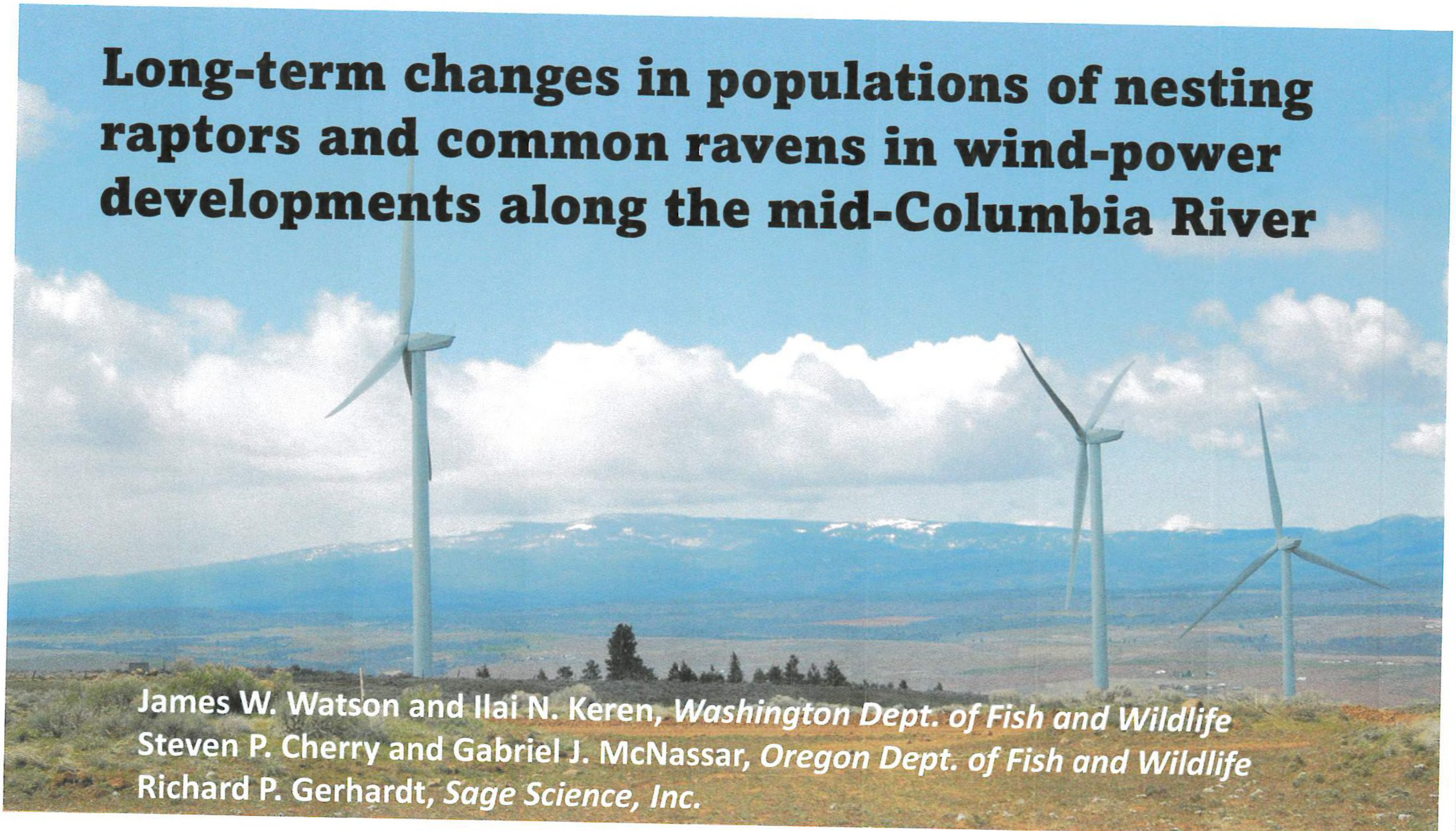


Long-term changes in populations of nesting raptors and common ravens in wind-power developments along the mid-Columbia River

James W. Watson and Ilai N. Keren, *Washington Dept. of Fish and Wildlife*
Steven P. Cherry and Gabriel J. McNassar, *Oregon Dept. of Fish and Wildlife*
Richard P. Gerhardt, *Sage Science, Inc.*

- **Potential impacts**


direct mortality


indirect displacement

- **Populations**


breeding

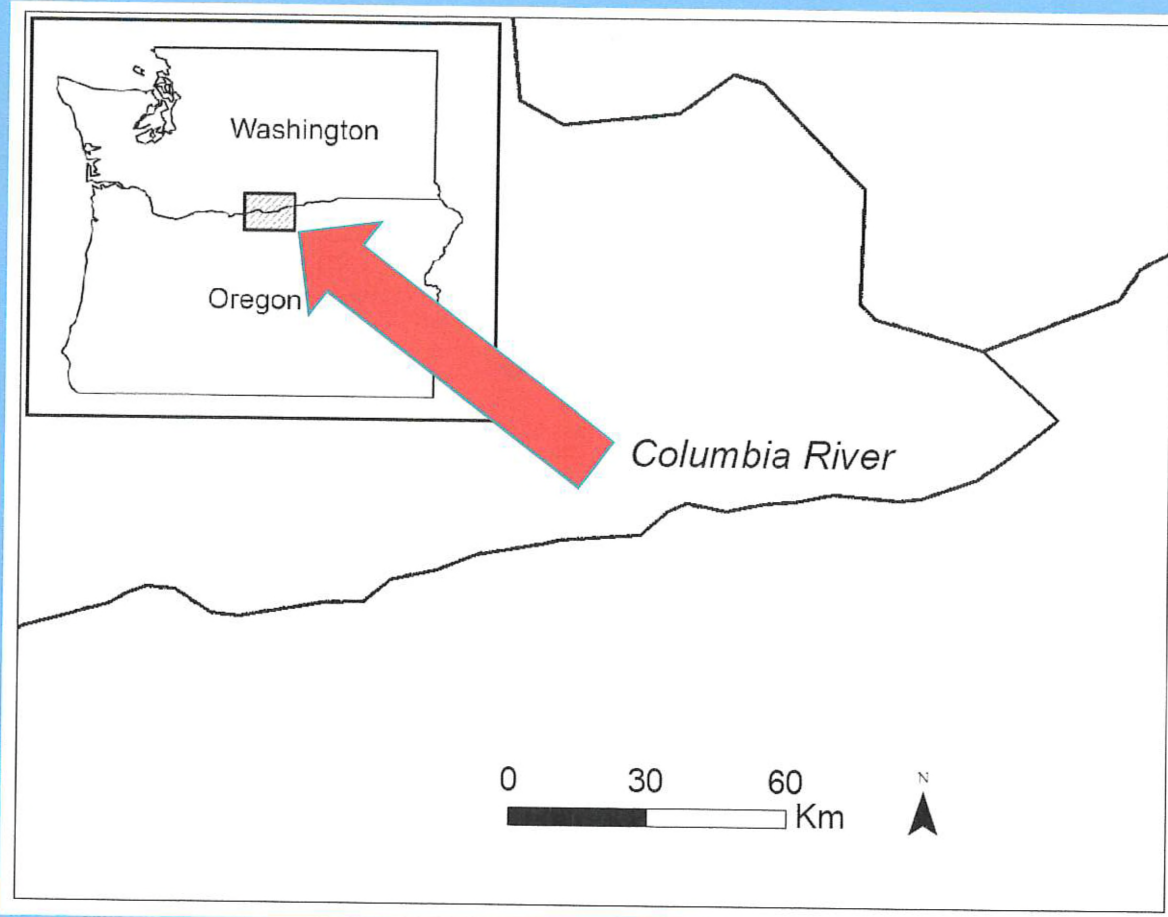

wintering/migrant


nonbreeders/floaters

But…

most studies don’t differentiate which raptor population (breeding, wintering, nonbreeding) is impacted

1. especially important for regional breeding populations (e.g., Oregon, Washington)
2. declining species
3. may need several years to assess



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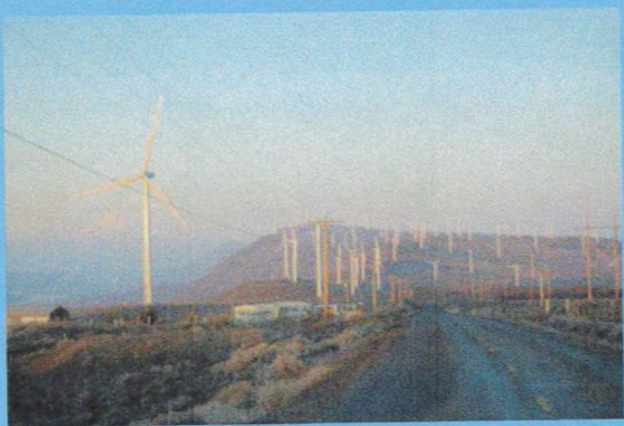
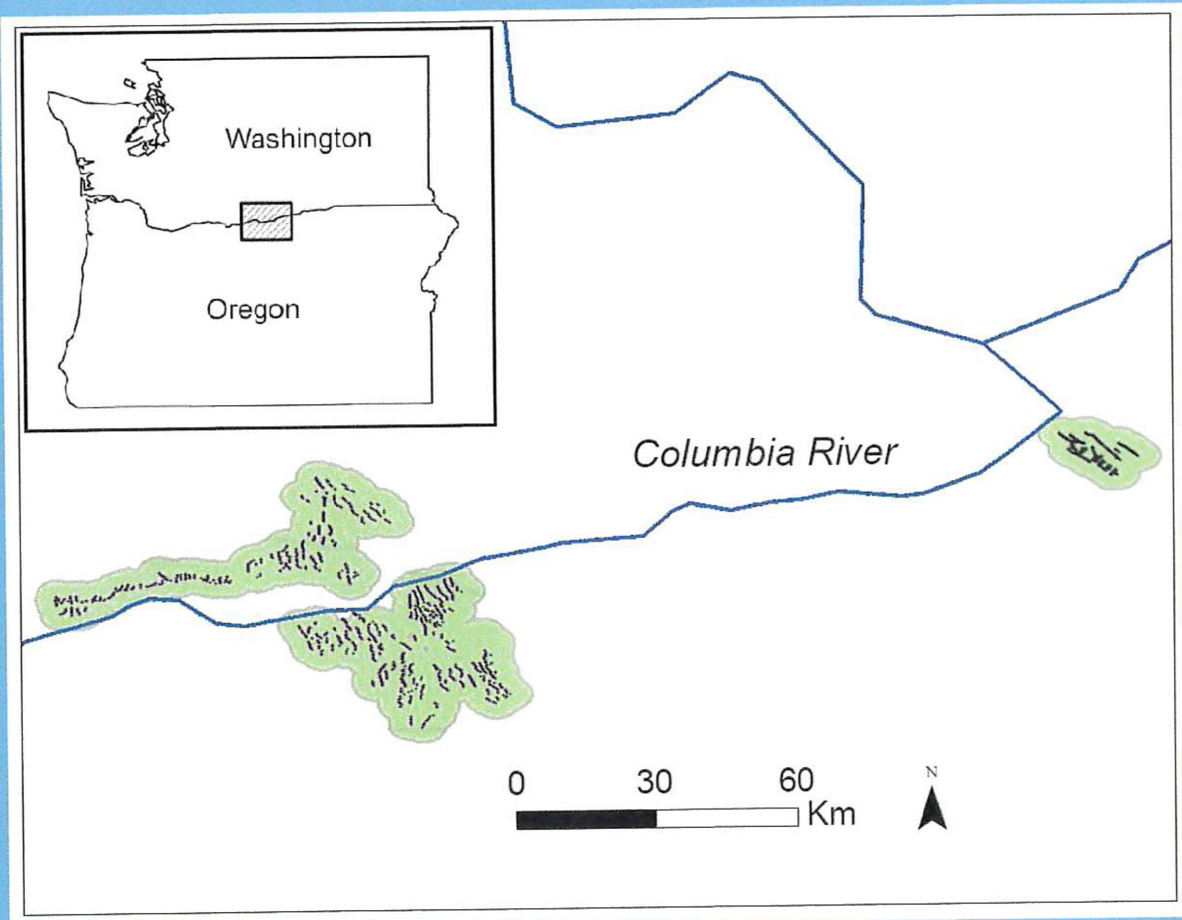
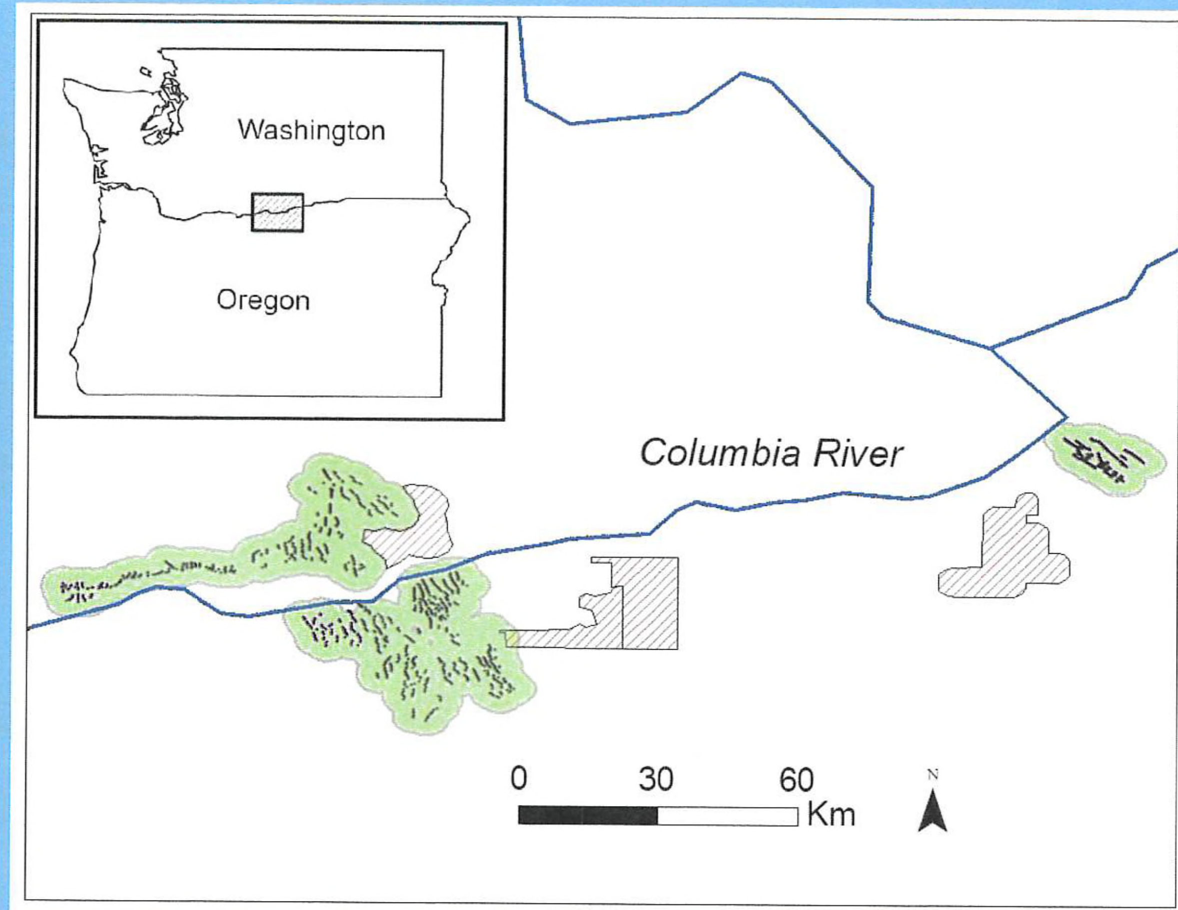




- 18 projects, 1,723 turbines, 2,753km^2
- construction completed 2003 to 2019
- 279 nests of 11 raptor species and common ravens identified during pre-construction surveys



- 4 “reference” areas
  NOT a BACI design

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Objectives

Hyp_0: no effect of wind projects on species numbers and relative abundance

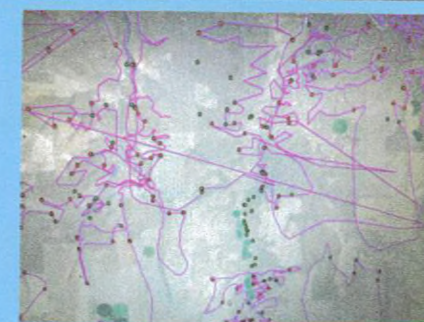
- Revisit projects in 2020-21 and evaluate difference in nest numbers and relative change among species between pre- and post-construction;

- Compare results to 4 reference sites (non-BACI comparison)
- Evaluate whether linear change in numbers over time.

- Evaluate spatial shift in nests for each species over time relative turbine locations (not in this talk).

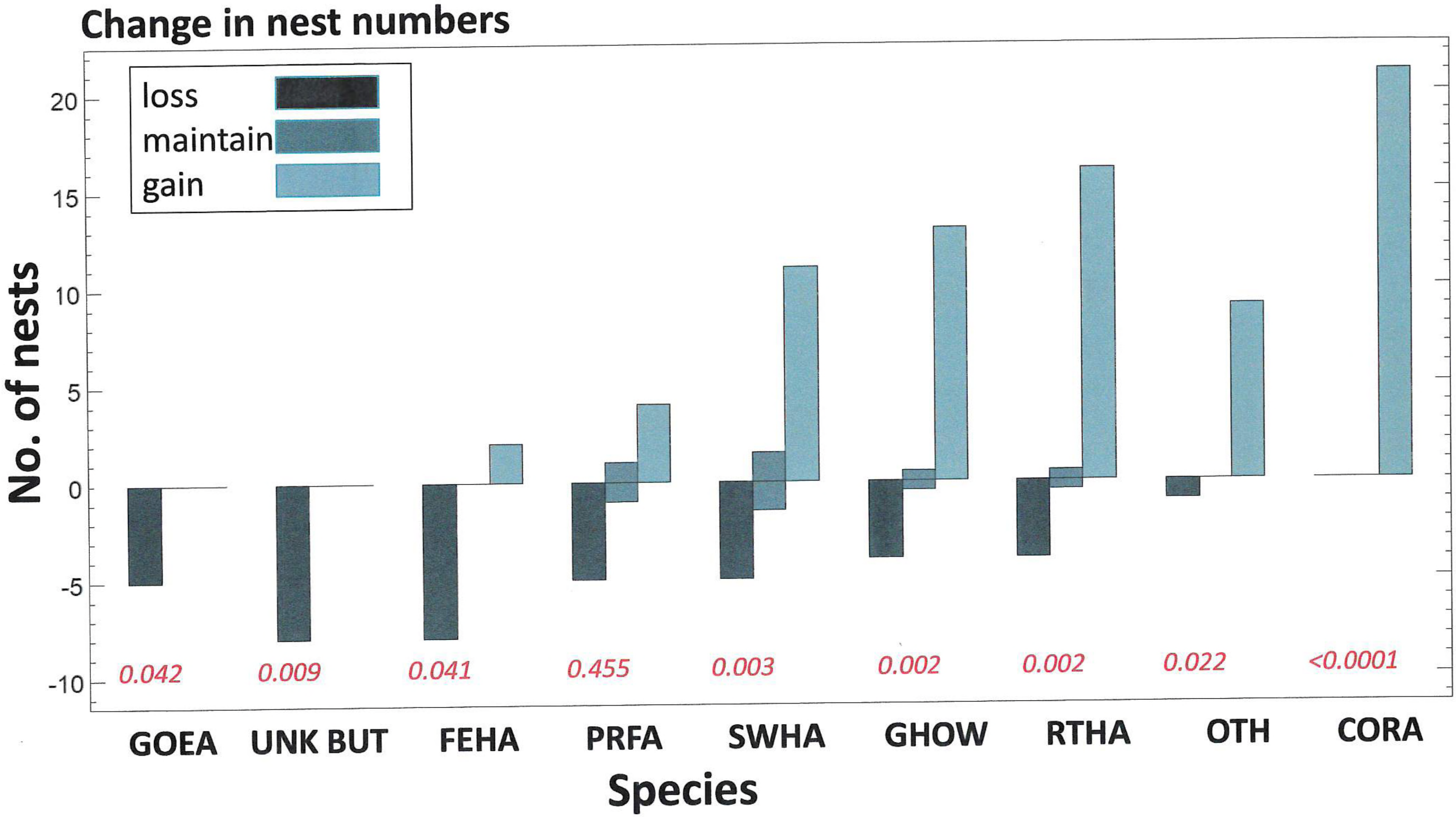
Methods

- Survey protocol mirrored pre-construction surveys:
  helicopter; blind search (no prior knowledge of nest locations)
  elevated structure (cliffs, trees, towers, etc.); 15 April – 15 May
  3.2 km project boundary (2-mi from outermost turbines)
  occupancy confirmed (2 adults, one incubating adult, etc.)



