

Grant Application



Salix Scoresby

Email : ss4945@nau.edu

Application ID : A68SS143

Custom Ref. -

Application Start Date: 2023-10-28 01:23:56

Application Completed Date: 2023-10-31 03:22:40

1 Have you previously applied for a grant from the Oregon Wildlife Foundation?

no

2 Has a previously submitted grant application been denied funding support?

no

3 Title of your proposed project

Understandin g the Diet of Sierra Nevada Red Foxes

4 Name of your organization

Species From Feces lab at Northern Arizona University

5 If your organization is not a 501c3 nonprofit, please identify your fiscal sponsor

If do o apply o yo , w N/A

N/A

6 Your name or the name of the Project Manager

Salix Scoresby

7 organization mailing address

Please enter full address with city, state & zip

Pathogen and Microbiome Institute Northern Arizona University Applied Research & Development Bldg. 1395
S Knoles Drive, Flagstaff, AZ 86011-4073

8 your phone number or that of the Project Manager

(502)807-9337

9 your email address or that of the Project Manager

ss4945@nau.edu

10 a brief biographical statement about yourself or that of the Project Manager

Salix Scoresby is a wildlife biologist who has been lucky enough to work with some of the most elusive mammals in the West. A middle-school drop out from Kentucky, they pursued an unconventional education comprised of traveling, time in the wilderness, and self-study, and began to dive into wildlife science more intensively in their late twenties. After several years dangling hundreds of feet up in the old-growth canopy of the Oregon Coast Range while surveying for tiny red tree voles, scouring the precipices of Glacier National Park for mountain goats, bushwhacking through the Klamath Mountains after Humboldt martens, and traversing the North Cascades setting cameras for wolverine, they are excited to be a graduate student at Northern Arizona University's School of Forestry. While learning genetic techniques in the Species From Feces lab is a dream come true, they can't keep away from working towards conservation of wildlife in Oregon and are thrilled to be continuing fieldwork there.

11 social media handles that your organization uses

Enter social handles or URLs such as instagram, facebook, twitter, youtube, etc. so that we can use to cross promote on our channels - if you do not have any, please place N/A

@speciesfromfeces (IG) @SpeciesFecesCo (X/Twitter)

12 are you are currently following Oregon Wildlife Foundation on its social media channels?

- None of these channels

13 what is the total estimated cost of your project?

74702

14 Funding that you are requesting from OWF

If your request is for more than \$5,000, please contact Tim Greseth tim@myowf.org before submitting your application.

5000

15 what type of project are you proposing?

fish or wildlife research

16 will your project address an Oregon Conservation Strategy habitat or species?

yes

16.Y.1 What habitat or species is addressed?

Sierra Nevada Red Fox

17 what is the location of your proposed project?

Oregon Cascades

18 what ecoregion and Conservation Opportunity Area (COA) is your proposed project located in?

See <https://www.compass.dfw.state.or.us/> for the information you need to answer this question

Both East and West Cascades ecoregion, Central Cascades Crest (all), Mt. Hood Area COAs

19 what is the anticipated start date of your project?

Day/Month/Year

15-01-2024

20 what is the anticipated end date of your project?

31-10-2023

21 have a local, state or federal biologist reviewed this project?

yes

21.Y.1 What is their name and contact info?

Dr. Faith Walker, faith.walker@nau.edu; Dr. Seafha Ramos, seafha.ramos@nau.edu

22 have you already or will you obtain necessary permits from all requisite agencies as applicable to proposed project?

yes

23 what will the funding you are requesting be used for?

It would be a good time to review, if you haven't already done so, our grantmaking guidelines at www.myowf.org/grants

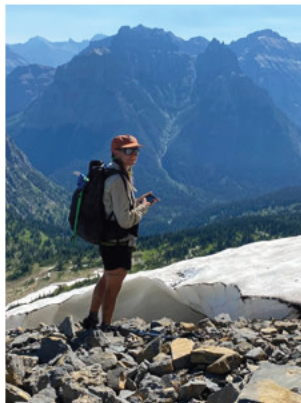
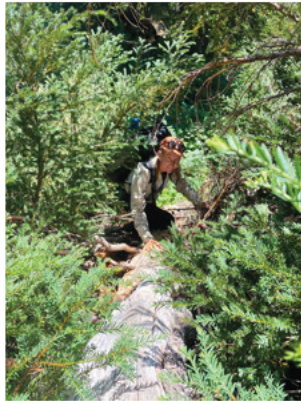
Genetics assay testing reagents and consumables and fecal DNA metabarcoding supplies

