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Project Title:

Balancing fuel considerations and rare carnivore habitat: an evaluation of risk and reward

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1. Project Description:

Background and Justification:

California has recently experienced significant increases in the extent and severity of wildfires that have devastated human communities as well as public and private forests, leading to substantial economic costs and effects to sensitive wildlife species. To inform an increased scale and pace at which land managers need to address this emerging wildfire crisis, we propose to focus on opportunities to inform strategic fuels reduction prescriptions that minimize disturbance to forest-dependent species and their habitat. Protecting small wildlife populations from fuel treatments while balancing the need to manage or treat forests has been difficult for both land managers and regulatory agencies. Unfortunately, broadly defining fire hazard and risk reduction strategies across California may inadvertently negatively affect small wildlife populations in naturally fire-resilient forests.

We propose to evaluate vegetation and fuel conditions in areas used by two rare species. Our goal is to evaluate tradeoffs of retaining or promoting both dense vegetation and coarse woody material that may benefit wildlife species with the challenge of increasing fire risk in increasingly more common hot and dry weather conditions.

Objectives and Scope:

We propose describing the fine-scale vegetative conditions used by two rare forest carnivores [Humboldt marten (*Martes caurina humboldtensis*) and Pacific fisher (*Pekania pennanti*)] to inform vegetation and fuel reduction strategies within fuel treatments or proposed habitat retention areas. Humboldt marten and Pacific fisher are forest specialists and structural obligate species. Researching their structural needs within the context of understanding fuel loads and fire risk will directly support the needs of land managers in balancing economic, ecological, and conservation goals.

Depending on funding availability and EMC needs, we have split our objectives into 3 possible options:

- Option 1: Humboldt marten vegetation surveys and analyses
- Option 2: Fisher location data, vegetation surveys and analyses
- Option 3: Forest carnivore vegetation use (combining both Humboldt marten and fisher related goals)

Future Vision: Within each objective, we will collect detailed vegetation and fuel measurements to inform forest planning. For measuring large woody material and slash, we aim to collect data using similar protocols as the current EMC-2023-003 project focused on fuel loads and implications for site productivity such that fuel hazard and fire modeling could be seamlessly conducted combining our two projects as desired. Dr. Bailey aims to submit a proposal in 2025 for a Phase II extension of that work, expanding fuel hazard estimates and forest plans to estimate landscape-scale wildfire risk. Data collected with this carnivore project would contribute to that effort.

Our scope would be within the redwood belt of coastal northern California, an area with a maritime climate that will likely allow for increased habitat retention with minimal impacts to predicted fire risk compared to drier and warmer regions of California. This work would address complicated questions as to whether and how to best promote wildlife habitat in a unique geographic area.

2. Research Methods:

If selected, we envision one of 3 options described in the deliverables and timeline section. All options focus on addressing aspects in Themes 6, 9, and 10.

If we were to focus on collecting vegetation and fuel data at known marten locations and random locations and analyzing selection (option 1), we would directly address Theme 6 by describing use of post-treatment slash as habitat structures (or the lack thereof) and by describing the vegetation and fuel aspects selected for by martens. Additionally, we would address Themes 9 (Wildlife Cumulative impacts) by providing direction to promote and not adversely affect wildlife species, 10 (Wildlife structures) by evaluating the prevalence and type of structures used.

If we were to increase geographic scope and focus on fishers (option 2), we would address the same themes. Fishers appear much more likely to use slash piles compared to martens (Ellison et al., unpublished). For example, fishers were detected at 25% of monitored slash piles in coastal northern California while martens were only detected at 2% (Ellison et al., unpublished; Figure 1). It would be a boon to identify fisher movement and use in similar and extended areas compared to coastal marten.

Figure 1. A pacific fisher (Pekania pennanti) was detected on remote camera at a slash pile on private timber land in coastal northern California. NCASI biologists monitored > 130 slash pile sites in this area where fisher and Humboldt marten (Martes caurina humboldtensis) populations overlap. Fisher were detected at 25% of monitored sites while martens were detected at only 2% of monitored sites.