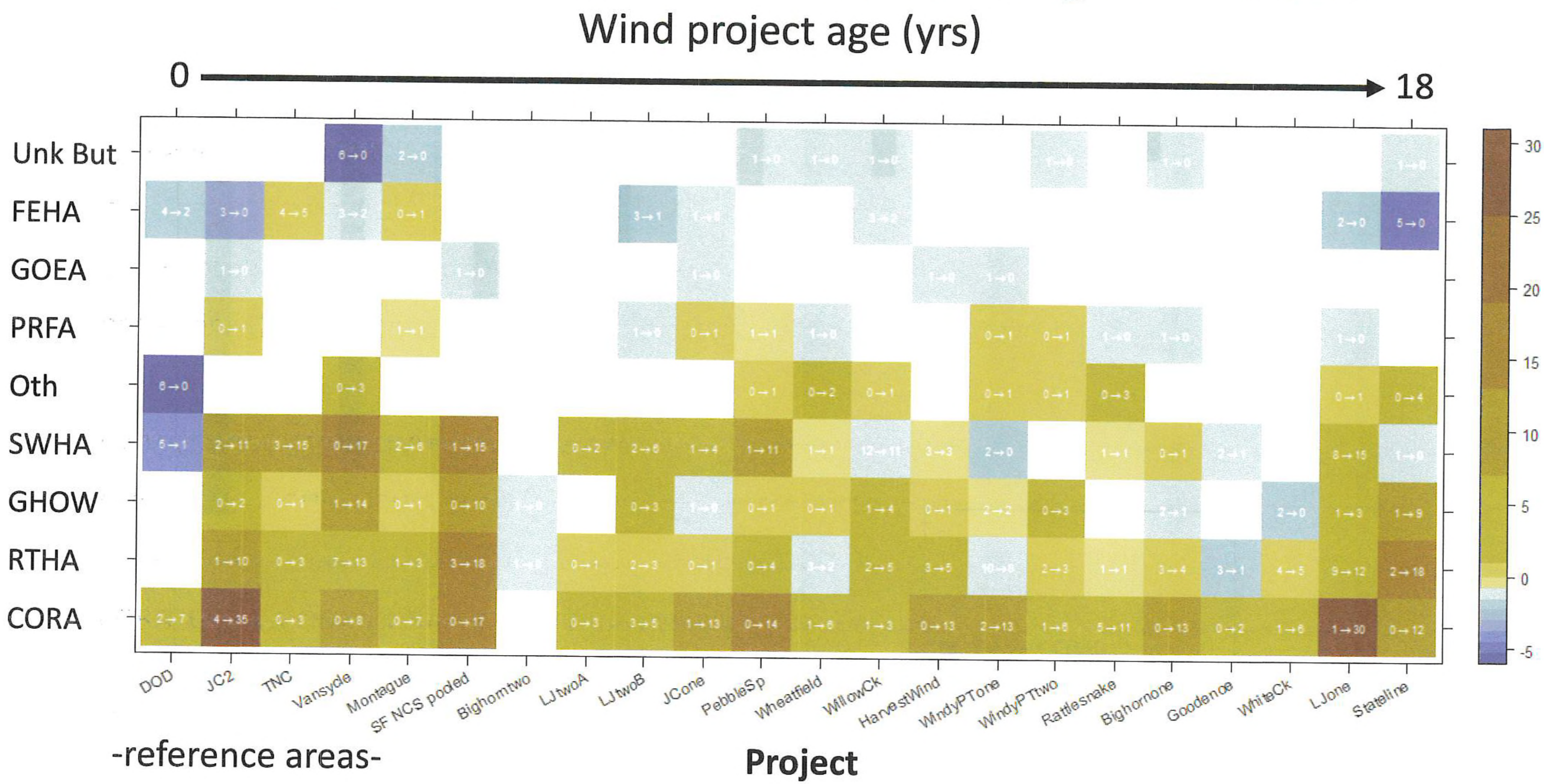
- Assessed probability of detection (0.98)

- Analysis of species change per site pre-post construction
  - ✓ by number of nests using GLMM, Poisson dist. with log link
  - ✓ by percent of nests relative to other species using multinomial modeling; included reference site data (0 yrs since construction)

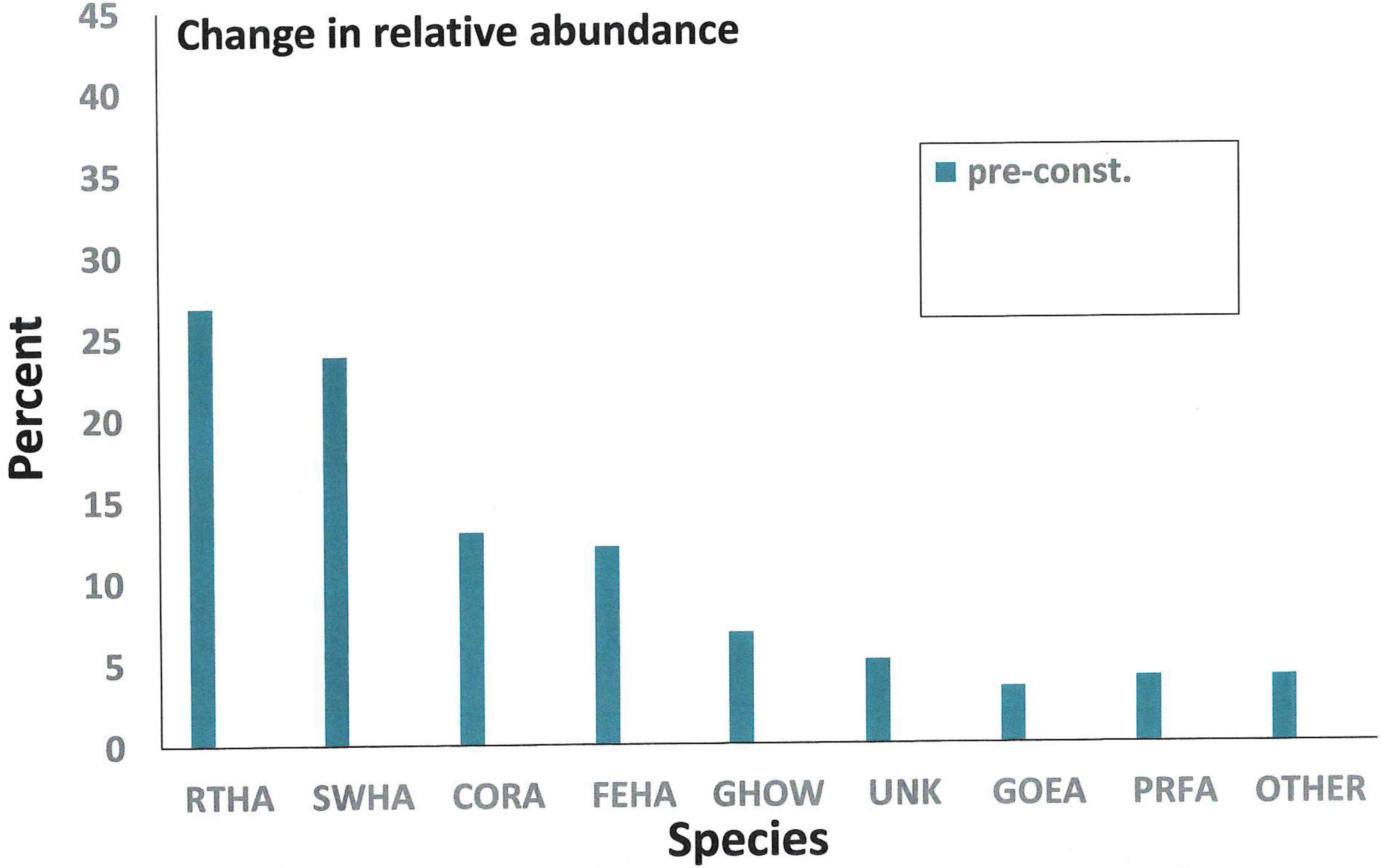


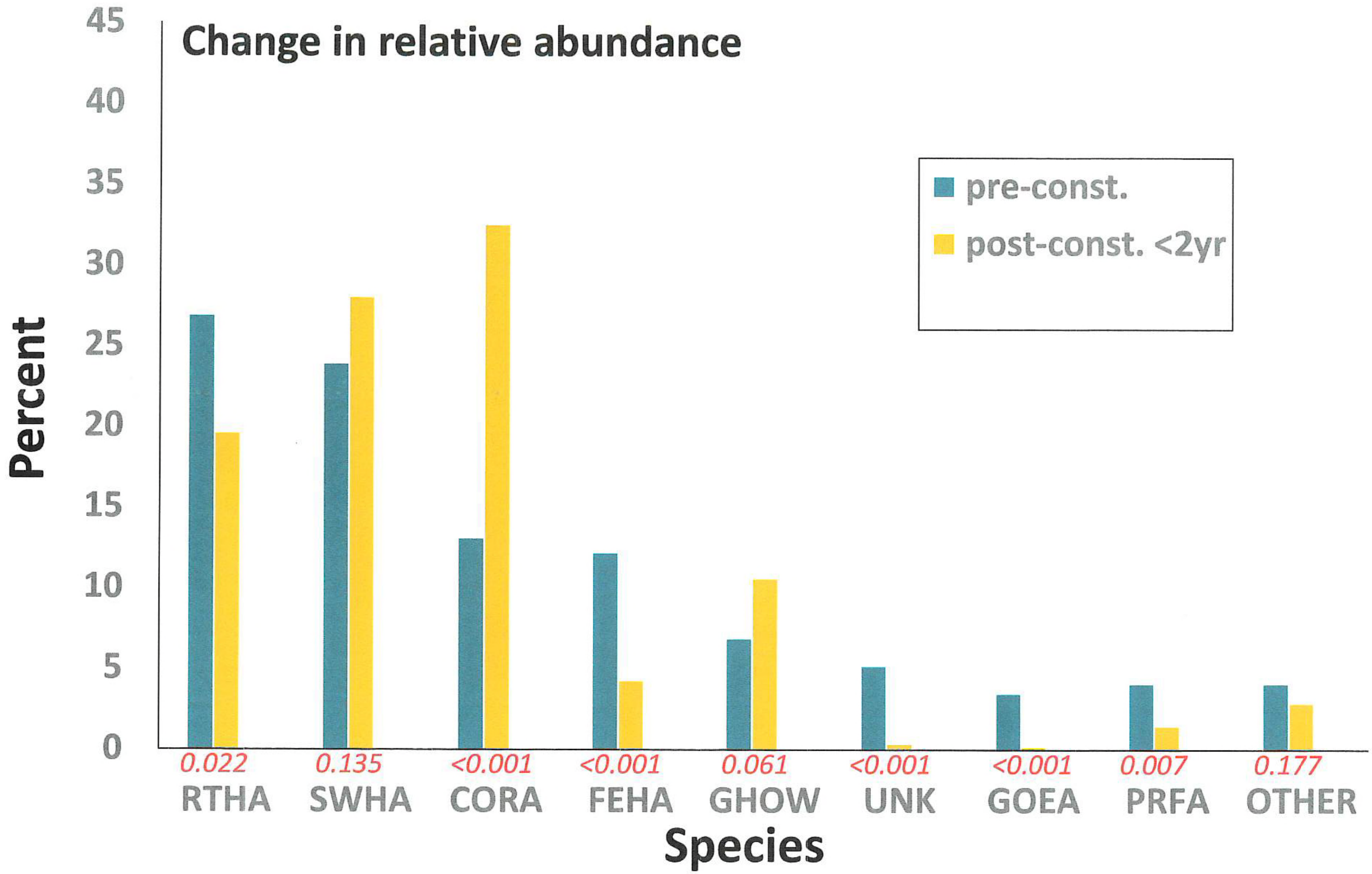
Watson-000359

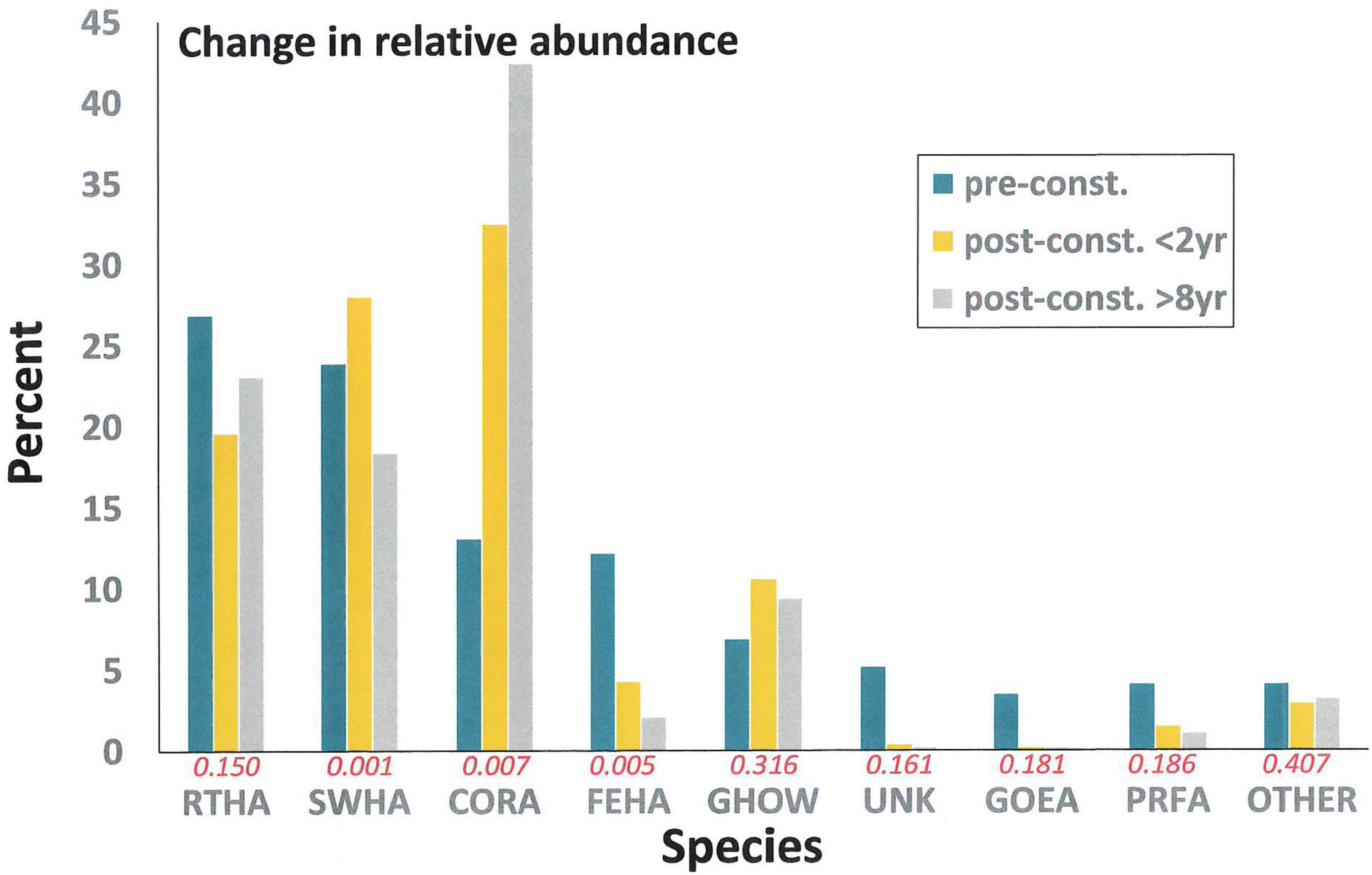
Did time since project completion influence change in numbers?



Watson-000360


Change in relative abundance
Percent
45
40
35
30
25
20
15
10
5
0
pre-const.
RTHA
SWHA
CORA
FEHA
GHOW
UNK
GOEA
PRFA
OTHER
Species


Change in relative abundance
Percent
45
40
35
30
25
20
15
10
5
0
pre-const.
post-const. <2yr
0.022
RTHA
0.135
SWHA
<0.001
CORA
<0.001
FEHA
0.061
GHOW
<0.001
UNK
<0.001
GOEA
0.007
PRFA
0.177
OTHER
Species



Watson-000363

Did wind development <u>cause</u> or <u>contribute</u> to changes in the raptor species guild?

Behavioral influences on raptor guild evolution – increasing species:

- Higher tolerance of/ adaptability to human change

- Compete for nests

- Predate eggs and young

Summary:

- Tolerant raptors/ravens increased nesting and less tolerant species declined up several years after windpower development
- Increasing species are known to compete and predate declining species
- The degree to which windpower contributed to changes in the nesting raptor guild as opposed to outside factors was unclear, but could be improved by establishing control sites before initiation of future projects

Funding was provided through PR grant number F19AF00789 and windpower mitigation funds. Authors were supported by the Wildlife Programs of the Washington Department of Fish and Wildlife the Oregon Department of Fish and Wildlife.

TETRA TECH

EXHIBIT NO. 5
WITNESS J. Watson
DATE: 07/14/2023
Danielle Schemm, CCR

Memo

To: Dave Kobus, Scout Renewable Energy

From: Troy Rahmig, Tetra Tech; Erik Jansen, Western EcoSystems Technology, Inc.

Cc: Tim McMahan, Stoel Rives

Date: January 20, 2022

Subject: **The Application of Novel Ferruginous Hawk (*Buteo regalis*) Data and Recommendations for the Horse Heaven Clean Energy Center, Benton County, Washington.**

BACKGROUND

Since 2017, Scout Clean Energy (Scout) has been in the process of planning and developing the Horse Heaven Clean Energy Center (HHCEC) proposed for Benton County, Washington. As described in the Horse Heaven Wind Farm Bird and Bat Conservation Strategy, the Project has been developed to avoid, minimize, or mitigate potential effects to avian species, consistent with the U.S. Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (WEG; USFWS 2012), the USFWS Eagle Conservation Plan Guidance (USFWS 2013), the Washington Department of Fish and Wildlife (WDFW) Wind Power Guidelines (WDFW 2009), and consistent with Washington Administrative Code (WAC) 463-60-332, which outlines the standards for the assessment of habitat, vegetation, fish, and wildlife resources during the siting of energy facilities.

Consistent with the WEG, HHCEC coordinated with the USFWS and WDFW on baseline studies, survey protocols and design as well as minimization measures to reduce impacts to avian and wildlife species. HHCEC met with USFWS and WDFW in two joint consultation meetings regarding the proposed Project on September 19, 2017 and January 28, 2020. Following the January 28, 2020 meeting, WDFW provided spatial and temporal buffers surrounding ferruginous hawk (*Buteo regalis*) nests consistent with Priority Habitats and Species (PHS) management recommendations (Larsen et al. 2004). Subsequent virtual meetings with WDFW occurred on January 27, 2021 to provide Project status updates as well as a summary of the avian habitat surveys completed in 2020. On April 1, 2021 WDFW provided written comment to the Energy Facility Site Evaluation Council (EFSEC). At no time during this multi-year coordination effort did WDFW suggest that alternative analyses or buffers, other than those described by Larsen et al. (2004), be used to minimize effects to ferruginous hawk or their habitats.

Scout has been proceeding with the work on the HHCEC with EFSEC and WDFW with the understanding that avoidance and minimization measures described in PHS Management Recommendations be applied for ferruginous hawk. On December 14, 2021, Mike Ritter (WDFW) mentioned a potential restrictive area surrounding active ferruginous hawk nests (5 and 10 km radius) that may need to be implemented to protect the species based on recent agency research. However, it was not until a follow-up meeting occurred on January 06, 2022 to discuss the status of ferruginous hawk in Washington and behavioral research conducted by Jim Watson (WDFW), that WDFW explained how the research may apply to the HHCEC. Watson, a recognized raptor biologist, and co-author of the publication considered by the Washington Fish & Wildlife Commissioners to uplist the species to state endangered (Hayes and Watson 2021), provided a summary from studies conducted in southcentral Washington, 2007-2014. Watson stated 17 birds (33 home ranges) were fitted with satellite receivers to measure daily movement. Aggregated daily movements provided a measure of bird use on the landscape surrounding a single nest site during the breeding period. Based on the research, WDFW determined that an area with a 3.2 km radius surrounding the nest is considered a core use area and 10 km is considered the full home range during the nesting period in Washington.