24 provide us a brief summary of your proposed project

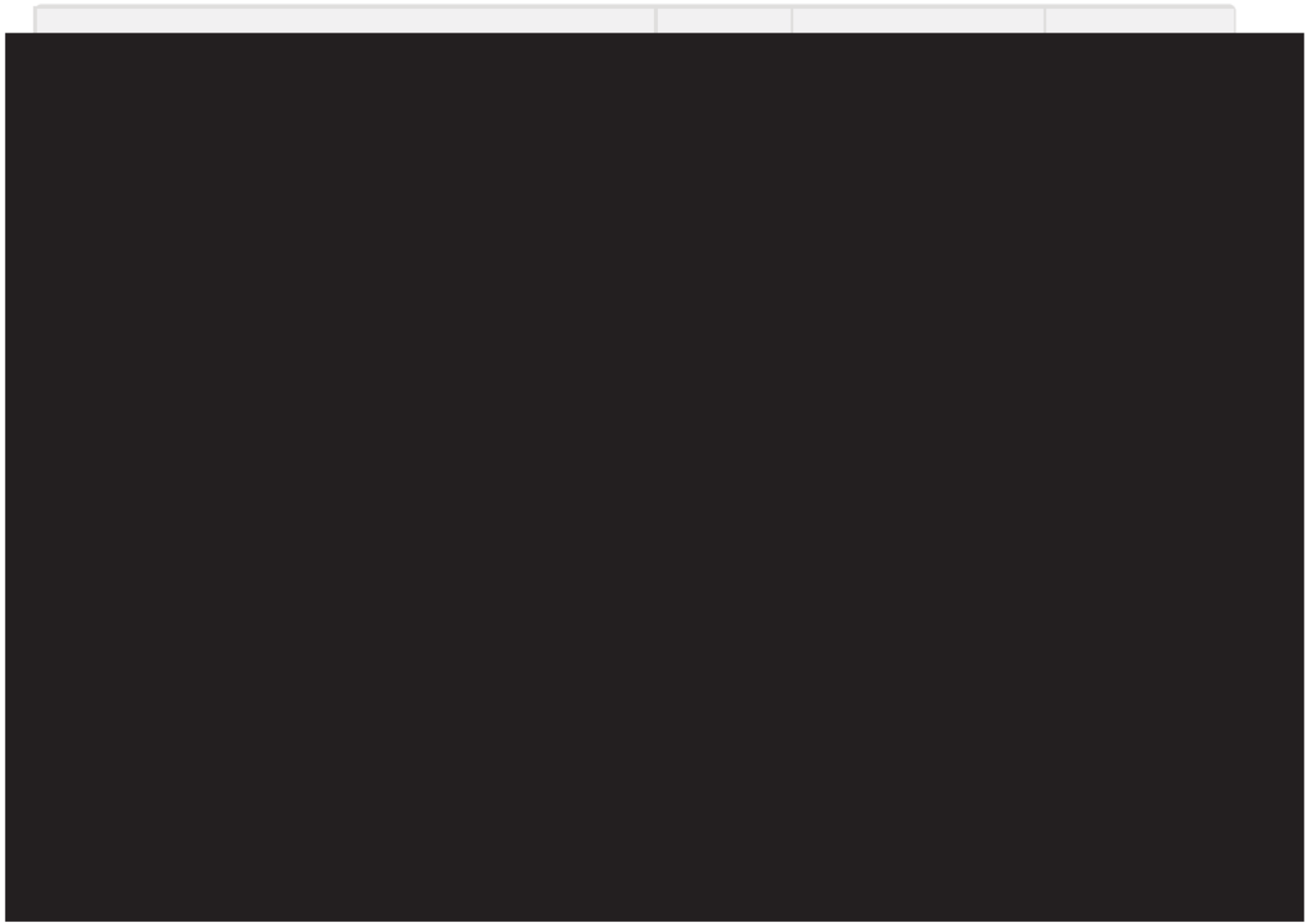
This project will be the first of its kind to reveal the full diet of the Sierra Nevada Red Fox, a Conservation Strategy Species listed as Sensitive in Oregon. Collaborating with wildlife biologists, graduate students, and community science volunteers up and down the Cascade Crest, we will use non-invasive survey techniques in known fox habitat to collect scats. These scats will be brought to the cutting-edge Species From Feces lab at Northern Arizona State University, where we will use next generation sequencing of fecal DNA metabarcodes to perform a complete assessment of the contents and reveal the vertebrates, invertebrates, and plants that these foxes eat. This full-taxa understanding of Sierra Nevada Red Fox diets will greatly enhance our knowledge and ability to appropriately manage for the continuation and conservation of these highly adapted alpine specialists.