Lastly, these data are difficult to collect and often not fully utilized. Here (option 3), we aim to increase collaborations on fuel hazard and wildfire risk – both locally with increases in slash pile occurrence and broadly across landscapes. We would need new expanded field data to inform future fire

behavior models and evaluate increases in flame length and predicted spread given the retention of slash piles for wildlife habitat. This option would directly address Theme 6, including how best to manage fuel loads, vegetation patterns and fuel breaks, fire hazard reduction and overall wildfire risk mitigation in order to promote and maintain forest resistance and resilience while minimizing adverse impacts to wildlife habitat and resting/denning structures.

Given a selected option, we will first conduct a power analysis to inform the number of vegetation plots needed to robustly address critical questions and characterize potential uncertainty. Specifically, with this minimum goal in mind, we would implement the following methods under each option:

Option 1: Humboldt marten vegetation surveys and analyses

Given option 1, we will quantify vegetation selection characteristics relevant to martens. We have collected GPS data from coastal Humboldt martens since 2020, providing 100s of resting locations in coastal northern California primarily on Green Diamond Resource Company land (see methods in Hance et al. (2021), Movement Ecology). We have also identified both marten and fisher locations using scat detection dog teams and remote cameras, which can provide ecologically relevant locations for these elusive species. Specifically, we conducted paired searches in areas with large slash piles and in adjacent forest. A similar method could be employed on collaborator properties (Humboldt and Mendocino Redwood Company, Green Diamond Resource Company).

We will randomly select a subset of known used locations by martens for our reference sites, each paired with a random location within 7 km, which is an averaged daily distance moved for martens and fishers. We will prioritize known resting or denning locations, then areas of foraging based on detection dog team surveys, and last may consider recent camera detections to obtain a relevant sample size.

To reduce wildfire risk, potential treatments often remove understory vegetation and lower limbs of trees (ladder fuels). At each location (used/random), we will quantify canopy cover, basal area, snag density and size class, and woody material. Similar to Forest Inventory Analysis plots, we will establish three 18 meter (59.05 feet) transects at 30°, 150°, and 270° bearings. Along these transects, we will record canopy cover, horizontal cover, shrub and small tree cover, and assess woody volume, including large log volume and slash (Figure 2). To measure horizontal cover and obstruction relevant to martens, we will use a modified Robel pole method (Robel et al., 1970, Bello et al. 2001, Toledo and Herrick 2010).

To measure fuels, we will use an abbreviated version of the procedure described in Brown (1974) and used in the current EMC-2023-003 project. Within the first 1.8m, wood pieces under 0.6cm and 0.6cm-2.5cm diameter that intersect sub-transect will be tallied. Within the first 3m, we will additionally tally woody material between 2.5 and 7.6cm diameter. Throughout the total length of 18m, “logs” over 7.6cm diameter will be tallied, along with their length, diameter, and condition. This equates to 54m of log or large woody debris intersection, 18m of small wood, and 10.8m of small fire prone material tallied per plot. We will measure debris depth at three points per sub-transect by inserting a meter stick through the debris and measuring from the highest point of the debris and down past the litter layer to the duff below.

We will use decision trees to evaluate fine-scale vegetation use at marten resting and denning locations. Decision trees and other supervised machine learning approaches (e.g., random forest) attempt to model the relationship between a response and its predictors and offer powerful alternatives to traditional ecological modeling approaches (e.g., generalized linear models; De'ath

and Fabricius (2000), Olden et al. (2008)). We will build decision trees by incorporating plot-level data into a boosted C5.0 algorithm using the same methods reported within Delheimer et al. (2023); Figure 3). Vegetation data describing marten selection will be analyzed by Dr. Munro.

Figure.8¡.*NCASI field biologists measure (A) visual obstruction relevant to Humboldt martens using a modified Robel pole method, and (B) the diameter at breast height of a live Douglas fir (Pseudotsuga menziesii). Similar to our proposed EMC project, we (NCASI biologists) collected vegetation measurements at used Humboldt marten locations and random available forest plots in southern coastal Oregon from 2023 – 2024. These data will help NCASI and land managers in Oregon understand how to identify, preserve, and/or recruit key habitat components that martens need when managing forests for fuels reductions.*