APPLICATION OF NEW INFORMATION

In a research capacity, satellite GPS data represent the most accurate form of animal movement on the landscape available. However, Scout believes the data in its current form and potential application to HHCEC should not be considered during the State Environmental Protection Act (SEPA) analysis for the Site Certificate for the following reasons:

Informal Guidance and Unclear Application

To date, the recommended application and implementation for these data, which is yet to be published and peer reviewed, is informal. The consideration of these data has come from WDFW staff at project meetings and is not part of any published statewide guidance; the agency is in fact still developing guidance, including confirming any buffers and how they may be applied. WDFW staff made it clear during the January 06, 2022 meeting with Scout and EFSEC that the HHCEC is the first project under consideration for this new approach. It was not clear when, or if, more formal guidance from WDFW would be forthcoming. Further, the idea of using core use area and home range buffers was presented by WDFW without any specific instruction for how the buffers should or could be utilized in a SEPA analysis. The use of these data in any assessment at this time is by definition a novel exercise that has not been vetted by peers, resource agencies, regulators, or stakeholders. Guidance of this sort, which could have wide-ranging implications on renewable energy development in Washington, should be approached in a measured and thoughtful manner when formally released and broadly adopted by agencies and stakeholders.

Not Representative of Best Available Science

Per Washington Administrative Code, "best available science" means current scientific information used in the process to designate, protect, or restore critical areas that is derived from a valid scientific process following WAC 365-195-900 through 365-195-925. Indeed, expert opinion is a source of scientific information but lacks many elements inherent to a robust scientific process. The information relayed in the meeting on January 6, 2022 has not been peer reviewed and there are inconsistencies between what WDFW states and the limited information that is available. The only published source of the information is found in the periodic status assessment where Hayes and Watson (2021) state: home ranges averaged 315.9 km^2 (Brownian Bridge 95% isopleths) and 32.3 km^2 (50% isopleths) for seventeen breeding pairs in southcentral Washington and northcentral Oregon from 2007 to 2014 (J. Watson, WDFW, unpublished data). However, there is no distinction of how alternative nest territories, occupied inactive or failed nests, or historic nests are considered and, more importantly, how these data should be applied in a management context. Clearly, these discrepancies represent the preliminary nature of the data and future vetting and consideration is needed to ensure:

- The data are being implemented in a manner that is consistent with its intended purpose,

- Analyses are robust and peer-reviewed,
- Implementation of the data in a management setting are within the bounds of inference that can be made from the original data,
- Recommendations are adopted or codified in a manner that ensures the consistent application and interpretation across land use decisions in Washington.

For example, determinations of minimum habitat thresholds, resource use and selection, and land use intensity thresholds within core use areas and home ranges are beyond the inferences that can be made from data (J. Watson, WDFW, pers comm). The application of preliminary use data to create a novel analytical framework that evaluates an effect to a species is by definition not the best available science.

As stated on WDFW's website, the WAC refers to PHS in sections dealing with Critical Area Ordinances, Shoreline Master Programs, and the EFSEC. The state supreme court has held that PHS is a valid source of best available science for the Growth Management Act. Accordingly, Scout has incorporated into its project design the existing management recommendation for ferruginous hawk as described by the current published Priority Species recommendations (Larsen et al. 2004) and as instructed by WDFW during pre-application consultation meetings.

Inappropriate Timing of New Guidance

Scout has been diligently working on the HHCEC with EFSEC since 2020 and with WDFW since 2017 consistent with the WEG and the WDFW Wind Power Guidelines and is committed to implementing actions that are protective of the ferruginous hawk consistent with available data and guidance. The information presented by WDFW on January 6, 2022 was collected between 2007-2014. Data now being used to justify the proposed guidance have been available since 2014 but have not yet been published or otherwise made publicly available. Although ferruginous hawks have only recently been listed as state endangered, WDFW has had concerns for years regarding this species. Raptor nest surveys were completed annually within 2-miles of the HHCEC project boundaries from 2017 to 2019 and the presence of ferruginous hawk nest locations near the project site have been known to WDFW since 2017. If WDFW wanted this information to be considered in the SEPA analysis, then it should have raised it during pre-application consultation meetings or in the Environmental Impact Statement (EIS) scoping process, to allow for proper vetting and incorporating into project design documents. The SEPA scoping period ended in June 2021 and the EIS is expected to be completed in May 2022. Combined with the unprecedented application, inserting new information late into the planning process, particularly new requirements of this magnitude, will very likely result in costly schedule delays. The HHCEC needs to be constructed by 2024 in order to meet the anticipated interconnection date, which is responsive to regional utility plans resulting from state carbon-reduction policy initiatives.

Burden for Guideline Development

The burden for the development of new guidelines rests with WDFW. Utilization of core use area and home range buffers for ferruginous hawk may have significant implications on whether or how renewable energy projects are built in Washington State. How the buffers should be used in project planning and SEPA analyses has not been made clear by WDFW. At present, WDFW seems to be relying on EFSEC, and their consultants for the HHCEC SEPA review, to create that methodology. The implications of these buffers on renewable energy development go far beyond the HHCEC and therefore should not move forward without the ability for stakeholder involvement and thoughtful analyses. Wide-ranging precedent like this should not be set haphazardly. It should be done with careful consideration of the short- and long-term implications for Washington's renewable energy future.

PROPOSED MITIGATION APPROACH IN LIEU OF GUIDANCE

Despite the concern regarding the premature application of these buffers for this Project at this time, Scout intends to continue to implement measures to minimize impacts on ferruginous hawk, as described in the Application for Site Certification (ASC) and Habitat Mitigation Plan (Appendix L to the ASC), and develop compensatory habitat mitigation to offset any potential remaining impacts to ferruginous hawk once minimization measures have been implemented (Larsen et al. 2004). Scout has worked with WDFW and EFSEC since 2017 to characterize the potential for ferruginous hawk, and other raptors, to occur in or near the project area and tailored minimization and mitigation measures specifically to minimize and mitigate impacts to ferruginous hawk. In addition to providing mitigation to meet the tenets discussed in the WDFW 2009 Wind Power Guidelines and related administrative codes, Scout intends to identify a mitigation approach that meaningfully contributes to the conservation of suitable foraging and nesting habitat, which are identified as conservation priorities (Hayes and Watson 2021). Scout is committed to providing habitat mitigation consistent with the mitigation ratios presented in the Habitat Mitigation Plan (HMP), which include shrub-steppe and grassland habitat, both of which provide suitable habitat for ferruginous hawk. When finalizing a mitigation approach, Scout will consider areas of high prey concentration as mapped by Washington Wildlife Habitat Connectivity Working Group and locations within core use areas or home ranges for ferruginous hawk, such that the final mitigation solution provides conservation value relative to the potential impacts the project may have. This general strategy is consistent with the approach that was discussed in the HMP submitted with the ASC (Appendix L), yet broadens the criteria to include species-specific characteristics that would benefit ferruginous hawk.

RECOMMENDED FERRUGINOUS HAWK ASSESSMENT METHOD

Scout has been working in coordination with WDFW since 2017 and has followed the USFWS Land-Based Wind Energy Guidelines, the USFWS Eagle Conservation Plan Guidance, the WDFW Wind Power Guidelines and had been proceeding with the work on the HHCEC with the understanding that the avoidance, minimization and mitigation measures for the ferruginous hawk were consistent with WAC 463-60-332 and WAC 365-195-900 through 365-195-925. However, in light of WDFW's recent discussions regarding its informal guidance, Scout proposes to implement additional conservation measures utilizing the following approach which will provide context for land cover types surrounding a nest and potential benefits from mitigation activities, when occupied[1] ferruginous hawk nests are observed near project-related infrastructure.

In order to confirm that the mitigation approach meaningfully contributes to the conservation of ferruginous hawk, and potential impacts to ferruginous hawk from the project are adequately offset, the following assessment process is proposed. This assessment process will be incorporated in the HMP and utilized when selecting the location of the final mitigation approach (i.e., placement of a conservation easement or contribution to relevant conservation efforts).

General Assessment Steps

1. An assessment will be conducted for all occupied[1] nests in the PHS database within 10 km of the project boundary. If recent information about the status of a nest within 10 km is not known it will be considered occupied, unless data is available to state otherwise.
2. Within the 3.2 km and 10 km buffers of the occupied nests identified in #1, the following information will be assessed and summarized to the extent possible. Additional information that is relevant to ferruginous hawk ecology will be included as available.
    a. Acres and percent of buffer that is suitable habitat for ferruginous hawk (as defined in Management Recommendations for Washington's Priority Species – Volume IV: Birds [Larsen et al. 2004]).
    b. Acres and percent of buffer that is comprised of habitat concentrations for prey species.
    c. Acres and percent of buffer that is comprised of human altered habitat (e.g., urban, paved roads, industrial, vineyards or other intensive agriculture that would not provide suitable habitat for ferruginous hawk).
3. Utilizing the data from #2 the estimated impacts from the project due to habitat loss or alteration will be considered within the context of resources available to ferruginous hawk within the core use area and home range, allowing for a statement of relative impact that the project may have on a nest location.
4. Similarly, using the data from #2, the potential benefits of any proposed mitigation approach will be considered. For example, if a proposed mitigation area is located within a known ferruginous hawk core use area or home range, the resources (as noted in #2) within the mitigation area will be evaluated relative to the needs of ferruginous hawk. These available resources will then be assessed in context with impacts estimated at the project site, and the relation of those impacts to ferruginous hawk ecology. The mitigation approach will offset project effects within core use areas and home ranges for known nest locations.

[1] Larsen et al. (2004) uses the term occupied nest but does not provide a definition. Recommend reference to USFWS 2013 for definitions and determination of nest status.

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State of Washington
DEPARTMENT OF FISH AND WILDLIFE
Pasco District Office, Habitat Program • 2620 North Commercial Avenue, Pasco, WA 99301

January 11, 2022

Patricia Betts
Washington Energy Facility Site Evaluation Council
621 Woodland Square Loop SE
PO Box 43172
Olympia, WA 98504-3172

Subject: Ferruginous Hawk

Due to the recent discussions we (EFSEC, Golder, Scout, West, and WDFW) have had regarding ferruginous hawk (FEHA) nests, buffers, core areas, zones of influence, etc., we thought we should make a formal comment on the November 23, 2021, Memo from Erik Jansen (West, Inc.) to Dave Kobus (Scout) entitled *WDFW Data Request for Ferruginous Hawk Nests and Distances to Project Infrastructure Received from the Washington Energy Facility Site Evaluation Council on November 18, 2021.*

1. WDFW is using the best available science regarding core areas and home ranges of FEHA as the basis for our analysis and recommendations. Presently, WDFW is in the process of updating management recommendations for FEHA in PHS.

2. The memo uses outdated WDFW PHS recommendations from 2005 that were not meant to address energy development and are from a time when the species was not listed as endangered.

3. The only FEHA nests of importance based on the memo were those observed from 2017-19 by WEST. In contrast, WDFW considers the relevance of all historical FEHA nest (territory) locations as relevant for management to provide known historical habitat for recovery and to meet recovery goals.

4. WEST used a 2-mile buffer based on USFWS rules for surveys but WDFW is basing potential needs on home ranges and core areas from regional FEHA data.

5. WEST uses "nests" as the point of management whereas we manage on the basis of territory (i.e., breeding pair) and consider the relevance and relationship of multiple nests on the territory.

6. The focus on distance of the nest to turbines is important for assessing probability of turbine strikes but is not the only issue related to development that will affect FEHA. As we have seen with the other turbine/raptor study, long-term declines in occupancy after the initial birds are gone declines for FEHA, and eagles, at least in part related to increase in ravens, red-tails, great-

horned owls, and Swainson's hawks. These species kill or displace FEHA from nests. Secondarily, reductions in prey (ground squirrels) likely also play into long-term occupancy for FEHA.

7. Our approach is using what the birds need as the basis for "mitigation" (i.e., core area and home range buffers) RATHER THAN what we can remove or impact within that area before they are affected. These are two different approaches – the former approach addresses all these effects cumulatively for an endangered species – the later approach is a piece-meal plan of what might affect the birds potentially with a lot more uncertainty and increased risk.

Please contact me at 509-380-3028 or at Michael.Ritter@dfw.wa.gov with any questions.

Sincerely,

Michael Ritter

Michael Ritter
Area Habitat Biologist
Statewide Technical Lead: Wind and Solar

Population Viability Analysis of Ferruginous Hawk (*Buteo regalis*) in Eastern Washington

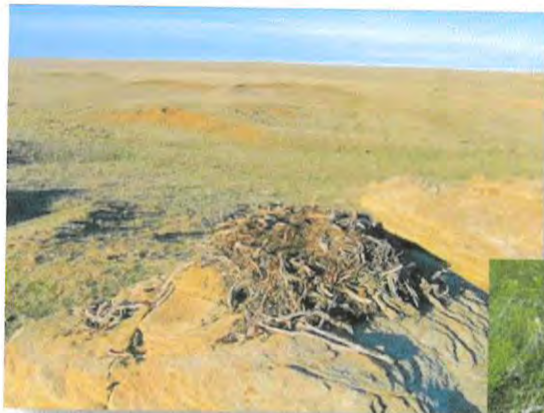

EXHIBIT NO. 7
WITNESS J. Watson
DATE: 07/14/2023
Danielle Schemm, CCR

Prepared for:

Horse Heaven Wind Farm, LLC
5775 Flatiron Parkway, Suite 120
Boulder, Colorado 80301

Prepared by:

Erik W. Jansen and Jared K. Swenson

Western EcoSystems Technology, Inc.
2725 Northwest Walnut Blvd.
Corvallis, Oregon 97330

November 14, 2022

WEST

EXECUTIVE SUMMARY

Horse Heaven Wind Farm, LLC (Horse Heaven) is proposing development of the Horse Heaven Clean Energy Center (Project) in Benton County, Washington. The breeding range of the state-endangered ferruginous hawk (*Buteo regalis*) overlaps the Project. Although the Washington nesting population size has historically been low compared to populations in surrounding states, the decline in the Washington breeding population over the past half century was a factor considered in the recent decision to uplist the species to state endangered. Due to the species vulnerability to the effects of wind energy development, Western EcoSystems Technology, Inc. (WEST) analyzed how ferruginous hawk populations might be impacted by hypothetical impact scenarios and how the population might respond to potential mitigation measures.

We used a population viability analysis (PVA) to model projected outcomes and sensitivities to various levels of impacts from wind energy development and proposed mitigation measures. Our study objectives were to: 1) use a stochastic growth model to generate a baseline population growth rate based on published vital rates, 2) simulate how biologically realistic levels of direct and indirect effects influence nesting population trends, 3) identify sensitive life-history stages to guide future conservation management actions, and 4) simulate how conservation efforts from the construction and use of artificial nest platforms (nest platforms) might affect population trends.

Using a range of scenarios, ferruginous hawk PVA simulations resulted in the following key points:

- Declining baseline population growth rates (λ) of 0.97 reduced the number of occupied nesting territories (territory) by 49% from 47 to 24 nesting territories over a 30-year period.
- The low levels of direct effects simulating loss of six adults over 30 years due to wind energy reduced the number of nesting territories by 50% over a 30-year period; however, indirect effects from the loss of one territory resulted in a 57% a reduction in nesting territories. Thus, population trajectories showed a comparatively greater response to the loss of nesting territories than collisions (the loss of individual birds). Combined, these scenarios magnified the effects on population trend, depending on the intensity of the effect.
- The average number of nesting territories were largely unaffected by variable survival rates of adults and juveniles.
- Construction of artificial nest platforms in suitable areas lacking natural nest substrates can effectively maintain or increase nesting territory occupancy. Assuming an average annual occupancy rate of 36%, increases of three to 10 nesting territories can positively affect ferruginous hawk population trends.

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Cover Page: Unoccupied ferruginous hawk nest in the shrub-steppe grasslands of the Big Horn Basin, Montana, June 2005; ferruginous hawk nestlings adjacent to a coal bed methane gas pad in the Powder River Basin, Wyoming, June 2005. This Page: Adult ferruginous hawk on an electric power pole in the Llano Estacado Plateau, Texas, February 2013. All photographs by E. Jansen

STUDY PARTICIPANTS

Erik Jansen	Project Manager
Jared Swenson	Statistician
Leigh Ann Starcevich, PhD	Statistical Review
Karl Kosciuch, PhD	Report Review
Joel Thompson	Report Review
Eric Hallingstad	Report Review
Andrea Palochak	Technical Editor

REPORT REFERENCE

Jansen, E. W., and J. K. Swenson. 2022. Population Viability Analysis of Ferruginous Hawk (*Buteo regalis*) in Eastern Washington. Prepared for Horse Heaven Wind Farm, LLC, Boulder Colorado. Prepared by Western EcoSystems Technology, Inc. (WEST), Corvallis, Oregon. November 14, 2022. 20 pages + appendix.

1 INTRODUCTION

Horse Heaven Wind Farm, LLC (Horse Heaven) is proposing development of the Horse Heaven Clean Energy Center (Project) in Benton County, Washington. The breeding range of the state-endangered ferruginous hawk (*Buteo regalis*) overlaps the Project and historical nests are located within 2.0 miles (mi; 3.2 kilometers [km]) of Project facilities. Decline in the Washington breeding population over the past half-century was a factor considered in the recent decision to uplist the species to state endangered. Mortality from turbine collisions and reduced territory occupancy resulting from wind energy development both have the potential to affect population trends, particularly in populations with few individuals (Squires et al. 2020, Diffendorfer et al. 2021, Watson et al. 2021). Due to the species vulnerability to the effects of wind energy development, Western EcoSystems Technology, Inc. (WEST) analyzed how ferruginous hawk populations might be impacted by hypothetical impact scenarios and how the population might respond to potential mitigation measures.

We used a population viability analysis (PVA) that incorporated ferruginous hawk population demographics to model projected outcomes and sensitivities to various levels of Project impacts and proposed mitigation measures (Reed et al. 2002, Saeher and Engen 2002). PVA models have been used in a wide variety of applications to model extinction probabilities, identify sensitivities in demographic or genetic parameters, or simulate the outcome of different management scenarios (Beissinger and McCullough 2002). Specifically for ferruginous hawk, PVA models have been used to examine how changes in demographic vital rate parameters affect population growth in US Forest Service Region 2 (Collins and Reynolds 2005), and to simulate how collisions with wind turbines could affect population growth rates throughout the species' range in the US (Diffendorfer et al. 2021). In this study, our overall objective was to compare effects of management actions and vital rate sensitivities following Reed et al. (2002), who provided guidance on the application of demographic matrix models. This study does not attempt to predict the probability of extinction due to the small population size (e.g., < 200 individuals) and uncertainty of survival rates and long-term territory occupancy in Washington. To our knowledge, this is the first PVA of ferruginous hawk in Washington applied to a proposed wind energy development scenario.

We considered a range of model scenarios to account for uncertainty in demographic vital rates, direct and indirect effects, conservation efforts, and how Project impacts could affect the population. We used vital rate parameters (e.g., survival, nesting success) typically used in population modeling to determine how direct effects (wind turbine mortality), indirect effects (nest occupancy), and conservation effects (artificial nest platforms) influenced population trends. Specifically, our study objectives were to: 1) use a stochastic growth model to generate a baseline population growth rate based on published vital rates, 2) simulate how biologically realistic levels of direct and indirect effects influence nesting population trends, 3) identify sensitive life-history stages to guide future conservation management actions, and 4) simulate how conservation efforts from the construction and use of artificial nest platforms affected nesting population trends.

Ritter-01696

2 ANALYSIS AREA

The Analysis Area consisted of two areas. We considered a Study Area that included the entire breeding range of the ferruginous hawk in Washington; and a comparatively smaller Project Area where wind energy development is proposed and potential Project impacts to the population were evaluated.