25 upload pre project picture or a video

By submitting these photos or video I warrant that I am the legal owner of this media and grant the Foundation permission to reproduce, exhibit, or publish them for all general purposes in relation to Oregon Wildlife Foundation's work. If you have questions about photo or video submissions please refer to myowf.org/grants for guidance.



26 fill out our budget form



27 upload a narrative of your proposed project

Please make sure your narrative is no more than 7 pages long, single spaced, 12 pt. font (Calibri preferred).

1 Document Uploaded

28 upload letter of support

Letters of support are strongly encouraged. In particular, a letter from a supervising biologist

1 Document Upload

29 I understand that I am required to submit a Project Completion Report, copies of any publications or social media posts crediting the Foundation's support, and post-project pictures at the completion of my project

yes

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— Grant Application

Sa x Scoresby

Application ID: **A68SS143**

Understanding the Diet of Sierra Nevada Red Foxes through Fecal Metabarcoding

The Sierra Nevada red fox (*Vulpes vulpes necator*), an Oregon Conservation Strategy Species listed as Sensitive, is a native mesocarnivore highly adapted to the subalpine and alpine zones of the Oregon Cascades and California's Sierra Nevada mountains (Akins, Aubry, & Sacks 2018; Lewis, Akins & Chestnut 2021; Quinn et al. 2018; Sierra Nevada Red Fox Conservation Advisory Team 2022). Their populations are of high conservation concern, having shown dramatic decline in the past 30 years with a population of possibly fewer than 50 individuals for Sierra Nevada red fox in California and an unknown population size in Oregon (Quinn et al. 2018).

A full assessment of the vertebrate, invertebrate, and plant elements in the diet of these imperiled populations is urgently needed (Lewis, Akins & Chestnut 2021; Quinn et al. 2018; Sierra Nevada Red Fox Conservation Advisory Team 2022). Without a complete understanding of the diet of montane red foxes we cannot fully understand how the impacts of anthropogenic climate change and the resultant changes in prey communities, plant communities, and intraguild competition are affecting their precipitous decline (Delheimer et al. 2023, Newsome & Ripple 2015).

While low elevation and fur-farmed red foxes have been studied extensively (Hisano et al. 2022, Quinn et al. 2022, Wierzbowska & Skalski 2010), montane species inhabit a very different ecological niche, and little is known about their diets. For the closely related Cascade red fox (*V. v. cascadenis*) the only published diet study is 40 years old and presumably used morphological scat analysis (Aubry 1983). For the Sierra Nevada red fox there is a single analysis using DNA metabarcoding for the vertebrate content of 30 verified samples collected in summer of 2017 and 2018 in the Oregon Cascades (Delheimer et al. 2023) and a morphological analysis of putative Sierra Nevada red fox scats from Lassen collected 1998-2002 (Perrine 2005).

The Sierra Nevada Red Fox Conservation Advisory Team (2022) assesses diet analysis as a research priority. The Advisory Team also classifies identification of diet niche width and overlap/competition with sympatric carnivores as a research priority, which would necessitate a full assessment of Sierra Nevada red fox diet. Fecal DNA metabarcoding is a novel non-invasive approach to examining the diet of wildlife which can accurately portray the complexities of the many taxa consumed by mesocarnivores and is both more precise and more accurate than previous methods (Ando et al. 2020, Taberlet et al. 2012).

The bulk of diet studies on mesocarnivores in general and Sierra Nevada red fox specifically have looked exclusively at vertebrate diet components (Delheimer et al. 2023, Perrine 2005). This is due to a number of factors, such as difficulty in identification of invertebrate and plant components in morphological analyses (Ando et al. 2020, da Silva et al. 2019, Morin et al. 2019). All studies which have looked at plants in the diet of red foxes have found them to be an important dietary category (Aubry 1983; Roemer, Gompper & Van Valkenburg 2009), and studies that have looked at invertebrates have found them to have high frequencies of occurrence (Hisano et al. 2022, Wierzbowska & Skalski 2010).

We predict that Sierra Nevada red fox have a highly specific landscape dependent diet, and that the unique species communities that they rely on will be highly affected by climate change. There is also some evidence that Sierra Nevada red fox in the Oregon Cascades is

habituated to human presence (Cate Quinn, personal communication), which can increase incidence of disease, human caused mortality, inbreeding and predation.

Our study will collaborate with Oregon Department of Fish and Wildlife biologists, Cascadia Wild and other citizen scientist groups, and potentially fellow graduate students at the Mammal Spatial Ecology and Conservation Lab at Washington State University, to survey in known fox habitat and collect scat samples. Depending on funding availability we will survey in the alpine environments used by Sierra Nevada red foxes either in the snow-free summer months of 2024 only or with additional funding we will be able to additionally conduct surveys in Spring of 2024 and Winter of 2024/2025.