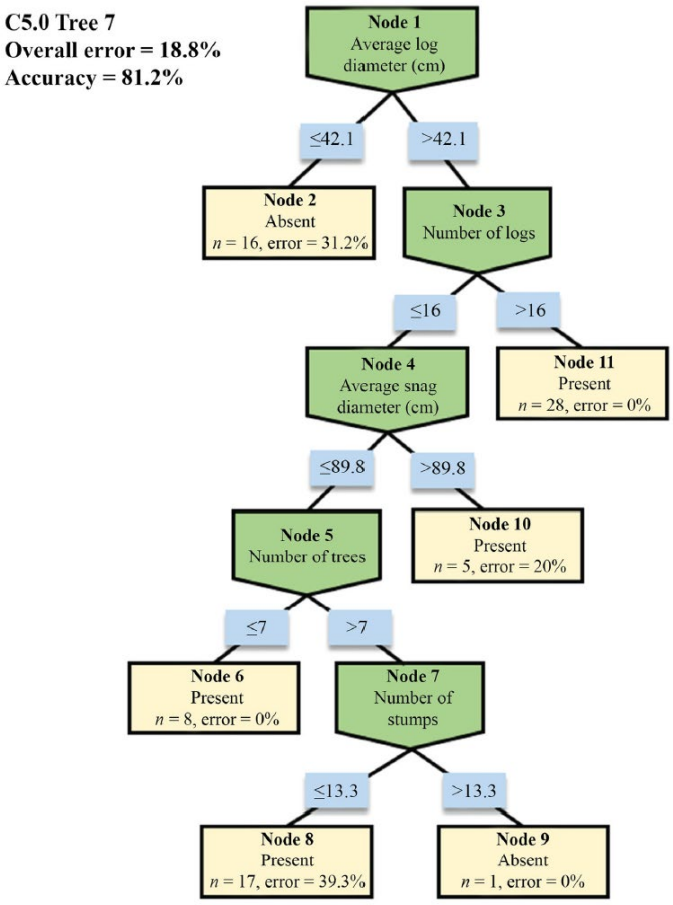

Figure 3. *To provide the flexibility within treatments that balance manager's needs and maintaining conditions for sensitive wildlife, an understanding of the conditions used by such species in similar geographic environments would both satisfy wildlife biologists and foresters. This is an example of a decision tree used to describe plot-level features at resting and denning locations of Pacific martens (Martes caurina) in northern California (published with Delheimer et al. 2023, Journal of Wildlife Management, Figure 5). Dr. Munro used the boosted C5.0 model to extract one of many iterations of the machine learning outputs where green boxes represent intermediate steps that corresponded with martens' rest and den sites and tan boxes represent a conclusion from that path (i.e., terminal node). The blue boxes indicate the feature split point. For example, if average log diameter was less than 42.1 cm (16.5"), then the likelihood of martens resting or denning in plots was low, representing 16 plots with these conditions but a fairly high amount of potential error (31%). If the average log size was greater than 42.1cm and there were greater than 16 logs within a plot, likelihood of marten resting or denning was high. By having 6 relatively diverse characters of what a site could look like, managers could recognize that not all locations need to have the same prescription. All 3 options described would involve collecting vegetation data and assessing conditions used or not-detected for martens, fishers, or both species.*

Option 2: Fisher location data, vegetation surveys and analyses

Given option 2, we will expand efforts to multiple landowners, collect GPS movement data on fishers in areas with current slash piles, and quantify vegetation selection characteristics relevant to fishers.

We will expand efforts to include both Green Diamond Resource Company and Humboldt and Mendocino Redwood Company land. Here, we will perform pre-trapping surveys using remote cameras to identify areas of fisher use (Cal Poly Humboldt IACUC # 2020W98, Supplemental attachment). At these areas, we will trap and collar fishers with GPS and VHF telemetry enabled devices following the guidelines under our approved Animal Care and Use Permit (Cal Poly Humboldt IACUC # 2022W62-A, Supplemental attachment). Field personnel will then use VHF telemetry to remotely download GPS movement data and locate fishers at rest and den structures. Additional rest sites will be identified through GPS movement data (see methods in Hance et al. 2021).

We will then collect vegetation and fuels data, as described under option 1, at fisher rest and den sites identified from GPS movement and/or telemetry data paired with random locations within 7 km. Similarly, we will prioritize known fisher resting or denning locations, then areas of foraging based on detection dog team surveys, and last may consider recent camera detections to obtain a relevant sample size. Vegetation data describing fisher selection will be analyzed by Dr. Munro as described under option 1.