2.1 Study Area

The Study Area occurs in the Level III Columbia Plateau Ecoregion (CPE) in eastern Washington (Clarke and Bryce 1997). The CPE includes the shrub-steppe and grassland nesting habitat that encompasses the northwestern extent of ferruginous hawk nesting in the US. As part of the larger Great Basin Bird Conservation Region (BCR 9), approximately 74% of the CPE is located within Washington (Bird Studies Canada and US North American Bird Conservation Initiative 2014). We used the CPE in Washington as the Study Area because its inclusion of suitable nesting habitat, including all publicly available records of ferruginous hawk nests in Washington, as well as it being a focal area for renewable energy development in the region (Hayes and Watson 2021, Washington Department of Fish and Wildlife [WDFW] 2021, Renewable Northwest 2022).

8VLQJ %UHHGLQJ %LUG 6XUYH\ %%6 GDWD FROOHFWHG IURP í 3DUWQHUV LQ)OLJKW estimated 130 ferruginous hawk (95% confidence intervals [CI]: 0–370) within the Washington portion of the Great Basin BCR. Population trends corresponded with -1.59% annual change &, í LQ :DVKLQJWRQ EDVHG RQ %%6 GDWD í 6DXHUHWDO 7KH last WDFW statewide-population surveys conducted in 2016 documented 32 breeding pairs and 47 occupied nests at 263 known territories (Hayes and Watson 2021).

2.2 Project Area

The Project Area consisted of a 113 mi^2 (293 km^2) Project Lease Boundary, of which approximately 35 mi^2 (91 km^2; 31%) consists of micrositing corridors[1] where 244 wind turbines, three areas of solar array and related infrastructure are proposed in a maximum build scenario (Horse Heaven Wind Farm, LLC 2021). The Project Area is located adjacent to the Tri-cities urban areas of Kennewick, Richland, and Pasco. The majority of native land cover (e.g., shrub-steppe and grassland) within and surrounding the Project Area has been converted to dryland and irrigated wheat (*Triticum aestivum*) cropland (Horse Heaven Wind Farm, LLC 2021). Portions of the 63-wind turbine generator Nine Canyon Wind Project were located within or adjacent to the Project Area.

Historical ferruginous hawk nest sites occurred within 2.0 mi of the proposed infrastructure, primarily at a relatively broad ridge along the northern perimeter of the Project Area. Four years of surveys during the nesting season resulted in low historical nest occupancy[2]. Nest surveys conducted for the Project during 2017–2019 and 2022 resulted in two occupied nests, one of

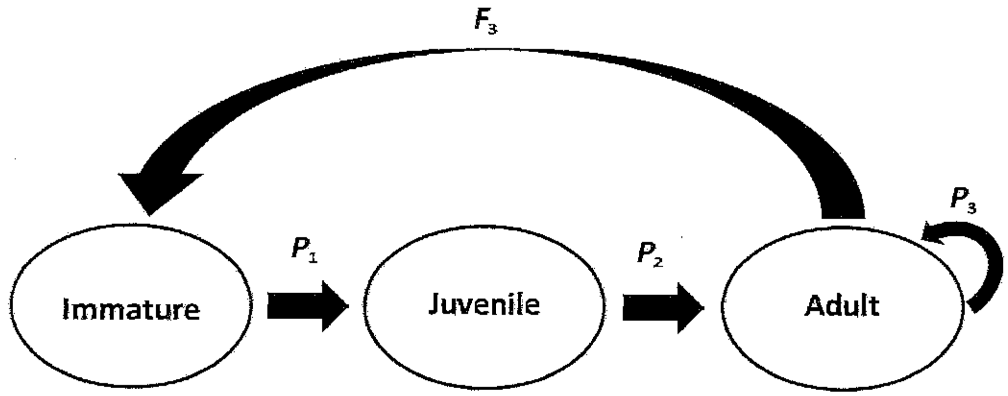
[1] Micositing corridors consisted of an 18.5 mi^2 (47.9 km^2) Wind Energy Micrositing Corridor and 16.8 mi^2 (43.5 km^2) of a Solar Siting Area (Horse Heaven Wind Farm, LLC 2021).

[2] As defined by Steenhof and Newton 2007 and USFWS 2013

which had an adult incubating during the 2017–2019 nesting seasons and the other nesting attempt was abandoned in 2017, and then was gone in subsequent nesting seasons (Jansen 2022).

3 METHODS

In this study, we used a 3-stage population projection matrix with three life history stages to estimate population growth rate (λ) and simulate population trends under potential model scenarios (Figure 1). The three life history stages followed Lande (1988) and incorporated a 1-year projection interval.



$$\begin{pmatrix} 0 & 0 & F_3 \\ P_1 & 0 & 0 \\ 0 & P_2 & P_3 \end{pmatrix}$$

Figure 1. Life cycle diagram and corresponding structure of the 3×3 projection matrix used in the ferruginous hawk population trend analysis in Washington. The probability (*P*) of survival from each stage to the next stage is represented by the subscript value. Fecundity (*F*) demonstrates biological productivity from adults back into the immature stage.

The first stage, immature, included individuals that survived from fledgling to dispersal, the second stage represented non-reproductive juveniles, and the third stage represented reproductively mature adults (Lande et al. 1988). Ferruginous hawk reach reproductive maturity between the ages of two and three (Wheeler 2003, Ng et al. 2020); thus, the projection matrix assumed reproduction after year two and continues indefinitely as birds age. Natural mortality due to age was implicit in the adult survival parameter. We selected vital rates for each parameter from published literature (Table 1). Because of the geographically constrained breeding population in southeast Washington, we attempted to keep all parameter values as local as possible to avoid introducing regional or national vital rates that may not reflect the condition of the breeding population.

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Baseline adult fecundity estimates were based on 38 years (1978–2016) of nesting and reproductive success data in Washington (Table 2; Hayes and Watson 2021). The adult fecundity parameter (*F*) was calculated by taking the average number of successful nestlings per pair (2.4) and multiplying it by the average proportion of known successful nests (0.81), the proportion of breeding pairs contributing to the breeding pool (0.68), and 0.5 to account for sex ratios in the adult breeding population (Table 1). Baseline survival estimates were taken from the literature directly for immature (Watson et al. 2019), juvenile (Collins and Reynolds 2005), and adult life stages (Table 1; Watson and Pierce 2003). We assumed 47 initial occupied nesting territories (nesting territories or territories) based on the 2016 reporting (Hayes and Watson 2021).

Table 1. Baseline vital rate parameter values for ferruginous hawk in Washington.

Life Stage	Parameter	Value	Source(s)
Immature	Fecundity	0.00	Wheeler 2003, Ng et al. 2020
	Survival	0.62[a]	Watson et al. 2019[b]
Juvenile	Fecundity	0.00	Wheeler 2003, Ng et al. 2020
	Survival (Dispersal to Year 2)	0.43	Collins and Reynolds 2005
Adult	Average Number of Nestlings	2.40	Hayes and Watson 2021
	Average Nest Success Rate	0.81	Hayes and Watson 2021
	Occupied Nesting Territories	0.68	Hayes and Watson 2021
	Fecundity	0.66[c]	Hayes and Watson 2021
	Survival	0.76	Watson and Pierce 2003
	Baseline # Occupied Nests (2016)	47	Hayes and Watson 2021
	Baseline # Breeding Pairs (2016)	32	Hayes and Watson 2021
	Average # Breeding Pairs (1978–2016)	54	Hayes and Watson 2021

[a] Range-wide estimate was used as it is more conservative than the Montana survival estimate of 0.86 (Zelenak et al. 1997)

[b] As reported in Hayes and Watson 2021

[c] Calculated from table 2 from Hayes and Watson 2021 (2.4 nestlings per nest × 0.81 success rate × 0.68 proportion breeding × 0.5 females)

We generated a 3×3 projection matrix from vital rate parameters to calculate baseline values for growth rate (λ) using eigenanalysis to identify the dominant eigenvalue following Caswell (2001) and Stevens (2009). Additionally, the stable stage distribution (Table 2), elasticity, and sensitivity (Table 3) were calculated following Stevens (2009). We used the proportions from the stable stage distribution to calculate the initial abundance for each age class based on the 47 nesting territories observed in 2016 (Hayes and Watson 2021). We calculated sensitivity and elasticity of the projection matrices to determine how λ varied by the transitions between life stages. Sensitivity represented the effect a small change to the projection matrix would have on λ for each transition stage (i.e. immature to juvenile, juvenile to adult, adult mortality, or births). Elasticity represented the relative magnitude of effect that each transition has on λ.

Table 2. Proportions and initial abundances of ferruginous hawk based on the stable-stage distribution calculated from the projection matrix, according to Caswell (2001).

Parameter	Immature	Juvenile	Adult
Proportion	0.32	0.21	0.47
Initial Abundance[a]	32	21	47

[a] adult column represents the number of occupied nesting territories

Table 3. Sensitivity and elasticity during life-stage transitions from eigenanalysis of the projection matrix.

Parameter	Immature to Juvenile	Juvenile to Adult	Adult Mortality	Births
Sensitivity	0.27	0.39	0.67	0.17
Elasticity	0.12	0.12	0.36	0.12

3.1 Population Growth Model

This PVA incorporated demographic stochasticity to reflect the variation in vital rates caused by dynamics inherent to small populations, such as ferruginous hawk in Washington. Demographic stochasticity can have large impacts on population size estimates and are important to model for reliable population projections (Saeher and Engen 2002). Demographic stochasticity incorporated the fluctuating random probabilities that affect nest productivity, which included nest success, nest occupancy, and number of nestlings. To incorporate demographic stochasticity, we allowed all vital rates in the baseline projection matrix to vary from year to year. Vital rate variation was based on random sampling from a normal distribution based on the mean (μ) and standard deviation (σ). The σ for average nest success ($\mu = 0.81$, $\sigma = 0.138$) and average number of nestlings ($\mu = 2.4$, $\sigma = 0.446$) were calculated from Hayes and Watson (2021). Nest occupancy and survival rates lacked published σ, therefore, a σ of 0.1 was used for these parameters to reflect a high level of uncertainty. Vital rates from the normal distribution were restricted so reasonable biological levels (within σ) were not exceeded. The model assumes that the net influence of immigration or emigration was zero.

Although we do not explicitly incorporate environmental stochasticity into the PVA, we acknowledge the effect of extrinsic environmental factors on ferruginous hawk nesting populations. Annual fluctuations in climate (e.g., temperature, precipitation), habitat quality (e.g., prey availability), and catastrophic events (e.g., wildfire, disease) can all affect ferruginous hawk populations and the underlying vital rates (Wallace et al. 2016a, Shoemaker et al. 2019, Squires et al. 2021). For example, annual fluctuations in the spatial and temporal variability of prey abundance affects age-specific survival rates (Collins and Reynolds 2005, Hayes and Watson 2021). Environmental stochasticity was not directly modeled in this effort; however, the variation in occupancy and nestling counts from Hayes and Watson (2021) from 1978–2016 enabled us to vary fecundity in our model in a way that likely reflects the inherent environmental fluctuations that could impact this population.

3.2 Model Scenarios

Population models were simulated over 30 years based on the anticipated life expectancy of the Project. The average population sizes and λ were calculated across 10,000 model iterations for each model scenario. First, we modeled a baseline population trend for all model scenarios using the vital rates in the projection matrix, no annual take, and the initial abundance established from the stable stage distribution (Figure 2). To compare the mean baseline population trend with historical occupancy data, we graphed historical counts of occupied territories, occupied territories with known breeding outcomes, and successful territories reported in Hayes and Watson (2021) against the predicted territory occupancy trend (Figure 3). Historical occupancy data were unadjusted for inter-annual survey effort and survey areas, which were unavailable. The mean λ and final population sizes from the 10,000 iterations are reported with 90% CIs (Appendix A).

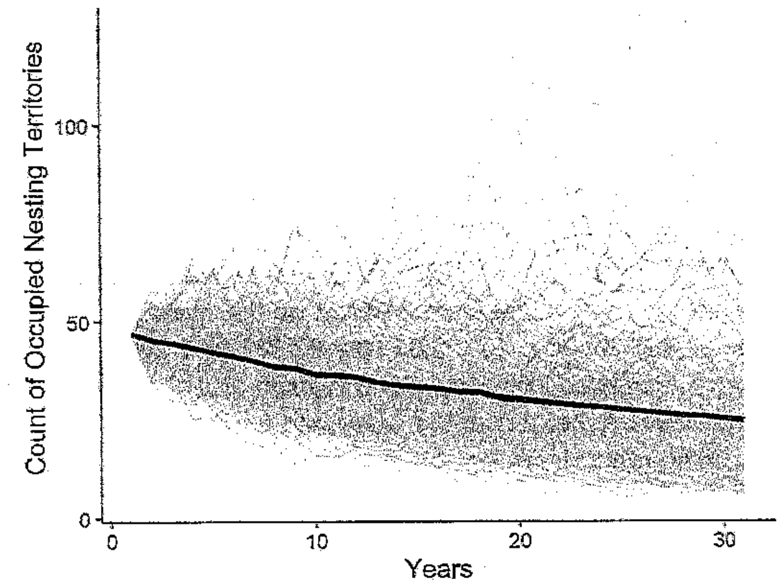

Figure 2. Baseline 30-year predicted trend for occupied nesting territories based on the projection matrix values derived from the literature. Each grey line represents one of the first 300 of 10,000 iterations to visualize variability.

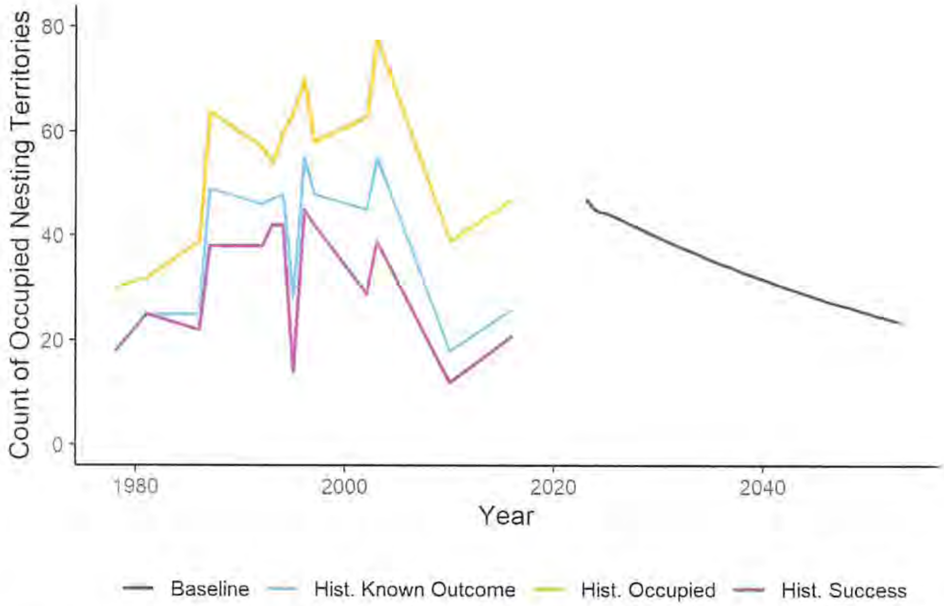

Figure 3. Comparison of historical occupied nesting territories, with the mean baseline predicted trend of occupied nesting territories from 10,000 iterations.

Direct and indirect effects were modeled separately and together to illustrate the relative effect on the population. We report decimals of territories instead of whole numbers to better illustrate the variation in the model results. Population benefits resulting from the construction and use of artificial nest platforms used the combined effects to simulate the biological response of increased nesting success. To simulate the effects on population trends from Project impacts and conservation efforts, we modeled the following scenarios:

- Direct effect from wind turbine collision considering low-, medium-, and high-effect scenarios (defined below);
- Indirect effect from loss of available nesting territories considering removal of one, two, or three territories;
- Direct and indirect effects from Project operations considering a combination of effects; and
- Artificial nest platform construction and use considering variable occupancy levels.

3.2.1 Direct Effect Scenario

We simulated population trends that reflected variable levels of mortality from turbine collision to provide a range of possible population effects. We used fatality counts from publicly available post-construction fatality monitoring (PCFM) studies at multiple spatial scales to develop a biologically realistic range of mortality scenarios. Count data was used because many of the fatalities were found outside of standardized PCFM when the estimation process was not possible, species-specific fatality estimates were unavailable, or study designs lacked rigor in one or more areas. Because of the discrepancies, count data provided a larger sample size of studies conducted within a particular region and was used to standardize the enumeration of ferruginous hawk fatalities across regions. Fatality count data were unadjusted for searcher efficiency or carcass persistence; thus, the range of fatalities should be considered a conservative estimate within each region. We quantified the number of fatalities documented during PCFM in the US, the CPE, and Washington (Table 4).

- Within the US, there were 40 ferruginous hawk fatalities reported from 20 operational wind facilities, 1996–2021 (WEST 2022).
- Within the CPE, there were eight ferruginous hawk fatalities reported from six operational wind facilities, 1999–2020 (WEST 2022).
- Within Washington, there were four ferruginous hawk fatalities reported from two operational wind facilities, 1999–2020 (WEST 2022).

Table 4. Regional ferruginous hawk fatalities recorded during post-construction fatality monitoring studies at operational wind energy facilities, 1996–2021.

		Fatality Age Group			Total	Fatality
Region	**# Years**	**Adult**	**Juvenile**	**Unknown**	**Fatalities**	**Rate[a]**
United States	25	9	6	25	40	1.60
Columbia Plateau Ecoregion	21	5	1	2	8	0.38
Washington	21	3	1	0	4	0.19

[a] calculated as Total Fatalities ÷ # Years

To derive a range of fatality rates used to estimate direct effects, we used region-specific ferruginous hawk PCFM data divided by the total number of years of PCFM data available in the region to calculate a fatality rate, multiplied by 30 years, and rounded up to the nearest whole bird. The range of direct effect estimates were classified into three levels: low, intermediate and high. We used fatality rates from the CPE and Washington to calculate a high (12 fatalities/ 30 years) and low (six fatalities/30 years) level, respectively, and split the difference between estimates for the intermediate (nine fatalities/30 years) level. The US fatality rate was not used because it would exceed the entire size of the CPE breeding population.

Direct effects on ferruginous hawk populations were predicted by varying age specific survival in the projection matrix for low, intermediate, and high levels of fatalities. Because Hayes and Watson (2021) suggested a bottleneck exists for earlier life history stages, we implemented direct effects in age specific patterns. In one set of models, predicted fatalities were applied to just adults, whereas in another set of models, fatalities were split evenly between adult and juvenile age classes.

3.2.2 Indirect Effect Scenario

Indirect effect scenarios were evaluated by varying the fecundity parameter in the projection matrix to reflect biologically realistic reductions of nesting territories. The three scenarios reflect a permanent removal of one, two, or three nesting territories across the 30-year period. Removal of a nesting territory may result from the permanent abandonment due to disturbance or displacement or from land conversion to unsuitable habitat types that may cause territory loss.

3.2.3 Combined Direct and Indirect Effects Scenario

We simulated the combined impacts of direct and indirect effects by incorporating both into the models.

3.2.4 Artificial Nest Platform Scenario

Artificial nest platforms have been demonstrated as an effective mitigation and habitat-enhancement tool that provide supplemental nesting substrates in areas where nests have been destroyed or substrates were not available (Tigner et al. 1996, Wallace et al. 2016b). Artificial nest platform scenarios were incorporated into the modeling to determine population responses from the use of artificial nest platforms. These scenarios assume that direct and indirect effects occur as described above, but incorporate an increase in fecundity from artificial nest platform use and resulting nesting success. For an artificial nest platform to be successful in this scenario, it must be additive to the breeding population and increase breeding success, and not result in relocation of a presumably successful breeding pair to an artificial nest platform.

To determine anticipated platform occupancy for each scenario, we calculated the average annual artificial nest platform occupancy from a review of nine studies over 53 study years in the US and Canada, 1976–2019 (Table 5). Nest occupancy varied widely in the studies that cumulatively surveyed 1,155 nests with an average annual occupancy of 36% ± 24% (Table 5). We used this average annual occupancy value to model possible effects from the addition of three, seven, and 10 artificial nest platforms within the CPE.