The scat samples collected will be brought to the Species From Feces lab at Northern Arizona University, where we will use these as well as previously gathered samples to assess the breadth and diversity of Sierra Nevada red fox diets. Utilizing next-generation sequencing of DNA metabarcodes, we will use at least four different assays to ascertain the vertebrate, invertebrate, and plant components of diet. Lab analysis of currently collected samples will begin in January 2024 and will continue through February 2025 as needed.

Despite the challenges presented by the complexities of discerning primary versus secondary or accidental consumption of insects and plants, we will use novel methodologies to carefully extract a full picture of fox diet from our scat samples. We will examine frequencies of occurrence and weighted percentages of occurrence rather than only simple presence/absence of dietary items, which in combination with post hoc probabilistic co-occurrence analyses have high potential to tease out some of the dietary truths hidden in these data (Tercel, Symondson & Cuff 2021). This full-taxa understanding of Sierra Nevada red fox diet will greatly enhance knowledge and ability to appropriately manage for the continuation and conservation of these highly adapted alpine specialists.

This project will produce not only several academic and technical papers which will be used by the Sierra Nevada Red Fox Conservation Advisory Team and US Fish and Wildlife Service to guide management plans and habitat conservation, but also several presentations and articles for the public. Science communication is of utmost importance, especially when it comes to sensitive and threatened wildlife species on our public lands. Through collaboration with Cascadia Wild, Wild Diversity, public libraries, and other widely accessible venues, the project lead Salix Scoresby will present the information from this study to audiences across Oregon throughout the summer of 2025.

Sources:

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da Silva, L. P. *et al.* Advancing the integration of multi-marker metabarcoding data in dietary analysis of trophic generalists. *Molecular Ecology Resources* **19**, 1420–1432 (2019).

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30 October 2023

Oregon Wildlife Fund

Dear Project Committee,

I enthusiastically recommend Salix Scoresby for a grant from the Oregon Wildlife Fund. I have known Salix for the past year as they have enrolled in a graduate program at NAU and developed their proposal. Salix has identified an innovative means to advance conservation of Sierra Nevada and Cascades red foxes, and to do so non-invasively through analysis of DNA in fecal samples. Importantly, Salix already has extensive skills in marten tracking, scat sampling, and DNA metabarcoding, which will ensure the timely success of this project.

Salix is one of the most advanced beginning Ph.D. students that I have advised, with a strong background of diverse wildlife ecology projects. Their skillset will be bolstered through exposure to leading investigators in the fields of wildlife ecology and genetics because of their association with the School of Forestry and the Pathogen & Microbiome Institute, which are both world-class research units.

Salix is on a trajectory of becoming a research leader. They are ethical, well-spoken, excited about research and its translation, and a pleasure to interact with, qualities which have contributed to their success. I am very impressed by Salix and believe they and their project are exceptional candidates for a grant from the Oregon Wildlife Fund.

Please do not hesitate to reach out with questions.

Yours sincerely,

A handwritten signature in cursive script, appearing to read "Faith M. Walker".

Faith M. Walker, Ph.D.
Faith.Walker@nau.edu









Project Revenue	Cash	In-Kind	Committed / Pending
Oregon Wildlife Foundation Request	5000		Pending
Sloan-MITSI Fellowship	43200		Committed
Banks Family Education Fund	2000		Pending
Sigma Xi Grants-in-aid of Research	5000		Pending
Lewis and Clark Fund for Exploration and Field Research	5000		Pending
BLM Threatened and Endangered Species Program	10000		Pending
Annie Rose Shapero (Field Housing)		4000	Committed
REVENUE	70200	4000	
		TOTAL PROJECT SUPPORT	74200
Project Expenses	Cash	In-Kind	Total
Project Lead Salary (Salix Scoresby), 18 months @ \$2400/month	43200		43200
Fecal DNA undergrad tech, 4 months @ \$1800/month	7200		7200
Fecal DNA tech fringe benefits (EREs) @ 8.06%	576		576
Fecal DNA kits	378		378
Expendables (Lab)	1000		1000
Sanger Sequencing, 100 samples @ \$35/sample	3500		3500
Fecal DNA Metabarcoding, 100 samples @ \$60/sample	6000		6000
POV Mileage Reimbursement @ \$0.575/mile	1725		1725
Field Housing, 4 months @1000/Month		4000	4000
Expendables (Fieldwork)	2000		2000
Presentation Materials	600		600
NAU indirect costs (17.5% MTDC, SRP rate)	4021		4021
		TOTAL PROJECT EXPENSES	74200
Balanced budget? This cell should read "0" ---->		NET	0.00