Option 3: Forest carnivore vegetation use

Given option 3, we will expand efforts to multiple landowners, collect GPS movement data on fishers in areas with current slash piles, and quantify vegetation and fuels measurements at marten and fisher used and random vegetation plots (as described under options 1 and 2). This option provides the most robust dataset for future fire risk modeling relevant to these areas given current forest practices, evaluates opportunities for both fishers and martens, and is most cost efficient overall. We gain significant benefits from the combined project due to flexibility in workloads and timing. For instance, while crews collect vegetation data for martens within this fiscal year, they can simultaneously set cameras in remote sites to scout for fisher trap locations. Fisher trapping can seamlessly occur. The crews are currently trained and efficient at collecting both vegetation data and handling these rare indicator species.

Vegetation data describing marten and fisher selection will be analyzed by Dr. Munro as described under option 1.

We believe this proposal has value to land managers and would address several EMC themes and critical monitoring questions. We provide information focused on several themes centered around maintenance of functional/suitable wildlife habitat and technical rule addendum #2 that provides guidance on assessment of snags and den trees, downed large woody debris, hardwoods, and habitat continuity. Because some of the difficult location data are already collected, this addition provides a unique opportunity to study marten and fisher on managed timberlands relative to these topics.

3. Scientific Uncertainty and Geographic Application:

We strongly believe there is high scientific uncertainty of the effectiveness of the FPRs relevant to protecting sensitive wildlife species while reducing fire hazards associated with timber operations. There is currently a dearth of knowledge necessary for land managers to identify and protect structures and other habitat conditions required by marten and fisher as mandated (14 CCR § 919 [939, 959], 16 U.S.C. § 1531(a)(3)). Our study would directly address this incomplete knowledge by characterizing sites and structures used and minimally required by marten (Options 1, 3) and/or fisher (Options 2, 3).

Additionally, several of the FPRs aimed at hazard reductions may result in the removal of structures beneficial to wildlife such as marten and fisher (14 CCR § 917.2 [937]). However, given the cooler temperatures and higher humidity of coastal northern California, we aim to build a dataset that will robustly address whether, and how much, hazard reduction practices may be safely altered in these areas in favor of marten and fisher conservation.

We propose an observational study, but one where we can first conduct a power analysis to inform the number of vegetation plots needed to characterize potential uncertainty. Because of the lack of information on marten and fisher habitat, even small datasets can provide significant value.

Data collection and implementation would be most appropriate within the coastal region of northern California, including Del Norte, Humboldt, and Mendocino counties. Information learned could be broadly extrapolated to much of the range of coastal martens in northwest California and southwest Oregon. We have just finished collecting complementary vegetation datasets in southern Oregon at used marten locations, including rest structures, and paired random locations (Figure 2, Figure 4). For example, preliminary data examination shows us that martens use sites with slightly higher median values of tree diameter, shrub cover, and horizontal cover, but may avoid sites with low average tree diameter, shrub cover, and horizontal cover despite availability on the landscape (Figure 5). These data could be synergistically combined with our proposed study and with those collected presently by Dr. John Bailey (EMC 2023-003) and his team. Together, these data would provide much needed guidance for both public and private land managers on how to retain sites and structures essential for marten and fisher when planning and conducting critical fuels reductions. Additionally, combining these products would provide a robust dataset for future fire risk modeling necessary to guide managers on the tradeoffs of fire risks when promoting wildlife habitat for sensitive species.