Table 5. Annual ferruginous hawk nest occupancy of artificial nest platforms (ANP)

Survey Year	# ANP	# ANP Occupied	% Occupied	Location	Reference
1976-2004[a]	105	64	61	Wyoming, US	Neal 2007
1976	97	2	2	Alberta, Canada	Schmutz et al. 1984
1977	98	4	4	Alberta, Canada	Schmutz et al. 1984
1981	81	11	14	Alberta, Canada	Schmutz et al. 1984
1982	81	12	15	Alberta, Canada	Schmutz et al. 1984
1983	78	11	14	Alberta, Canada	Schmutz et al. 1984
1988	25	11	44	Wyoming, US	Tigner et al. 1996
1989	54	34	63	Wyoming, US	Tigner et al. 1996
1990	61	33	54	Wyoming, US	Tigner et al. 1996
1991	65	41	63	Wyoming, US	Tigner et al. 1996
1992	71	37	52	Wyoming, US	Tigner et al. 1996
1993	71	29	41	Wyoming, US	Tigner et al. 1996
2009	130	45	35	Alberta, Canada	Migaj et al. 2011
2013[b]	27	18	67	Wyoming, US	Wallace et al. 2016
2016	2	1	50	Alberta, Canada	Kemper et al. 2020
2017	3	2	67	Alberta, Canada	Kemper et al. 2020
2017-2018[c]	57	5	9	Utah, US	Hopkins 2019
2018	2	0	0	Alberta, Canada	Kemper et al. 2020
2019	2	1	50	Alberta, Canada	Kemper et al. 2020
2019	16	6	38	Alberta, Canada	Parayko et al. 2021
2019[d]	29	2	7	Washington, US	Hayes and Watson 2021
Total	**1155**	**369**	**32[e]**		
Mean	**55**	**18**	**36**		
St.Dev.	**38**	**18**	**24**		

[a] Annual occupancy ranged from 52.1–69.7% - median (60.9%) calculated for simplicity
[b] Re-occupancy = 0.66 (95% confidence interval = 0.10–0.97)
[c] 32 ANP in low predicted nesting likelihood, 25 ANP in medium to high
[d] Undetermined level of survey effort, construction and survey occurred same year
[e] Total # ANP occupied ÷ Total # ANP surveyed: 369 ÷ 1,155 = 32% overall

4 RESULTS

Based on eigenanalysis of the projection matrix, adult mortality was affected disproportionally more than other life stages by small shifts in vital rates with a value of 0.67 (Table 3). Fecundity or births demonstrated the lowest sensitivity (0.12) compared to other life stages; however, our effect scenarios did not reflect this pattern which showed more stable patterns when vital rates varied between age classes and fecundity.

The baseline scenario revealed that occupied nest outcomes can vary widely (Figure 2), likely due to the small population size and uncertainty in vital rates. However, even with this uncertainty the 90% CI for the average Obf 0.9776 (90% CI: 0.9774−0.9779) and the mean number of nesting territories after 30-years, 23.52 (90% CI: 23.31−23.74) resulted in narrow CI across all 10,000 iterations (Appendix A). Mean Ofor the baseline scenario was an annual population decline of 2.2% (Appendix A).Effect scenarios are discussed in further detail, below.

4.1 Direct Effect Scenario

The low direct effect scenario simulating six adults over 30 years resulted in 52% fewer nesting territories (22.71; 90% CI: 22.5–22.93), than the starting number of territories (47). The difference in nesting territories between the low direct effect scenario and the baseline was 3.5% (difference of one nest), indicating a similar outcome after 30 years. Mean λ for the low direct effect scenario was 0.9764 (90% CI: 0.9761–0.9767), resulting in an average 2.4% annual population decline.

Low juvenile survival that reduced the number of birds reaching reproductive age has been suggested as a mortality bottleneck affecting population growth (Hayes and Watson 2021). However, our simulations did not result in a more rapid population decline when mortality rates were split evenly between adults and juveniles (Figure 4). Direct effect models focusing on only adult fatalities resulted in a range of 19.05–22.71 nesting territories after 30 years, whereas models that split fatalities between adult and juvenile age classes resulted in approximately one fewer nesting territories after 30 years (18.26–21.41 territories; Appendix A).

4.2 Indirect Effect Scenario

The removal of nesting territories resulted in more substantial declines in nesting territories (Figure 5) compared to variability in adult or juvenile survival (Figure 4). Reduction of one to three territories resulted in 19.34 to 12.73 (of 47) nesting territories remaining after 30 years, whereas low to high fatality rates (direct effects) resulted in 22.71 to 19.05 nesting territories. Compared to the baseline, removing one nesting territory across all years resulted in a 59% decline (from 47 to 19.34 territories [90% CI: 19.16–19.51]) in nesting territories after 30 years, and λ of 0.9708 (90% CI: 0.9705–0.971; Appendix A). Removal of three nesting territories decreased the predicted number of nesting territories nearly 73% from a starting baseline of 47 nesting territories to 12.73 territories after 30 years.

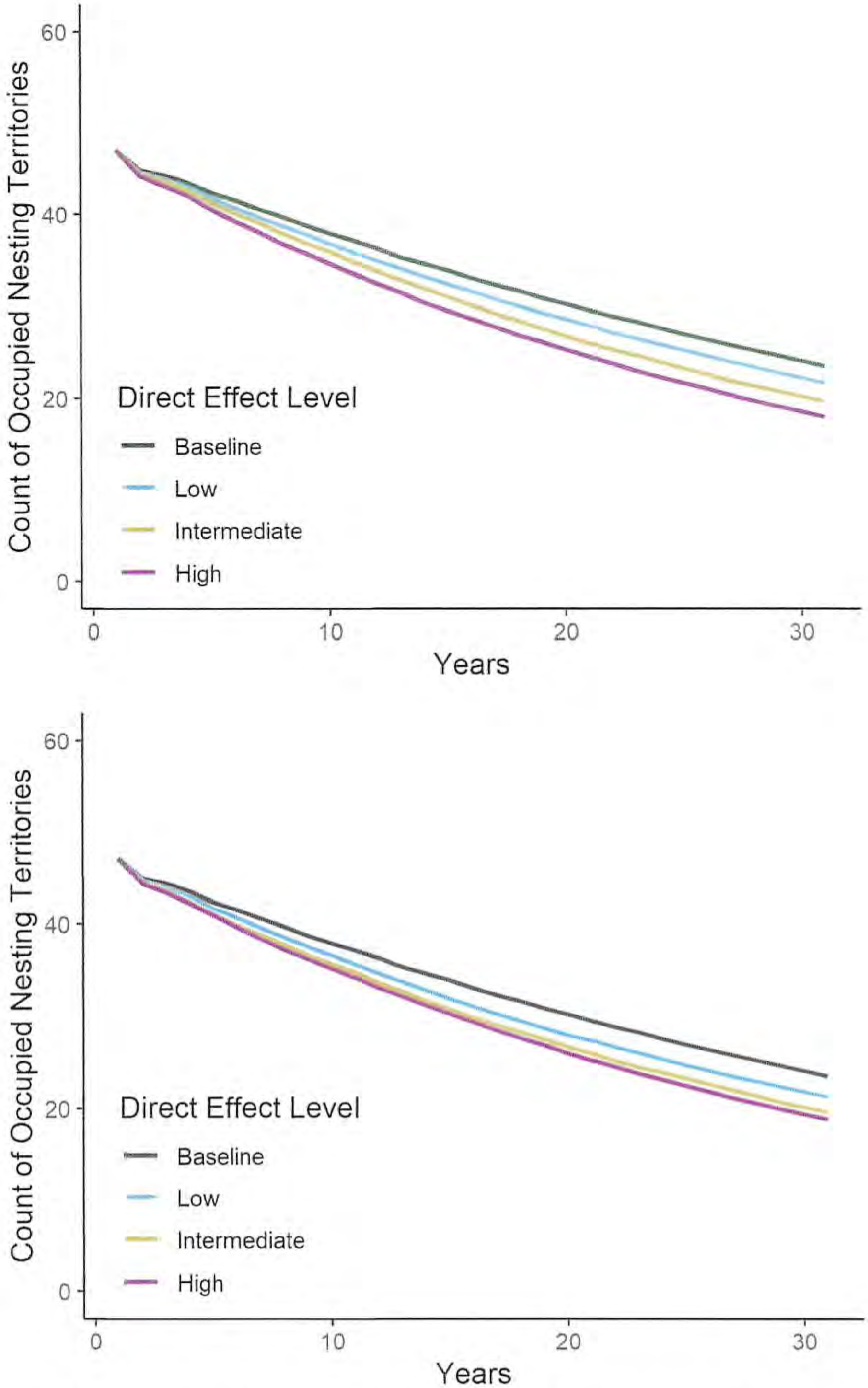

Figure 4. Predicted trend of occupied nesting territories accounting for direct effects to adults (top) and split evenly amongst adults and juveniles (bottom).

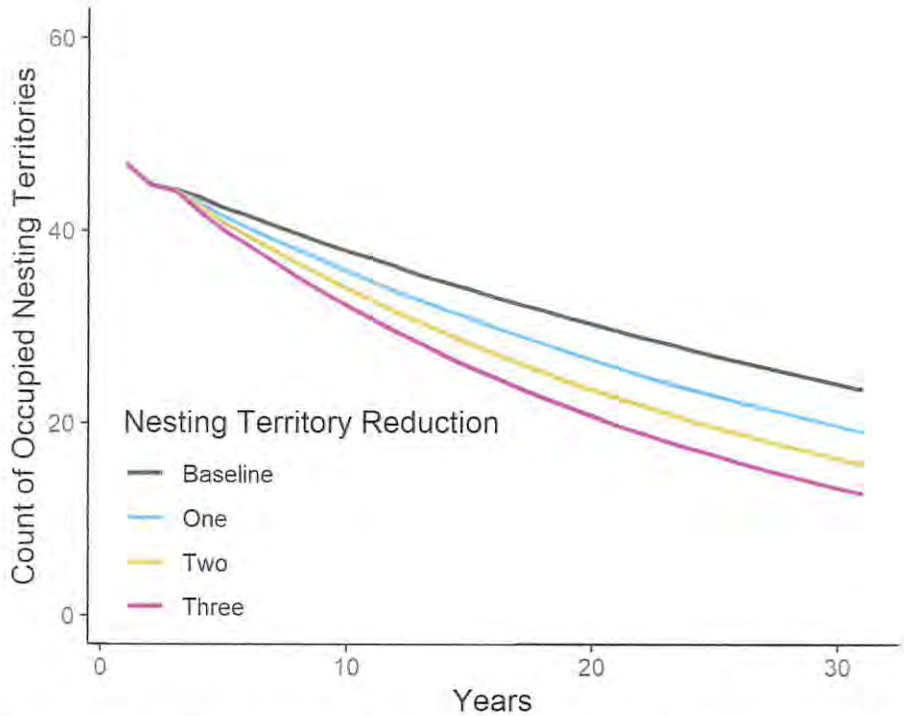

Figure 5. Predicted trend of occupied nesting territories accounting for indirect effects of nesting territory reduction.

4.3 Combined Direct and Indirect Effects Scenario

Population trends declined more substantially when the scenarios of reduced survival and declining territory occupancy were combined. Low direct effects and reduction of one nesting territory predicted 18.27 nesting territories remaining after 30 years, whereas high direct effects and reduction of three nesting territories predicted 10.12 territories after 30 years (Figure 6).

The difference in the magnitude of the effect is seen when compared with the baseline (Figure 6). The combined scenario of low fatality rates and reduction of one nesting territory resulted in a reduction of five nesting territories when compared to the baseline, and O of 0.9694 (90% CI: 0.9691–0.9696; Figure 6; Appendix A). High direct effect levels and three removed territories resulted in 2.5 times fewer territories compared to baseline, and O of 0.9495 (90% CI: 0.9492–0.9498; Figure 6; Appendix A). The corresponding average population decline was 2.2% for the baseline scenario compared with a 5.1% average annual decline for the combined high direct and indirect effect scenarios.

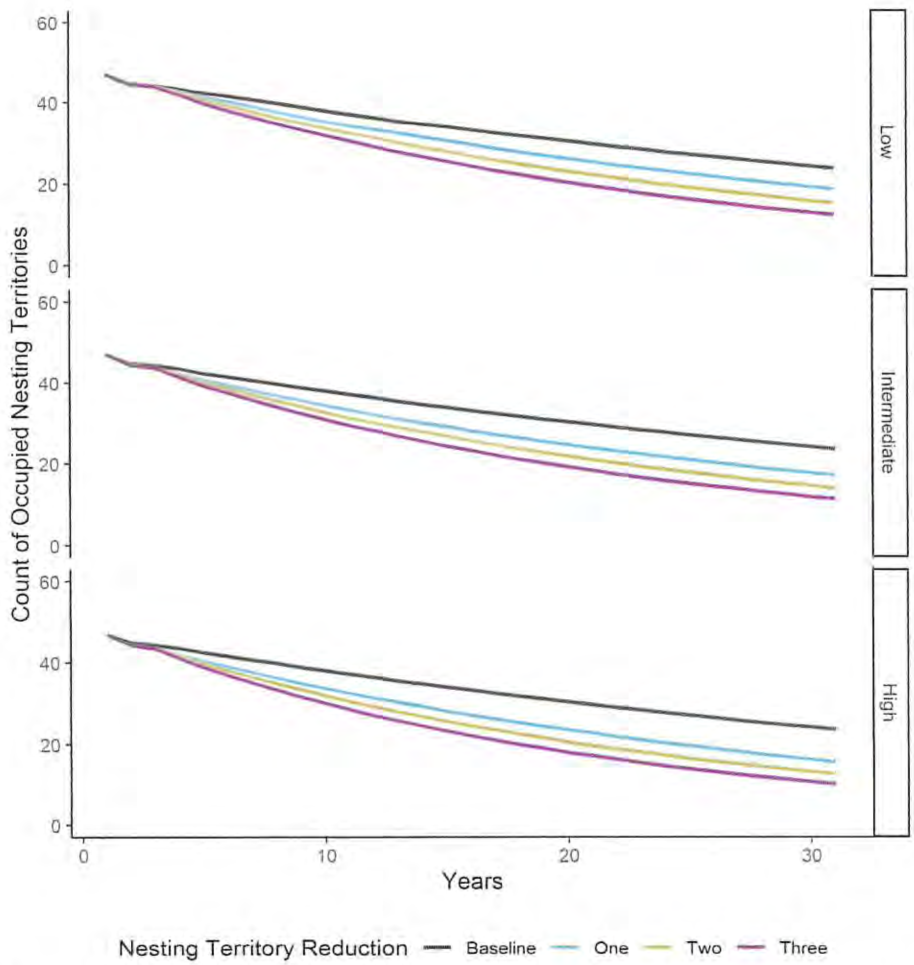

Figure 6. Predicted trend of occupied nesting territories accounting for direct effects (low, intermediate, and high) and indirect effects (reduction of one, two, or three nesting territories).

4.4 Artificial Nest Platform Scenario

Predicted Ofor baseline, direct effect, indirect effect, and combined effects was always below 1.00, resulting in declining population trends across all scenarios (Appendix A). However, simulations incorporating artificial nest platforms resulted in a positive values of Ocorresponding with an increase in successful breeding pairs in the population due to the construction and use of artificial nest platforms (Figure 7). Offsetting the effects of low or intermediate direct effects and the reduction of one occupied territory would require three artificial platforms to be constructed with an average annual occupancy of 36% (Appendix A). If high levels of direct effects occur, then seven artificial platforms are needed to return the number of nesting territories above baseline. Across all three levels of directs effects, 10 new territories are necessary to achieve a positive trend in nesting territories (Figure 7).

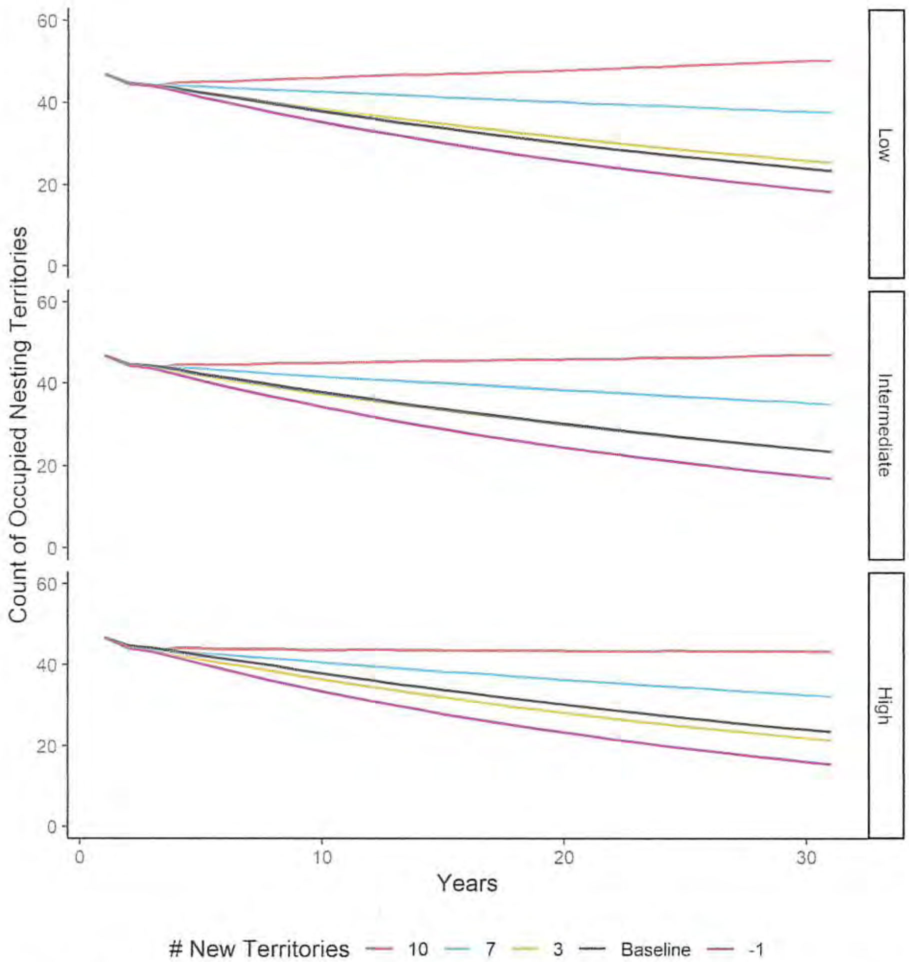

Figure 7. Predicted trend of occupied nesting territories accounting for direct effects (low, intermediate, high), indirect effects (reduction of one nesting territory), and construction of three, seven, and ten artificial nest platforms, assuming 36% occupancy.

5 DISCUSSION

Based on published vital rates and population estimates, our baseline model simulated a ferruginous hawk population with an annual average decline of approximately 2.4% over the next 30 years. By adjusting the simulated levels of turbine-related mortality and permanent loss of nesting territories, population trajectories showed a comparatively greater response to the loss of nesting territories than collisions (the loss of individual birds). Population trends did not respond to disproportionate effects to adult or juvenile age classes, suggesting age structure of turbine-related mortality has less of an affect than loss of a nesting territory or the removal of an individual from the population. When the effects of the scenarios were combined, the resulting influence to the population trends were magnified more than the influence of one effect alone. Our models simulated how the construction and use of artificial nest platforms, a common mitigation measure, could be used to mitigate the effects of Project operation.

As described above, simulations of the baseline population without the additive effects of increased mortality or loss of territories resulted in declining population trends for ferruginous hawk in Washington. Trend results corresponded with a -1.59% annual change (97.5% CI: -7.01–3.66) in Washington based on BBS data, from 1999–2019 (Sauer et al. 2019). Although statistically insignificant with credible intervals that included zero, BBS trend data in Washington reflected the patterns of declining nest occupancy, productivity, and nesting pairs observed over the last four decades (Hayes and Watson 2021). Despite the observed stability of ferruginous hawk populations across the US, Diffendorfer et al. (2021) modeled the vulnerability in maintaining a stable or positive Ofrom current (106 gigawatt [GW]) and future (241 GW) installed wind energy generation scenarios and found ferruginous hawk was comparatively more susceptible to changes in Ofrom turbine-related mortality compared to other species. In our study, localized effects on a small, declining population exposed to a myriad of existing environmental stressors unrelated to wind energy resulted in increased sensitivity to changes in demographic vital rates and O

In our PVA, there was no substantial change in population trends when the age structure of the survival parameter varied between adult and juvenile. Previous raptor research has shown adult survival can influence population viability (see Newton et al. 2016); however, the effect of low juvenile survival has been noted as a constraining factor in Washington populations of ferruginous hawks (Hayes and Watson 2021). The relatively equal effect of age class on population trends over a 30-year period perhaps underscores the demographic importance of all age classes, particularly for small populations. The reduced influence of adult survival on population trends compared to territory loss may suggest emigration of individuals into the breeding population during the non-breeding season or non-breeding "floaters" that replace breeding adults when densities decrease and breeding space becomes available (Watson and Keren 2019, Parayko et al. 2021).

Our scenarios show that the indirect loss of a nesting territory can have a greater affect than the direct loss of an individual and when combined, can substantially influence O Although nesting territories were not identified as a limiting factor in the Recovery Plan or status report

(Richardson 1996, Hayes and Watson 2021), loss of historical nesting territories and surrounding foraging habitat resulting from agricultural conversion, wildfire, reduced prey availability, urbanization and other anthropogenic sources have decreased or eliminated the suitability of nest sites over the ferruginous hawk breeding range in Washington. Efforts to increase availability of nesting territories through construction of artificial nest platforms in otherwise suitable areas lacking natural substrates can increase the number of nesting sites in a territory. Assuming an average annual occupancy rate of 36%, increases of three nesting territories may return the population trend to baseline conditions while 10 nesting territories may result in positive ferruginous hawk population trends.

Future PVAs could be refined to consider a range of probable fatalities based on annual fatality estimates from PCFM studies that adjust for searcher efficiency and carcass persistence. Count data excludes biases associated with carcass detection probabilities inherent with PCFM and thus is a coarse approximation we used to define a range of potential fatalities across spatial scales and not the biological reality that may occur. Despite the use of count data, we believe the relative magnitude in the effect of each scenario is representative of the biological response provided the same vital rates are considered. We want to acknowledge that the confidence intervals in Appendix A are narrower than we might expect for simulated ecological data suggesting that the data inputs are more precise than we might observe during the 30-year analysis period.

Our analysis scenarios demonstrate that reduced survival and territory occupancy can have synergistic effects on ferruginous hawk populations. Depending on the magnitude of the effects, the cumulative result of direct and indirect effects on small populations can substantially affect viability. The decrement in population growth from the loss of territories or individuals is not biologically restricted to wind energy development. As discussed in WDFW's Recovery Plan and Periodic Assessment, conversion and fragmentation of native habitats to agriculture and urbanization and the use of rodenticides and pesticides result in an increasingly human-disturbed landscape that affect ferruginous hawk populations (Richardson 1996, Hayes and Watson 2021). In addition to the installation of nesting platforms, WDFW discussed a range of conservation efforts including more comprehensive monitoring and research, increased funding and emphasis placed on habitat management and enhancement programs[3], reduced application of industrial chemicals, and strategic conservation planning that minimizes encroachment into unfragmented native habitats can result in incremental benefits (Richardson 1996, Hayes and Watson 2021). Mitigation of stressors that affect population trends should continue across the broad range of factors that impact ferruginous hawk nesting and foraging habitat in order to maintain viability of local populations over time.

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[3] Examples of habitat management or enhancement programs include, but are not limited to, the US Department of Agriculture, Farm Service Agency's Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), State Acres for Wildlife Enhancement (SAFE), or the Washington Wildlife and Recreation Program (WWRP)

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Appendix A1. Predicted λ and occupied nesting territories for each scenario after 30-years.

Scenario	Direct Effect Level	Indirect Effect Level	Added Nesting Territories	λ	λ 90% CI	# Territories	Territories 90% CI
Baseline	-	-	-	0.9776	0.9774–0.9779	**23.52**	23.31–23.74
Direct Effects	Low	-	-	0.9764	0.9761–0.9767	**22.71**	22.5–22.93
Direct Effects	Intermediate	-	-	0.9736	0.9733–0.9739	**20.78**	20.58–20.97
Direct Effects	High	-	-	**0.9708**	0.9705–0.971	**19.05**	18.87–19.23
Direct Effects (Adults and Juveniles)	Low	-	-	0.9746	0.9744–0.9749	**21.41**	21.22–21.61
Direct Effects (Adults and Juveniles)	Intermediate	-	-	0.9736	0.9734–0.9739	**20.87**	20.68–21.07
Direct Effects (Adults and Juveniles)	High	-	-	0.9694	0.9691–0.9696	**18.26**	18.09–18.43
Indirect Effects	-	1	-	0.9708	0.9705–0.9711	**19.34**	19.16–19.51
Indirect Effects	-	2	-	0.9639	0.9636–0.9641	**15.68**	15.54–15.83
Indirect Effects	-	3	-	0.9566	0.9564–0.9569	**12.73**	12.61–12.85
Combined Effects	Low	1	-	0.9694	0.9691–0.9696	**18.44**	18.27–18.6
Combined Effects	Intermediate	1	-	**0.9667**	0.9664–0.967	**16.96**	16.8–17.12
Combined Effects	High	1	-	**0.964**	0.9638–0.9643	**15.6**	15.46–15.75
Combined Effects	Low	2	-	0.9624	0.9621–0.9627	**15.05**	14.91–15.19
Combined Effects	Intermediate	2	-	**0.9597**	0.9595–0.96	**13.79**	13.66–13.92
Combined Effects	High	2	-	0.9569	0.9566–0.9571	**12.6**	12.48–12.71
Combined Effects	Low	3	-	0.9552	0.9549–0.9555	**12.14**	12.03–12.25
Combined Effects	Intermediate	3	-	0.9525	0.9522–0.9528	**11.15**	11.04–11.25
Combined Effects	High	3	-	0.9495	0.9492–0.9498	**10.12**	10.03–10.22
Artificial Nest Platform Credit	Low	1	3	0.9807	0.9804–0.9809	**25.61**	25.38–25.85
Artificial Nest Platform Credit	Low	1	7	**0.994**	0.9937–0.9943	**37.87**	37.51–38.22
Artificial Nest Platform Credit	Low	1	10	1.0044	1.0041–1.0046	**50.68**	50.22–51.15
Artificial Nest Platform Credit	Intermediate	1	3	0.9779	0.9776–0.9782	**23.52**	23.3–23.74
Artificial Nest Platform Credit	Intermediate	1	7	**0.9917**	0.9914–0.992	**35.02**	34.7–35.34
Artificial Nest Platform Credit	Intermediate	1	10	**1.002**	1.0017–1.0022	**47.15**	46.71–47.6
Artificial Nest Platform Credit	High	1	3	0.9749	0.9747–0.9752	**21.48**	21.28–21.68
Artificial Nest Platform Credit	High	1	7	**0.989**	0.9887–0.9893	**32.35**	32.04–32.65
Artificial Nest Platform Credit	High	1	10	0.9991	0.9989–0.9994	**43.44**	43.03–43.86

CI = confidence interval

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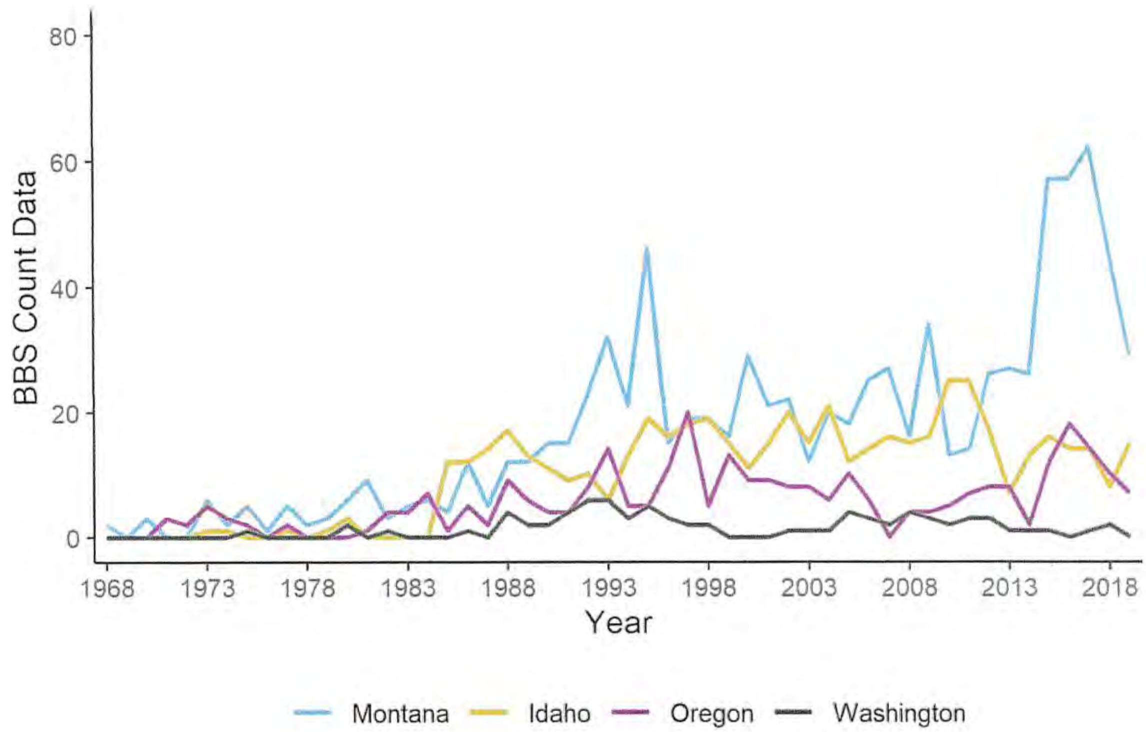

Appendix A2. Breeding Bird Survey count data by state for the northwestern United States. Washington historically has had low numbers relative to other states. Interannual and interdecadal counts appears high, although differences were not quantified. The number of routes surveyed increased until the early 1990s before remaining relatively consistent. Therefore, any perceived population growth from 1968 through 1993 is likely the result of survey effort.

General Range and Regional Distribution

The ferruginous hawk (*Buteo regalis*) occupies western North America from Canada through central Mexico (Ng et al. 2020). Washington is at the northwestern limit of the species' breeding range, which extends eastward to extreme southwestern Manitoba, and south to Texas (Fig. 1). Although range-wide breeding distribution mirrors that in historical times, there was a documented contraction of range in Alberta, Saskatchewan, and Manitoba in the 1900s from agriculture conversion and aspen (*Populus* spp.) invasion (Ng. et al. 2020).

Most (98%) ferruginous hawks migrate from breeding territories after nesting (Watson et al. 2018*a*). Post-nesting migration begins in late summer for regional breeding populations, except those in Canadian grasslands, with hawks migrating eastward and northward to the northern grasslands and Great Plains (Watson et al. 2018*a*). Hawks migrate again in fall, with hawks from Washington wintering in central to southern California, and other populations wintering eastward through the southern grasslands (Fig. 1).

Range-wide, ferruginous hawks spend ≥57% of the year away from their breeding territories in migration and on late-summer and winter ranges (Watson et al. 2018*a*). Because most ferruginous hawks do not spend the non-breeding period in Washington, and there is no wintering population of ferruginous hawks in the state, impacts from development and management recommendations in this document are limited to the breeding population. However, many of the same threats and management recommendations presented here are also relevant to Washington's hawks on their non-breeding ranges in other regions.

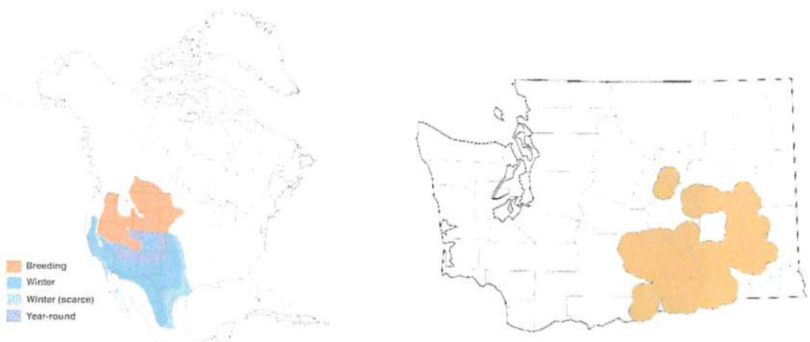

Figure. 1. (left) Distribution of ferruginous hawks in North America (www.allaboutbirds.org, © Cornell Lab of Ornithology) and (right) Washington (WDSM Data System, WDFW).

Rationale

Range-wide population estimates of ferruginous hawks in the early 1990s, tallied on a state and provincial basis, were between 2,921 and 5,665 nesting pairs (Olendorff 1993). Owing to perceived population declines the species was petitioned for federal listing under the Endangered Species act in 1983 and 1991 but not found to be warranted (USFWS 1992). Trend analysis of Breeding Bird Surveys indicate several states and regions have experienced downward trends since 1993 (Sauer et al. 2017). In Canada, the species was federally listed as Threatened in 1980, down-listed to Special Concern in 1995, and relisted to Threatened in 2008 (COSEWIC 2008). In Alberta, a breeding stronghold of the species range-wide, the species was designated as Endangered in 2006. In the U.S., the ferruginous hawk was designated a Species of Greatest Conservation Need in 17 states in 2005 in additional to specific listing status in several states (Ng et al. 2020). In Washington, the species was listed as state Threatened in 1983, and owing to continued decline in nesting pairs was up-listed to Endangered status in 2021 (Hayes and Watson 2021).

Resource Requirements

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The ferruginous hawk is an open country raptor that inhabits grasslands, shrubsteppe, and deserts of North America (Ng et al. 2017). These native habitats provide the critical resources that ferruginous hawks require for successful nesting: medium-sized mammal prey, low structure suitable for nest placement, and space that isolates from disturbance. In Washington, breeding habitat is most often shrubsteppe and juniper savanna that provides this native mammalian prey and where basalt rock outcrops or isolated trees, primarily juniper (*Juniperus* spp.), provide suitable nest sites (Bowles and Decker 1931, Bechard et al. 1990, WDFW 1996). Degradation or conversion of shrubsteppe and grassland often results in reduction or removal of the critical resources ferruginous hawks require for nesting.

Prey

Ferruginous hawks are dietary specialists that thrive on mammalian prey (Olendorff 1993) including ground squirrels (*Urocitellus* spp.) and jackrabbits (*Lepus* spp.), often supplemented by pocket gophers (*Thomomys* spp.). Ferruginous hawk nesting populations and breeding performance fluctuate in synchrony with populations of these prey. In high prey years this strong association of cyclic prey to ferruginous hawk reproduction may result in unusually large clutches (e.g., up to 8 eggs; Ng et al. 2020) with as many as 6 young fledging from nests (Clarke et al. 2008). High productivity buffers poor reproduction in low prey years, but also dictates a reliance on recovery of prey populations.


Photo: Rich Finger

Diets of ferruginous hawks in Washington are comparatively diverse, resulting largely from declines in their preferred prey of ground squirrels and jackrabbits. At 67 nests sampled in eastern Washington, diets were predominated by insects (51%) and mammals (49%) (Richardson et al. 2001). Mormon crickets (*Anabrus simplex*) were the main insect (92%), and northern pocket gophers (*T. talpoides*), the main mammal (72%). A low contribution of jackrabbits in diets was a major dietary shift noted since the 1920s. Other studies in Washington (Fitzner et al. 1977, Mazaika and Cadwell 1994, and Leary et al. 1996) found diets consisted of pocket gophers, mice (*Perognathus parvus*), reptiles (*Coluber constrictor* and *Pituophis melanoleucus*) and even gulls (*Larus* spp.). These dietary shifts from preferred prey are not without consequences because they may reduce nestling survivorship and have population implications (Preston et al. 2017, Heath et al. 2021).

Nests

Ferruginous hawks build their nests on the ground or on low structures that are natural or artificial, most often in isolated habitats away from human activity. Historically, ferruginous hawks may have built nests on the ground owing to fewer ground predators and less human disturbance, but a summary of nest use in the 1970s and 1980s from 21 study areas found 49% of nests were built in trees, 21% on cliffs, 9% on dirt outcrops, and only 6% on the ground (Olendorff 1993). Twenty-one percent of nests were built on human structures including utility structures, buildings, and haystacks showing adaptability to elevated artificial structures.

In Washington, ferruginous hawks nested primarily on cliffs (62%), followed by trees (34%) and man-made structures (4%) (Bechard et al. 1990). In southeastern Washington, early research found nest sticks made of greasewood (*Sarcobatus vermiculatus*; Bowles and Decker 1931). Later research found sagebrush (*Artemisia* spp.) and rabbitbrush (*Chrysothamnus* spp.) sticks ≤ 5 cm (2 inches) in diameter were used in nest building, with bunchgrass (*Festuca* spp.) and peeled sagebrush (*Artemisia* spp.) bark used to line nests (Fitzner et al. 1977).

Nests or nest structures of ferruginous hawks may be lost through human action or natural processes including fire, inclement weather, or tree intrusion into grassland or shrubland (Datta 2016, Parayko 2021). Natural or human-caused loss of nests or nest substrates reduce opportunities for nesting and may increase competition at existing nests with other raptors, common ravens (*Corvus corax*), and great-horned owls (*Bubo virginianus*).

Space

Nesting ferruginous hawks have comparatively large breeding home ranges. They often inhabit arid open-country habitats that afford isolation from disturbance but have limited nest structure and low-density prey. The breeding home range of a ferruginous hawk encompasses all resources necessary for one pair of hawks to nest successfully. The core area within the home range encompasses the resources that breeding hawks use most often. The size of the home range and core area vary with the density and distribution of these local resources (Fig. 2).

In Washington, seven hawks tracked via ground-based telemetry had breeding home ranges that were 10x larger (78.6 km^2) than those described previously in other regions (Leary 1996). Expansive ranges were attributed to long flights (>15 km) hawks made to the nearest irrigated agricultural fields where they likely fed on pocket gophers. These fields were harvested several times each year and had low canopy cover that enhanced foraging. More recent use of satellite telemetry, that provides a more precise measure of home range than ground-based methods (Walter et al. 2011) found ferruginous hawk ranges in southern Washington and north-central Oregon were even more expansive, averaging 378 km^2, with core areas 39.8 km^2 (17 hawks monitored 33 combined years; Watson et al. 2023). Comparatively large ranges were attributed to scattered distribution of prey. These studies indicate the distance ferruginous hawks travel from nests is strongly related to prey availability and distribution that ultimately influence home range size.

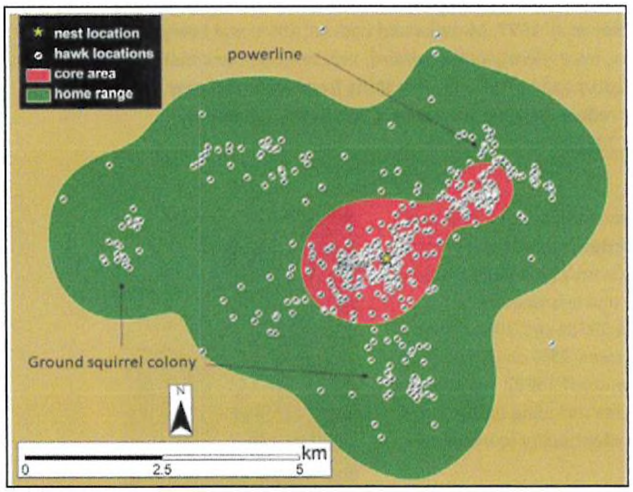

Figure. 2. Stylized ferruginous hawk home range and core area.

In the Pacific Northwest, adult hawks are present on their home ranges between 27 December and 17 October (Table 1; Watson et al. 2018*a*). A few adult male hawks (6%) return to winter on breeding ranges after late-summer migration, accounting for the December arrival date, but on average arrival is in spring in early March. Fledglings typically migrate before, and independently from, adults (Watson et al. 2019). Although earlier studies suggested ferruginous hawks moved nomadically during prey declines (Schmutz and Hungle 1989, Woffinden and Murphy 1989) more recent evidence based on satellite telemetry found ferruginous hawks have high fidelity (83%) to their breeding home ranges throughout their breeding distribution with most birds returning to the same ranges year after year (Watson and Keren 2019).

Table 1. Chronology of ferruginous hawk nesting in the Pacific Northwest (derived from 20 radio-monitored adults studied for 33 combined years, J. Watson, unpubl. data).