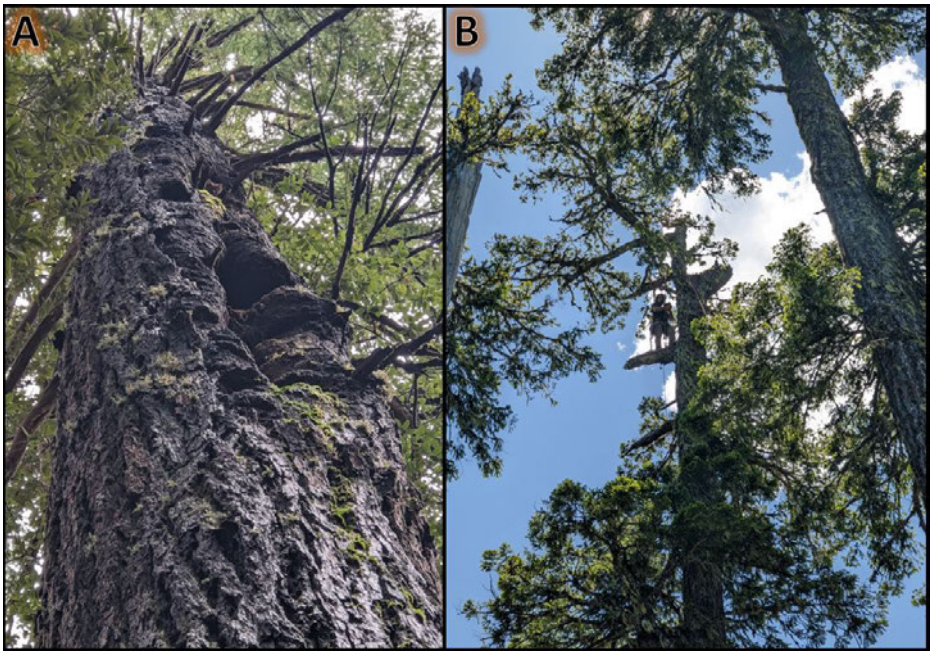

Figure 4. *Coastal Humboldt marten (Martes caurina humboldtensis) rest structures in Rogue Siskiyou National Forest of southwestern Oregon. NCASI biologists used VHF telemetry to track (A) female marten #11 to a cavity within a live Douglas fir tree and (B) male marten #10 to a broken top within a live Douglas fir where certified tree climber M. Stevens identified the used microsite. NCASI biologists then collected vegetation plot data at these structures including, but not limited to, shrub cover, canopy cover, and basal area.*