Behavior	**Date**		
	Begin	**Average**	**End**
Arrival of adults on home ranges	27 December	2 March	22 March
Incubation initiated	1 April	13 April	30 April
First eggs hatch	3 May	15 May	31 May
First young fledge	11 June	24 June	11 July
Late summer departure of adults from ranges	5 June	21 July	17 October

Limiting Factors

When prey, nests, and space are impacted by human-caused or natural changes in ferruginous hawk habitats they may reduce reproduction. Direct mortality and disturbance of hawks from development may limit size of breeding populations. A population viability analysis concluded the most important factors affecting ferruginous hawk population trend were adult survival and fecundity (Collins and Reynolds 2005). Adult mortality is likely additive (Dwyer et al. 2018), effectively meaning there is no surplus of adults to replace those lost to cumulative sources. Disturbance of nesting hawks may alter their behavior potentially impacting their reproductive success, health, and survival of their young. Disturbance of nesting raptors may result in nest desertion, damage to eggs and young by frightened adults, cooling, overheating, and loss of moisture from eggs or young, premature fledging of young, or avian and mammalian predation (Rosenfield et al. 2007). For ferruginous hawks, disturbances may not only reduce productivity, but cause future nest desertion, and be exacerbated during periods of depressed prey populations (White and Thurow 1985).

Residential, recreational, and industrial development (renewable energy, surface mining and road construction) may eliminate prey and nesting habitat during development of facilities, homes, solar arrays, roads, and other infrastructure. Hawks may respond with avoidance (shift away from portions of a development), or displacement, that is complete abandonment of the entire area (Dwyer et al. 2018). Hawks that continue to nest may be affected by disturbances associated with development (pedestrians, vehicles, machinery) both during and after construction. Disturbance is manifest as disruption of natural behaviors that may be subtle (flushing) or less obvious (displacement or abandonment) and may ultimately result in reduced reproduction. Direct, accidental mortality of ferruginous hawks is often due to collision with vehicles and more recently is associated with wind energy development when they collide with rotating, elevated blades that reside in the flight space of their home range. Ferruginous hawks also collide with powerlines or may be electrocuted on distribution poles, both of which are increasingly recognized threats to endangered bird populations (D'Amico et al. 2018). Solar energy development may also increase risk of electrocution and potential for fatal burns of hawks flying through solar flux fields (McCrary et al. 1986, Diehl et al. 2016). Recreational development and road construction that increase ORV access to areas increase potential for disturbance and illegal shooting of ferruginous hawks. Historically, shooting was the highest assigned cause of mortality (15.8%) for ferruginous hawks banded and recovered between 1916 and 1992 (Gossett 1993).

Nesting of ferruginous hawks is potentially impacted by several other land management activities that primarily affect prey. Recreational shooting or poisoning to control or eliminate burrowing mammals may result in lead toxicosis or sub-lethal hemorrhage of hawks that consume mammal carcasses (Chesser 1979, Knopper et al. 2006, Murray 2017, Vyas et al. 2012). Effects of cultivation on ferruginous hawk nesting have been studied extensively in ground squirrel habitats in Alberta, with highest densities of hawks maintained at about 10% cultivation, declining at 30% (Schmutz 1999). Overgrazing and overstocking cattle in pastures can have negative consequences on vegetation and prey (Fleischner 1994, Wick et al. 2016) as well as increasing rubbing and trampling of nest trees (Houston 1982). Because ferruginous hawks avoid dense forests and use isolated trees or groves for nesting, intrusion of aspen or juniper into grassland and shrubland may inhibit nesting (Woffinden and Murphy 1983, Bartuszevige et al. 2012, Kennedy et al. 2014).

Management Recommendations

A goal of ferruginous hawk management in Washington is to protect all areas associated with their nesting. This corresponds to areas in close vicinity of recently used and unused nests (see Identification of Ferruginous Hawk Habitat below). Their endangered status is one reason why WDFW has taken a broad interpretation of the areas that should be protected, including unused nesting areas. A status of endangered means that the species is "seriously threatened with extinction throughout all or a significant portion of its range within the state" (see WAC 220-610-110). We also recommend protecting unused nesting areas because the species can re-occupy former nesting territories. Specifically, ferruginous hawks have been observed returning to unused nests after an absence of at least 20 years (Romin and Muck 2002, M. Vekasy, pers. comm., J. Fidorra, pers. comm.).

Proponents of land-use activities in areas associated with ferruginous hawk breeding should determine the potential project impacts. Proponents should devise appropriate management strategies for conserving ferruginous hawk habitats associated with proposed actions. These are the steps for project assessment and implementation:

Identification of Ferruginous Hawk Habitat

Ferruginous hawk nests are the focal point of breeding. From 1978 to 2020 WDFW identified and mapped 672 ferruginous hawk nest locations on 287 home ranges (WSDM database). Nest locations were used to identify areas associated with ferruginous hawks breeding habitat.

Areas "associated with" ferruginous hawk are lands that provide the space and prey needed for ferruginous hawks to successfully reproduce ("breeding habitat"). Breeding habitat consists of vegetation types listed in Table 2 provided the land is either (a) within 10 km of a ferruginous hawk nest site that has been identified at any time since September 1, 1991, or (b) within 20 km of a nest used by Ferruginous Hawks within the past five years. Breeding ferruginous hawks may use pastures, CRP land, or edges of irrigated agricultural land. We address management of agricultural practices and activities in areas "associated with" ferruginous hawk in the section below titled Guidance for Voluntary Stewardship Planning.

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Table 2. Vegetation types associated with Ferruginous Hawk breeding habitat.

Vegetation Types
Columbia Plateau Scabland Shrubland
Inter-Mountain Basins Big Sagebrush Shrubland
Columbia Plateau Steppe and Grassland
Inter-Mountain Basins Big Sagebrush Steppe
Inter-Mountain Basins Semi-Desert Shrub-Steppe
Columbia Basin Foothill and Canyon Dry Grassland
Columbia Basin Palouse Prairie
Inter-Mountain Basins Active and Stabilized Dune
Inter-Mountain Basins Cliff and Canyon

Step 1. Determine if the proposed land use activity is in **zone D** outside of the mapped area associated with ferruginous hawk (Table 3, Fig. 3). This is usually done by the municipal or county authority in charge of planning and development. This step is carried out by overlaying the location of the proposed land use activity with WDFW's Priority Habitat and Species (PHS) data. The PHS data shows the location of ferruginous hawk habitat. If the activity is in **Zone D** no further action is necessary.

Table 3. Spatial zones and preferred habitats associated with breeding ferruginous hawk that project proponents should reference in their site assessments to determine next management steps. Zones are illustrated in Figure. 3.

Zone	Nearest nest (km)	Area of influence	Next steps for land use proposals
A	<3.2 km (core area)	All lands within 3.2 km of a ferruginous hawk nest should be managed to avoid disturbing nesting hawks.	• ***Survey Assessment*** - Recommended • ***Habitat Management Plan*** ✓ Avoidance strongly recommended in this zone ✓ Minimization measures require no net loss of function ✓ Compensatory mitigation strongly discouraged.
B	3.2 to 10 km (home range)	Lands between 3.2 to 10 km of a ferruginous hawk nest when lands are composed of vegetation types listed in Table 2 or are in pasture, CRP, or the edges of irrigated agriculture. These lands often support the prey that breeding hawks require.	• ***Survey Assessment*** - Recommended • ***Habitat Management Plan*** ✓ avoidance and minimization in areas associated with ferruginous hawk ✓ Strongly discourage compensatory mitigation for areas with ground squirrel colonies.
C	10 to 20 km	Lands between 10 to 20 km of a nest used by ferruginous hawks in the past five years <u>and</u> when these lands are composed of vegetation types listed in Table 2.	• ***Rapid Assessment*** - required • ***Survey Assessment*** – dependent on result of rapid assessment. • ***Habitat Management Plan*** – Only if Ferruginous Hawk nests or ground squirrel colonies are observed during rapid or survey assessment.
D	>20 km	All lands where the closest Ferruginous Hawk nest is >20 km away.	No action necessary

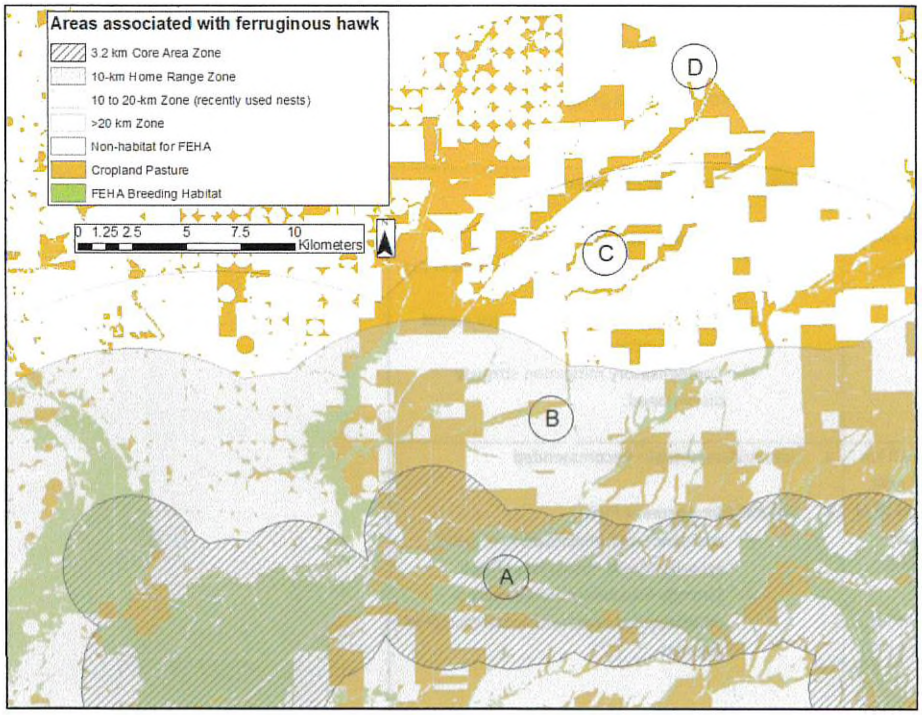

Fig. 3. See Table 3 for recommended Next Steps in each of the management zone illustrated here.

Site Assessment

Step 2. If the activity is in **zone C** of the area associated with ferruginous hawk (Table 3, Fig. 3), we recommend a *rapid* on-site assessment of the area where the activity is being proposed. The protocol for conducting a *rapid* site assessment is in Appendix 1. The *rapid on-site assessment* does not require collecting any detailed or elaborate measurements but is a brief survey of the site to determine if further action is necessary. If the rapid assessment demonstrates a need for further action, then proceed with a more detailed survey assessment (see Appendix 2). The *survey assessment* will be a requirement prior to developing a Habitat Management Plan (HMP).

Step 3. If the proposed project is in **zone B** of the area associated with ferruginous hawk (Table 3, Fig. 3) and avoidance measures are not possible, conduct a *survey* assessment of the site. The protocol for conducting a *survey assessment* is in Appendix 2. The *survey assessment* will be a requirement for development of an HMP. Note that the *survey assessment* includes an evaluation of pasture, CRP and irrigated agricultural land edges but are not addressed in the HMP but through voluntary measures (see Additional Guidance below)

Step 4. Avoidance of the land use proposal is strongly recommended when it is situated in zone A. If the project is in **zone A** (Table 3, Fig. 3) conduct a *survey* assessment of the site. The protocol for conducting a *survey assessment* is in Appendix 2. The *survey assessment* will be a requirement for development of a Habitat Management Plan (HMP). Note that the *survey assessment* includes an evaluation of pasture, CRP and irrigated agricultural land edges but are not addressed in the HMP but through voluntary measures (see Additional Guidance below).

Habitat Management Plan

Planners and developers should develop a HMP for parcels where there are available options to minimize impacts. A HMP (often called a Critical Area Report), when implemented, should at a minimum result in no-net-loss of ferruginous hawk habitat function. Although habitat function cannot be precisely measured, known attributes of quality habitat can be used to generate useful estimates.

Step 5. As needed, develop a HMP for proposals that are on sites determined to be associated with ferruginous hawk breeding habitat and 3.2 km to 10 km from documented nests (i.e., **zone C**, Table 3, Fig. 3).

Develop a HMP for all proposals that are on sites determined to be associated with ferruginous hawk breeding habitat and <3.2 km from documented nests (i.e., **zone D**, Table 3, Fig.3).

A template for developing an HMP is provided in Appendix 3. This template is made up of three parts:

Part 1 is filled in with basic information about the applicant, their representatives, the location of the site, and a description of the proposed project that will be mitigated through the measures outlined in this HMP.

Part 2 is where the site features of significant value to ferruginous hawks are described as well as depicted in a map that is attached with the HMP. This is where the survey assessment of the site will provide critical information.

Part 3 is where a detailed explanation of mitigation and post mitigation monitoring measures are described. This section should be written with sufficient detail so that anyone reviewing it can assess with confidence if the mitigation measures will or will not achieve no-net-loss of habitat function.

Mitigation

Step 6. In the HMP describe the mitigation measures designed to avert project impacts to ferruginous hawk habitat.

We recommend that users of this document follow the mitigation sequence when evaluating a project in habitat associated with ferruginous hawk. The mitigation sequence is a framework of alternate actions that a land use applicant should consider for reducing a project's negative impacts. These alternate actions are listed in order of preference:

- **Avoiding** impacts altogether by not taking a certain action. In this framework, avoidance is always the first action to consider because it is the preferred approach to conserving habitat for ferruginous hawk.

- **Minimizing** impacts by limiting the degree or magnitude of the action and its implementation by using appropriate technology, or by taking affirmative steps to best reduce impacts (e.g., habitat restoration). This alternate action is meant to minimize the negative impacts of a project on ferruginous hawks. Minimization should only be implemented after thoroughly considering all avenues to avoid impacts altogether. Project planners and developers at a minimum should aim to achieve a standard of no-net-loss of habitat function when devising a plan to minimize impacts. The preferred standard is a net-ecological gain of habitat function. This standard is preferred because ferruginous hawk is an Endangered Species in Washington that will likely require a greater amount of functional habitat to reverse population declines.

A HMP should be designed to identify the strategies that the project applicant will take to minimize their project's impacts. Common strategies to minimize impacts include reducing a project's footprint and intensity, siting a project further away from higher quality habitat, creating or restoring habitat, or using low impact development practices. A successful strategy will ultimately be designed around the site-specific opportunities to benefit the species. Often there will be more opportunities to mitigate negative impacts on ferruginous hawk when the parcel being developed is either relatively large or when it consists of varying levels of habitat quality. Parcels almost entirely comprised of higher quality habitat or where options to minimize impacts are limited should be strong candidates for taking a strategy of avoiding impacts altogether.

- **Compensating** involves the use of off-site mitigation for impacts. It is considered the last resort option and should be used only after all other on-site mitigation options have received serious consideration and are deemed unfeasible. Compensation is not supported within the core nesting habitat of Ferruginous Hawks (within 3.2 km of a nest) because of the highly imperiled status of this species in Washington. Beyond this 3.2 km zone of core nesting habitat this is still the least preferred alternative from a conservation standpoint. This is because compensatory mitigation will result in habitat loss and will likely harm or destroy areas of Ferruginous Hawk breeding habitat. Because Ferruginous Hawk is an Endangered Species in Washington and a species in decline, sites secured elsewhere to compensate for lost habitat should be larger than the site being replaced. We recommend that for every acre of habitat converted, three acres be secured and protected somewhere off-site. Off-site mitigation can also be combined with minimization, especially when actions to minimize impacts on-site cannot achieve no-net-loss of habitat function.

Compensatory mitigation should occur as close in proximity as possible to the parcel being replaced. Sites considered as off-site replacement habitat should undergo a survey assessment. The following are selection criteria for identifying an alternative site suitable to provide off-site mitigation:

- ✓ Mitigation site is of equal or greater habitat quality than the site being replaced as determined through a survey assessment of the mitigation site.
- ✓ Mitigation site should preferably be within 10 km from the replaced site and no more than 20 km away.
- ✓ Mitigation sites adjacent to other conserved properties are preferred.
- ✓ Mitigation sites greater than 20 km from replaced site should require a 5:1 mitigation ratio.
- ✓ Mitigation site is well connected to other areas of natural or semi-natural habitat.
- ✓ Mitigation site has little or no artificial impervious surfaces.
- ✓ Mitigation site will not require long-term maintenance to sustain ferruginous hawk breeding habitat functions.

Mitigation sites secured to replace lost or degraded habitat should be protected with a conservation easement or a comparable legal instrument in perpetuity. The easement or comparable legal instrument should be put into place before any portion of the replaced site undergoes construction or other disturbances. The legal documentation must, to the extent appropriate and practicable, prohibit incompatible uses on the mitigation site that might otherwise jeopardize the objectives of the compensatory mitigation project.

To aid in the development of an HMP, we provide potential mitigation measures (Appendix 4) that can be used to create a plan to mitigate impacts. The mitigation measures are categorized by development type and can be established within an HMP to address the loss of ferruginous hawk breeding habitat function. Industrial and residential construction activities should be avoided between April 1 (earliest time of incubation) through July 21 (average time of adult departure).

Step 7. Prior to its approval and implementation, the HMP should be reviewed by an unbiased party knowledgeable in the ecology of regional habitats. The WDFW district wildlife biologist in your area should be contacted to request their review or to provide a reference for a qualified reviewer.

Step 8. Implement approved HMP.

Step 9. Implement compensatory mitigation when there are no feasible options to avoid or minimize impacts.

Commented [WJW(4]: I can't remember if you said we should include a Step 10 ("monitoring mitigation and adaptive management"). If so, we need to develop a little bit.

Commented [JMA5R4]: I think monitoring and adaptive management is important and I can flesh this out with some more detail before it goes out for peer review.

Additional Guidance

Guidance for Community and Long-range Planning

Local governments can play an important role in helping to conserve and maintain functional ferruginous hawk breeding habitat. This section provides guidance to help local governments review, develop, and implement regulatory tools and incentives to protect habitat for ferruginous hawk.

Local governments should strive to maintain existing habitat functions for ferruginous hawk by regulating land use activities likely to impact these important ecological functions. To ensure this happens, the first step is to include language in critical areas ordinances (CAO) to require the use of maps showing known and potential habitat for ferruginous hawks (such as those published by our PHS program). That information can then be used to flag land use projects and proposals in or near areas of potential habitat.

It is also important to have language in a CAO requiring a site visit whenever a land use proposal could impact areas of potential habitat. For that, we recommend referring to the process outlined in our recommendations for conducting an on-site assessment to help determine when an area is associated with ferruginous hawk breeding habitat (see Identification of Ferruginous Hawk Habitat above). The results of that assessment should also inform mitigation actions, including the development of an HMP, that when implemented, will achieve at a minimum no-net-loss of habitat function on the site being developed.

While it is important to have ferruginous hawk habitat protections built into local codes, it is also important for jurisdictions to use the mapped data to inform decisions about zoning, comprehensive planning designations, and urban growth areas (UGA). More specifically, we recommend that local planning authorities carefully consider the potential impacts of rezoning sites with ferruginous hawk breeding habitat to more intensive land use designations. We recommend avoiding the expansion of UGAs or creating more intense land use designations in areas associated with ferruginous hawk breeding habitat. Such changes in land use designations creates greater expectations for development that then may be difficult to mitigate.

In places where land use designations are already set at levels likely to result in impacts, other tools should be made available to landowners to minimize potential impacts to ferruginous hawk breeding habitat. An example might be to incentivize cluster development with bonus densities for setting aside areas in proposed parcels where there is habitat. This can work on certain parcels that are large enough to accommodate the development while also having enough space to set aside as protected area for breeding birds.

Alternately, jurisdictions could adopt programs to offer financial incentives that promote land uses to levels that will not result in impacts to ferruginous hawk breeding habitat. One example would be a transfer of development rights program where landowners gain financial benefits by sending their development rights to other less sensitive areas. A second example is a Public Benefit Rating Systems program to provide tax incentives to encourage voluntary resource conservation on private property. A third example would be a conservation futures levy, which would levy local tax dollars for the use of acquiring properties for conservation. In general, jurisdictions with conservation futures programs can develop ranking criteria for selecting lands out of an application pool. A local jurisdiction could develop or modify such a program to give more points to applicants with ferruginous hawk breeding habitat in high-risk development zones. Eligible landowners can also get incentives through the Ferruginous Hawk State Acres for Wildlife Enhancement program. This federal Farm Bill program can provide incentives, including a reliable annual income, to eligible landowners who implement approved conservation practices.