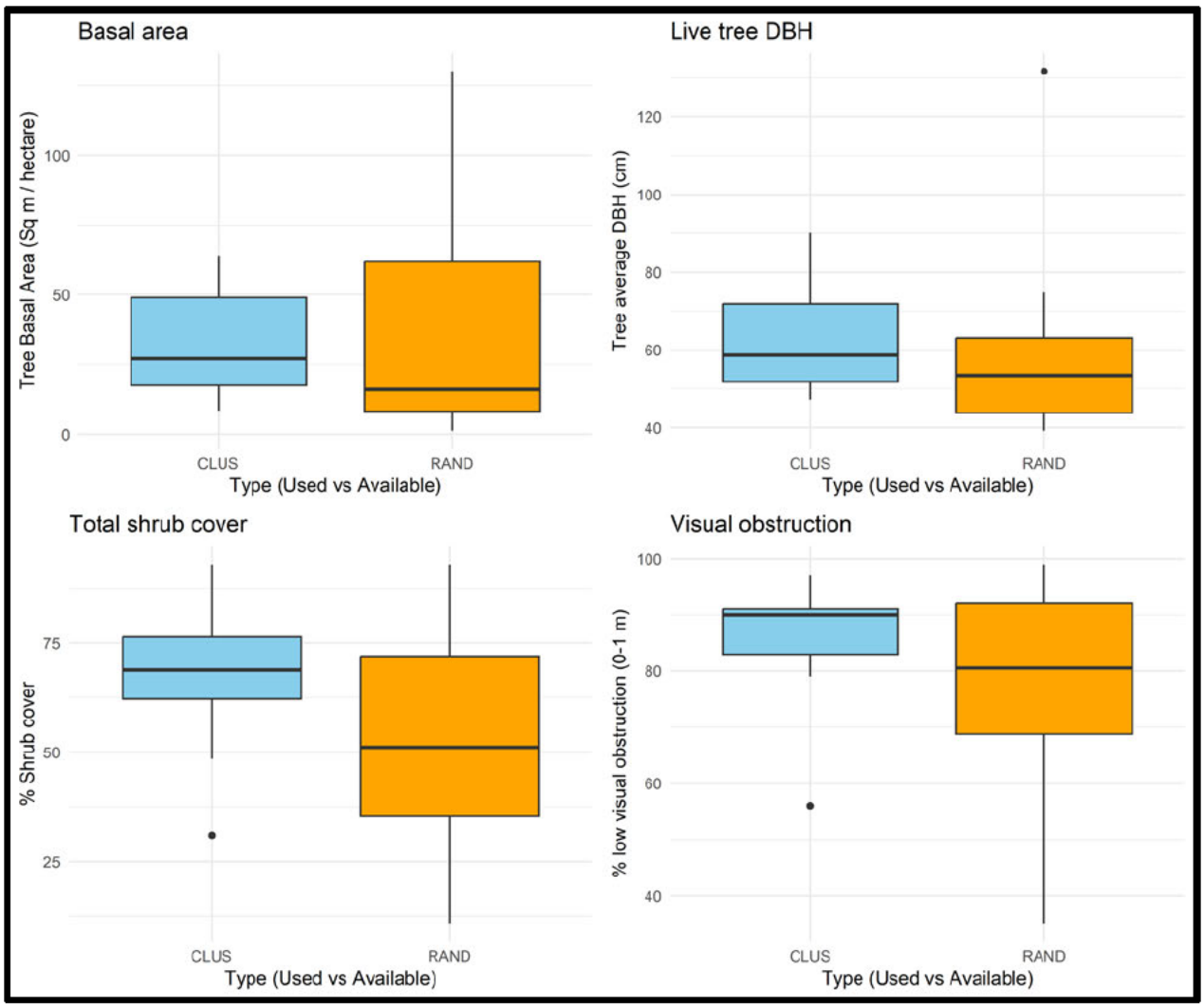

***Figure 5**. A preliminary examination of a subset of vegetation variables collected at used marten sites revealed by GPS clustering and lack of movement (CLUS, blue, n = 12) compared to random available sites (RAND, orange, n = 23), including: basal area in m2 / hectare (top left), average live tree diameter at breast height (DBH, top right), average total percent shrub cover (bottom left), and percent visual obstruction (or horizontal cover) from 0 – 1 m off the ground (bottom right). NCASI biologists collected these data in Rogue Siskiyou National Forest in southwestern Oregon in 2023, and these do not represent the entire dataset of variables collected through 2024.*

Literature Cited

De'ath, G., and K. E. Fabricius. 2000. Classification and regression trees: a powerful yet simple technique for ecological data analysis. Ecology 81:3178-3192.

Delheimer, M. S., K. M. Moriarty, H. L. Munro, D. A. Early, K. A. Hamm, and R. E. Green. 2023. Structural complexity characterizes fine-scale forest conditions used by Pacific martens. The Journal of Wildlife Management 87:e22388.

Hance, D. J., K. M. Moriarty, B. A. Hollen, and R. W. Perry. 2021. Identifying resting locations of a small elusive forest carnivore using a two-stage model accounting for GPS measurement error and hidden behavioral states. Movement Ecology 9:1-22.

Olden, J. D., J. J. Lawler, and N. L. Poff. 2008. Machine learning methods without tears: a primer for ecologists. The Quarterly Review of Biology 83:171-193.

4. Critical Questions and Forest Practice Regulations Addressed:

Theme 6: Wildfire Hazard

Critical Monitoring Question	Proposal focus
a) treating post-harvest slash and slash piles to mitigate fuel hazard, modify fire behavior and reduce wildfire risk?	We will use the same protocols for woody-material data collection as described and executed within EMC-2023-003 (John Bailey PI). As such, we can combine data sets in the future to model fire and fire behavior directly across a broader landscape and within the context of wildlife habitat suitability.
b) treating post-harvest slash while retaining wildlife habitat structures, including snags and large woody debris?	Our proposal will directly enumerate the number and types of structures used by martens (Options 1, 3) and/or fishers (Options 2, 3), allowing managers to identify characteristics beneficial to sensitive species post-harvest and into the future.
c) managing fuel loads, vegetation patterns and fuel breaks for landscape-level fire hazard reduction and risk mitigation? (Thematic question for Fiscal Year 2024/2025 funding).	By evaluating fuel quantity, distribution, size, and patterns, we will provide the foundation for fire hazard modeling and strategic risk planning in an area that has more moisture and, presumably, less risk than much of California's forests.
d) managing forest structure and stocking standards over time to promote and maintain wildfire resistance and resilience? (Thematic question for Fiscal Year 2024/2025 funding).	Our results would strategically inform land management opportunities to balance management activities reducing wildfire risk while maintaining sensitive species' habitat use by providing metrics in managed stands used by martens (Options 1, 3) and/or fishers (Options 2, 3). Terrestrial specialists, such as these two species, are highly sensitive to landscape change including treatments that reduce fuel loading.