Lastly, we strongly advise having a process in place to make sure all departments involved in land use permitting are coordinated. In addition to local planning departments, other departments can include public works that sometimes oversee permits for clearing and grading, which can be the precursor to a site being developed. So, all departments involved in permitting any part of a project proposal (e.g., building, clearing and grading, utilities) on a site flagged for ferruginous hawk breeding habitat should be coordinated and made aware of any related conditions or regulations in the local CAO.

Guidance for Voluntary Stewardship Planning

NOTE: This section will focus on ways to conserve FEHA habitat from impacts related to agriculture. I'll work with our VSP specialist to get assistance writing this. Content TBD. These are the measures (see comment) you included above re ag that we will integrate into this section

Commented [JMA6]: Sean Williams, our VSP expert, has agreed to write this section. THANK YOU, SEAN!!

Commented [JMA7]: *Cultivation*

•Avoid conversion of native grassland and shrubland within ferruginous hawk home ranges (Howard and Wolfe 1976, Van Horne 1993); maintain <30% cultivation (Schmutz 1989).

•Maintain ground squirrel populations in pastures between cultivated fields.

•Promote and protected edges of cultivated fields; do not burn or plow edges of cultivated fields, especially irrigated alfalfa fields (Howard and Wolfe 1976).

•Maintain fenceposts adjacent to edges (Watson 2020).

•Maintain lone trees or small groves amid cultivation.

•Restore cultivated fields to native habitats through the SAFE program (Conservation Reserve) with the goal of restoring small mammal populations.

Land management practices that affect vegetation

•Mow grain-crops periodically, those that are not plowed annually, to increase hawk access to pocket gophers and other small mammals (Cottrell 1981).

•Maintain edges of fields, especially irrigated alfalfa, that support pocket gophers (Wakeley 1978, Leary 1996).

•Implement low to moderate grazing intensities, avoid over-grazing or under-grazing, maintain stock ponds (Cottrell 1981). Open pastures to grazing after completion of incubation, 1 June (Atkinson 1992).

•Reinforce nest trees rubbed by cattle; provide artificial nest structures (ANS) where homestead or windbreak trees are lost and nest substrate is limited (see Appendix A for ANS information).

•Rehabilitate ranges by reducing stand density of junipers and aspen. Tree density should be in 4 small clumps per 2.6 km^2 for all buteos (Schmutz et al. 1980). Windrow brush after chaining to provide prey cover (Olendorff 1993).

•Rehabilitate pastures through cheatgrass (*Bromus tectorum*) removal and restoration of native grasses and shrub-steppe.

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Appendices

Appendix 1. Protocol for conducting a *rapid site assessment*.

A rapid site assessment involves an on-ground assessment of habitats in zone B (Fig. 3; between 10 km and 20 km from a nest used by ferruginous hawks within the past five years).

Within this zone:

- Document any ferruginous hawk nests.
- Document evidence of ground squirrel colonies.

If either ferruginous hawk nests or ground squirrel colonies are identified, a survey assessment should then be required (Appendix 2). If neither nests nor colonies are identified, no further action is necessary.

Submit the results of the *rapid site assessment* to the current planner assigned to the proposal. The current planner should then include these results with the project proposal.

Appendix 2. Protocol for conducting a *survey assessment*.

A *survey assessment* should be conducted for all land use proposals in **zone A** (Figure 3) and in zone **B** when the land use proposal is flagged as occurring on lands consisting of the vegetation types listed in Table 2. A survey assessment should also be conducted in **zone C** when the result of a rapid assessment shows that it is needed (see appendix 1). The survey assessment documents nests, prey, and habitat within the proposed project boundary.

We recommend hiring a professional consultant to conduct the survey assessment. The consultant should preferably be skilled in identifying and mapping vegetation as well as surveying wildlife. These skills are important for anyone carrying out the survey assessment because this is a tool that will be used to generate the data necessary for writing an HMP. Prior to collecting data for this survey assessment, please carefully read Appendix 3 to become familiar with the type of data that will be necessary to write an HMP.

Nest Documentation

Surveys for nests can be conducted by ground (optionally by air for professional consultants). This data will be used to provide the information required for subsection 2a in the HMP (see Appendix 3).

- Between 15 March and 15 May search for any raptor and common raven nests. Identify nesting species and map their nest locations when observed. Suspected raptor or raven nets should be mapped even when birds are not observed. To avoid disturbance do not approach nests and use optics at a distance to observe nests and record geolocations. Record the number of adult birds observed at the nest.
- Identify, document, map, and describe locations where there are elevated structures suitable for raptor nesting.
- Search elevated structures for nests including trees and artificial structures like transmission towers and windmills. Search cliffs, talus slopes, and rock outcrops.
- Use photo documentation and/or field identification guides to identify species.

Prey Documentation

Surveys for pray and prey habitat should be conducted from the ground. This data will provide the information required for subsection 2b in the HMP (see Appendix 3).

- Between 15 March and June 15 conduct ground surveys for and potential prey.
- Surveys for ground squirrels and jackrabbits are labor-intensive because animals are timid and signs of activity are used to determine animal presence (scat for both, and vocalizations and active burrows for ground squirrels). Ground squirrels may reside in disturbed habitats (roadsides, edges of orchards) and some species, like California ground squirrels (*Otospermophilus beecheyi*) may reside in rocky outcrops. These areas should be surveyed by direct inspection. More open and level habitats should be systematically searched by walking and listening or looking for sign along geolocated transects for complete coverage of the survey area (Finger et al. 2007). Spot-lighting at night may enhance searches for jackrabbits (Smith et al. 1985).
- Presence of pocket gophers is often evidenced by mounds of excavated soil in ground squirrel colonies or along edges of agricultural land.

- When small mammals are located the second step is to map the distribution (e.g., extent of ground squirrel colony) and point locations of prey species identified during surveys.

Habitat Documentation

Survey and map lands proposed for development composed of the habitat types in Table 2. Also, identify on the map any areas that are used as pasture or that are enrolled in CRP. This data will provide the information required for subsection 2c in the HMP (see Appendix 3).

- Survey and map areas composed the vegetation types listed in Table 2 along with a description of their state of quality or level of degradation.
- Survey and map any areas used as pasture or that are enrolled in CRP.
- The protocol in Appendix 9 in *Management Recommendations for Washington's Priority Habitats: Shrubsteppe* can be used to map vegetation and describe habitat quality.

Appendix 3. Habitat management plan template.[1]

PART 1

1a. Applicant's Full Name	1b. Applicant's mailing address:
1c. Plan prepared by: (Full name and company affiliation)	1d. Date submitted:
1e. County	1f. Parcel ID number(s) of proposed development site.
1g. Description of the proposed project:	

PART 2

2a. Location of nests In the space provided below (and on a separate sheet if more space is needed), please briefly describe any nests found on or adjacent to the parcel where the land use activity is proposed. This data is gathered as part of the survey assessment described in this report. Identify which nests, if any, are occupied, condition of each nest, and features supporting each nest (e.g., juniper, rock outcrop, telephone pole, ground). Label each of the nest descriptions with a unique nest ID (e.g., nest #1, nest #2). Also, identify, document, map, and describe locations where there are elevated structures suitable for raptor nesting. Attachment: • Map of site to scale clearly showing nest points with their ID numbers.[2]

[1] Attach supplemental pages if space in template is insufficient. Indicate in template when content for a section is continued on a separate page and indicate on the sheet the section(s) where the content is continuing from (e.g., continued from 2a).

[2] Attach a single map (rather than 3 separate maps) for all information required in sections 2a, 2b, and 2c.

2b. Prey

Describe below (and on a separate sheet if more space is needed) any signs of prey species (e.g., burrows, scat, animal observations) on the parcel. This data is gathered as part of the survey assessment described in this report. Also, describe below any verified prey locations on site that are mapped in a WDFW databases (e.g., PHS on the Web) or that are observed during the survey assessment. In the description, identify the species if known.

Attachment:

- Map of site to scale with locations along with legend clearly depicting species and type of sign.

2c. Space

Describe below (and on a separate sheet if more space is needed) the physical and ecological features that occur on the site. This includes the types of habitats, recent disturbances, location of waterbodies including creeks, as well as any physical features that Ferruginous Hawks might use for nesting. These include trees, rock outcrops and cliffs, as well as any elevated artificial features such as buildings or telephone poles. Habitat types on site should be identified using Ecological Systems of Washington State.

Attachment:

- Map of site to scale showing locations of all physical and ecological features. Habitat types should be shown on map as areas. Other features can be displayed with lines (e.g., creeks) or points (e.g., a single tree).

Part 3

3a. Mitigation sequencing

Describe below in detail reasonable efforts made to apply mitigation sequencing. Mitigation sequencing, to avoid, minimize, and compensate impacts to critical areas.

3b Mitigation

On a separate sheet (attached to HMP) describe plan you intend to implement to ensure no-net-loss of habitat features important to ferruginous hawk (see Appendix 4 for mitigation examples). Create a plan that includes adequate detail so that any reader will clearly understand the steps that will be taken, their precise mapped locations on the parcel, and their timing. Describe how these steps will ensure that no-net-loss of habitat function is achieved on the site, and if the site is being developed or undergoing any land use action, how the measures will fully offset the loss of function that may be caused by the land use activity.

Also, include a description of the process that will be implemented to monitor the mitigation measures to ensure their success over the long-term.

3c. Financial guarantees

Please describe in detail the financial guarantees to ensure compliance with the measures described in the mitigation section, such as a performance bond describing the dollar amount, terms in which claims can be made against the bond, as well as the period that the bond will be in effect.

Appendix 4. Sample mitigation measures

Industrial development – Wind Energy

- Build turbine strings and infrastructure outside of ferruginous hawk core use areas and home ranges to avoid nests, prey concentrations, and disturbance and collision impacts.
- Maximize proposed construction in areas that are already disturbed and reduce project footprint necessary to meeting project needs.
- Arrange turbines differently (Pearce et al. 2016; for ferruginous hawks avoid slope and rim edges and concentrate industrial development on unproductive agricultural land).
- Erect fewer turbines (fewer, newer, larger turbines are preferred over older turbines will lower energy generation).
- Consider whether solar panels may be part of project design to account for kilowatt hours in less impacting parts of the project area (homogenous agricultural land).
- Reduce risk of turbines proposed inside home ranges by stopping turbine motion when hawks are present using "Identiflight" or similar technology (Watson et al. 2018*b*, McClure et al. 2021).
- Address impacts related to new infrastructure (see Industrial development – Transmission Lines).

Industrial development – Solar Energy

- Build solar farms and infrastructure outside of ferruginous hawk core use areas and home ranges to avoid nests, prey concentrations, disturbance and collision impacts. Access the Washington Columbia Plateau Least-Conflict Solar Siting Gateway https://wsuenergy.databasin.org/
- Concentrate panels in unproductive agricultural areas to reduce impacts to raptors (Pearce et al. 2016).
- Setback panels from ridgelines to avoid potential impacts to ridge soaring, thermals, and hunting habitats.
- Address impacts related to new infrastructure (see Industrial development – Transmission Lines).
- For projects that use collection towers, spread aim points of mirrors to reduce temperatures when facilities are in stand-by mode that will reduce burn risk (Dwyer et al. 2018).

Industrial development – Transmission Lines

- Establish new distribution lines outside of hawk home ranges.
- Bury lines where possible.
- Develop raven monitoring and nest management (e.g., removal) plan for new transmission lines built within industrial developments.
- Apply state-of-the-art methods to prevent electrocutions and collisions (perch diverters, supplemental perches, wire-markers to improve visibility of lines).
- Report pole numbers and electrocution incidents to local utility companies and WDFW as soon as possible for remedial actions.

Industrial development – Surface Mining, Gravel Pit Construction, and Road Construction

- Develop surface mines, gravel pits and new roads outside of ferruginous hawk core use areas and home ranges to avoid nests, prey concentrations, and disturbance and collision impacts.
- Maximize line-of-site to hawk nests for projects located in coulees and narrow draws.
- Limit number of access roads to minimize recreational use. Reclaim abandoned as soon as possible after completion of operation or construction. Gate permanent roads to reduce access and post as "no-shooting".
- Leave remnant rockpiles in strategic locations to provide raptor perches and prey habitat.
- Improve ledges and crevices on solid banks to provide potential nest substrate.

- Implement program to remove road-killed carrion away from highways to prevent collision (Slater et al. 2022).

Residential development

- Develop residential housing outside of home range buffers.
- Cluster development and set aside areas with features important to breeding ferruginous hawks as undeveloped for conservation of habitat. This can work on certain parcels that are large enough to accommodate the development while also having enough space to set aside a protected area for breeding birds.
- Use open space requirements for residential developments to maintain prey habitats outside of home range buffers.

Mammal control and toxins

- Control small mammals if necessary for damage control versus complete eradication.
- Prohibit recreational shooting at ground squirrel colonies.
- Do not use lead bullets; only non-toxic ammunition. If encountered, bury animal carcasses shot with lead (e.g., ground squirrel, coyote, livestock).
- Support restoration/translocation of ground squirrels on adjacent rangeland.

Climate change

(note: all proposed projects, whether they contribute to these impacts or not, should consider how to minimize effects of increased fire, cheatgrass invasion, and nest loss)

- Create and maintain firebreaks and develop fire control plans for pasture/grassland interface. Use controlled fire to mimic natural fires to improve small mammal communities in sagebrush habitats Holmes and Robinson 2016).
- Remove cheatgrass and restore perennial grasses in pastures and native habitats (e.g., Clements et al. 2017).
- Reinforce and stabilize existing nests, nest trees, and cliff ledges to withstand extreme weather and provide protection from wind, sun, and rain (Shank and Bayne 2015, Migaj et al. 2011). See Appendix 5 for information on artificial nest structures.

Appendix 5. Artificial nest structures

Artificial nest structures (ANS) can be placed strategically to provide nest substrates on established ferruginous hawk territories that have lost structure due to factors including inclement weather, tree decadence, or cattle rubbing. Less often, ANS placement should be used to create new potential nesting opportunities. ANS placement is not an alternative for nest removal or translocating birds from a proposed development area. The lone exception is to move a nest from a hot distribution pole to protect the birds and equipment from fire. Ferruginous hawk nests on distribution poles that pose risk should be removed after the nest season, replaced with perch deterrents and installation of an artificial nest platform 250-500 m away. Movement of a nest that is in use should be progressive initially to a mobile artificial nest platform 25 m away and the permanent platform following the nesting season (Kemper et al. 2020).

Before considering ANS placement, management and maintenance of existing trees should be given priority. Bases of nests in trees can be reinforced with wire netting where limbs are failing, and predator access to the nest reduced using tin sheathing around the base (Craig and Anderson 1979). Groves of trees can be thinned as necessary to provide individual trees as or scattered stands for nest structure (Olendorff 1993).

New ANS placement is recommended only after an authorized wildlife biologist identifies open habitats devoid of nest structure, prey populations, and nearest-neighbor distance of >2.7 km. This is the distance Cottrell (1981) found ferruginous hawk nests were spaced on adjacent territories in Oregon.

Neal et al. 2011 provided recommendations to maximize utility of ANS placement: 1) occupancy of ANS is highest by hawks already habituated to disturbance or use of man-made substrates; 2) placement of ANS should be in association with extensive prey bases; 3) if translocating nestlings or eggs to an ANS it should be <1000 m and line-of sight of nest; 4) placement should consider potential for and implications of attracting other species to ANS; 5) provisions should be allocated for long-term monitoring, repair, and replacement of ANS at the time of installation; and 6) In dense development areas, placement of ANS should consider whether habitat quality is too poor because of dense development and may create a biological trap that attracts hawks but results in consistent nest failure. Additional considerations are that installation of ANS may also result in potential increased predation of sensitive species (e.g., sage grouse and burrowing owls) and may affect local ecosystem stability because of mammalian predation. We re-emphasize the need to plan for long-term maintenance and monitoring of ANS before placement.

ANS platform and pole designs are detailed elsewhere (Bohm 1977, Howard and Hilliard 1980, Schmutz et al. 1984, Olendorff 1993, Tigner et al. 1996, Skeen 1990, Neal 2007 Migaj et al. 2011). With increased summer temperatures shading of platforms should be considered. Shade designs for platforms were described by Schmutz et al. 1984. We recommend placement of sticks of the type and size used by ferruginous hawks on nest platforms (see description under **Nests** above). Schmutz et al. (1984) found shaded nest platforms were used twice as often as those that were unshaded, and Woffinden and Murphy (1983) found hawks tree nests used over repeated years that had branches above them but were otherwise unshaded. Howard and Hilliard (1980) recommended against "shade structure" based on two of three pairs that preferred non-shaded structure. Panting behavior and an unusually wide gape are adaptations of ferruginous hawks to extreme temperatures and may help nestlings avoid the need to seek shade on exposed nests (Martin et al. 2015).

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EDUCATION

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PROFESSIONAL EXPERIENCE

- **Research Scientist**, Washington Department of Fish and Wildlife, Olympia, WA 1997-present
- **Wildlife Research Biologist**, Washington Department of Fish and Wildlife, Olympia, WA 1992-1997
- **Wildlife Biologist**, Washington Department of Fish and Wildlife, Olympia, WA 1987-1992
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Paprocki, N., J. Kidd, T. Booms, **J. Watson**, A. Franke, S. Thomas, B. Bedrosian, J. Smith, C. Dillingham, and C. Conway. 2019. Differential migration in rough-legged hawks (*Buteo lagopus*). Raptor Research Foundation Annual Meeting. Fort Collins, Colorado. Oral presentation.

Watson, J.W. 2017. Do patterns of range use and migration support a nomadic lifestyle in the Ferruginous Hawk? Raptor Research Foundation Annual Meeting, Salt Lake City, UT. Oral presentation.

Watson, J.W., and R.G. Fischer. 2015. Impacts of 2014 wildfires on reproductive performance of nesting golden eagles in north-central Washington. Sacramento, California. Poster presentation.

Watson, J.W. 2014. Bald eagles 102 – *winter ecology*. Fidalgo Shoreline Academy. Anacortes, Washington. Oral presentation.

Watson, J.W. 2014. Bald eagles 103 – Washington's quintessential raptor. Sound Living Conference. Everett, Washington. Oral presentation.

Duff, A.A., and **J.W. Watson**. 2014. Resource use and selection in animal space use studies: a comparison of analyses using golden eagle (*Aquila chrysaetos*) global positioning system (GPS) radio telemetry. Washington Chapter of the Wildlife Society Annual Meeting. Pasco, Washington. Poster presentation.

Watson, J.W. 2013. Ferruginous Hawk: Range-wide status and limiting factors. 38th Annual Conference of the Western Field Ornithologists. Olympia, Washington. Oral Presentation.

Watson, J.W., and R.W. Davies. 2013. Lead levels and diet evaluation of breeding Golden Eagles in Washington. Lead Workshop, The Wildlife Society. Portland, Oregon. Oral presentation.

Watson, J.W. 2012. Ferruginous hawk movements in the North American Great Plains. Wildlife Society Central Mountains and Plains Section, Bismarck, North Dakota. Oral presentation.

Watson, J.W. 2012. Breeding range characteristics and resource use of Golden Eagles in Washington. Oregon Chapter of the Wildlife Society Annual Meeting. Portland, Oregon. Oral presentation.

Duff, A.A., and **J.W. Watson.** 2011. A comparison of home range mapping techniques for golden eagles in Washington. Washington Chapter of the Wildlife Society and Society for Northwestern Vertebrate Biology. Gig Harbor, Washington. Poster presentation.

Watson, J.W. 2011. Species overview and status – Ferruginous Hawk. Western Section of The Wildlife Society Annual Meeting. Riverside, California. Oral presentation.

Watson, J.W. 2011. Ferruginous hawk migration ecology: a tri-national investigation. U.S. Forest Service Rocky Mountain Region Annual Workshop. Fort Collins, Colorado. Oral presentation.

Watson, J.W. 2009. Ferruginous hawk ecology in a changing landscape. The Columbia Basin Shrub-steppe Ecosystem Conference. Dalles, Oregon. Oral presentation.

Watson, J.W., U. Banasch, B. McCready, T. Byer, and A. Lafon. 2006. Ferruginous hawk migration in North America. North American Ornithological Conference, Vera Cruz, Mexico. Oral presentation.

LICENSES AND CERTIFICATIONS

Master permit 24133, U.S.G.S. Bird Banding Laboratory
Migratory Bird Scientific Collection Permit MB182337, U.S. Fish and Wildlife Service

PROFESSIONAL SOCIETIES

Raptor Research Foundation