Theme 9: Wildlife Habitat: Cumulative Impact

Are the FPRs and associated regulations effective in...

Critical Monitoring Question	Proposal focus
a) protecting wildlife habitat and associated ecological processes?	Within a use-available framework, our study will provide foundational knowledge of biological habitat conditions suitable for martens (Options 1, 3) and/or fishers (Options 2, 3). This knowledge is currently meager, and our results will directly aid land managers in planning and conducting fuels and timber operations while retaining and/or recruiting suitable habitat for sensitive forest carnivores.
b) avoiding significant adverse impacts to wildlife species?	Results from this study will directly inform whether current fuels reduction prescriptions are effective at maintaining habitat, and key habitat elements (e.g., LWD and snags), for sensitive wildlife species.

Theme 10: Wildlife Habitat: Structures

Are the FPRs and associated regulations effective in retaining...

Critical Monitoring Question	Proposal focus
a) a mix of stages of snag development that maintain properly functioning levels of wildlife habitat?	Within a use-available framework, our proposal will directly enumerate the number and stages of snags and other structural elements minimally sufficient to maintain functional wildlife habitat for martens (Options 1, 3) and/or fishers (Options 2, 3).

Forest Practice Rules and Regulations:

Article	FPR	Proposal focus
Article 2. Timber Harvesting Plan	14 CCR § 1038	Pursuant to this rule, timber operations that include the cutting or removal of trees which eliminates the vertical continuity of vegetative fuels and the horizontal continuity of tree crowns for the purpose of reducing flammable materials and maintaining a fuelbreak to reduce fire spread, duration and intensity are exempt from standard THP preparation and submission requirements. However, 1038 also requires that no known sites of rare, threatened, or endangered plants or animals will be disturbed or damaged. This study will increase our understanding of the possible impacts of such operations on sensitive species habitat.
	14 CCR § 1051.4	We address operational standards under Modified Timber Harvesting Plans for Fuel Hazard Reduction by addressing the presumption that activities are unlikely to cause significant adverse impact, in this case by evaluating marten (Options 1/3) and/or fisher (Options 2/3) habitat use. Although this rule applies to owners with 160 acres or less (and this project would be on larger landowners), the results would broadly apply for this region.
Article 3. Silvicultural Methods	14 CCR § 913.4	By focusing on specific Retention Trees of value to wildlife, this rule focuses on larger trees that might be den, nest, or rest structures used by wildlife. The results of this study will help to inform what specific elements should have priority for retention.
	14 CCR § 933.4	This rule focuses on Aggregated Retention Area that may conform or move towards Late Succession Forest Stands or similar areas. These retention locations may be better informed for the purpose of sensitive wildlife by placement in areas used by martens or fishers.
	14 CCR § 953.4	Special prescription or treatment areas allow intermediate treatments within a Timber Harvest Plan, which might include varied harvests or retention of slash piles.
Article 7. Hazard Reduction	14 CCR § 917.2	Within the coastal district, slash and coarse woody debris >1" and <8" in diameter must be removed or piled and burned. Here, some of the larger material may benefit wildlife use and connectivity by retaining such structures. The data to inform the retention of these structures is currently unavailable.
	14 CCR § 937	This rule aims to reduce fire hazards associated with timber operations. Within the northern coast range, there may be less risk of fire hazards with the cool temperatures and high humidity. Data to inform strategic retention of piles could benefit wildlife.
Article 9. Wildlife Protection Practices	14 CCR § 919	This rule focuses on the protection of specific structures, including nest (and den) sites for sensitive species. Leaving designated trees unharmed would benefit from data collected using a combination of GPS collar and fine scale movement data transformed to such structures with a combination of hidden Markov and state-space models.

	14 CCR § 939	This rule entails planning timber operations to be planned and conducted in a way that maintains suitable habitat for wildlife species. In coastal northern California, managers could benefit from detailed information of marten and fisher habitat use as proposed within.
	14 CCR § 959	This rule focuses on overall habitat maintenance, including retaining diverse forest structure, snags and downed wood, wildlife corridors, potential enhancement of an area by creating den trees or retaining such structures. This rule also includes a monitoring component. Here, we aim to monitor sites directly and provide prescriptive information to inform future treatments to enhance habitat over time.
Article 7. Conversion Exemptions	14 CCR § 1104.1	Unless otherwise required, slash and coarse woody debris >1" in diameter and >2' long must receive full treatment no later than April 1 of the following year unless exempted. Here, we predict piles of larger material will benefit wildlife use and connectivity by retaining such structures. The data to inform these structures is currently unavailable. This particular article appears fairly uncommon, but may apply to other landowners within this region especially if fishers rest in piles with particular characteristics.
	16 U.S.C. § 1531(a)(3)	Under the Endangered Species Act, conservation programs and focused efforts are vital for threatened species, such as coastal marten. This project helps provide information to balance active forest management with prescriptions and information to aid in species conservation by identifying the conditions used versus areas that were available to individuals but not visited.

5. Roles, Collaborations, and Project Feasibility

NCASI Foundation will execute contracts, invoices, and provide integration with NCASI, Inc. with the project lead PI, who is responsible for project oversight, hiring and training of staff, progress reports, and deliverables. Susan McCord, Director, NCASI Foundation has 25yrs experience in contracts and grants management.

Principal investigator Katie Moriarty, Senior Research Scientist, specializes in rare and elusive forest-dependent species. Her research focuses on sustainable forestry, balancing the needs of sensitive wildlife species, and biodiversity. She has been working with martens and fishers for over 20 years and is leading a team designated by the IUCN to assess Pacific marten Red List status. She and her teams have published over 40 peer-reviewed papers specifically on forest management and either martens and fishers, focusing on providing science-based information for managers to assess risk and opportunities.

Principal investigator Holly Munro, Senior Research Scientist, has conducted forest biometrical and ecological research for 10 years. Her research has been at the intersection of forest biometrics, disturbance ecology, remote sensing, and machine learning applications. Through research collaborations she has co-authored approximately 24 peer-reviewed and outreach papers, technical reports, and large-scale environmental datasets.

John Bailey, Professor of Silviculture and Fire Management in Oregon State University's College of Forestry, specializes in characterizing the effects of fuels treatments on wildfire risk and forest health.

His research focuses on using traditional and experimental silviculture practices to achieve a spectrum of management objectives including sustainable wood production and wildlife habitat. His current EMC project is initiating our understanding of variable retention and selection harvesting on fuel loads and fire hazard; this work would expand that data set while linking wildlife habitat conservation.

Green Diamond Resource Company owns and manages approximately 400,000 acres in three northern California counties. Green Diamond Resource Company will provide access to existing site data, including marten and fisher locations from their research, access to GIS data at locations of interest, access to land, and field assistance with plot measurements. Keith Hamm and Desiree Early have over 25 and 12 years of experience respectively with the development and execution of silviculture and wildlife focused projects. Hamm and Early will participate in planning discussions including proposal development such that information can directly integrate into Green Diamond's workflow, facilitate information transfer, delegate coordination with field crews for safety and data collection, and review all products.

Humboldt and Mendocino Redwood Companies own and manage approximately 440,000 acres primarily in Humboldt, Mendocino, and Sonoma Counties in coastal northern California. Humboldt and Mendocino Redwood Company will provide access to existing site data, including fisher locations from previous surveys, access to GIS data at locations of interest, access to land for these proposed surveys (fisher only), and field assistance with plot measurements. Sal Chinnici has over 25 years of experience with the development and execution of silviculture and wildlife focused projects for Humboldt and Mendocino Redwood Companies. Chinnici will participate in planning discussions including proposal development such that information can directly integrate into Green Diamond's workflow, facilitate information transfer, delegate coordination with field crews for safety and data collection, and review all products.

Jessica Buskirk, Wildlife Biologist, has over 12 years of experience with wildlife capture and immobilization, field data collection, and thinking critically and creatively about wildlife data in applied settings such as sustainable forestry practices. Buskirk will interface directly with PIs and landowners to design the study to meet expectations, lead field crew hiring and training, maintain communication regarding forestry operations and NCASI staff access, manage workflow of field teams, and provide data summaries as requested.

Project feasibility is extremely high if support is considered for this fiscal year. We currently have a highly trained crew, federal, state, and animal care and use permits or permissions, and experienced collaborators. Unfortunately, our team is on soft money and will be dispersed unless we are successful at grants. Hiring a new team later would be significantly more costly due to the need for training all aspects of the methods. Further, the timing to pair this endeavor and vegetation data with EMC-2023-003 (John Bailey PI) would maximize products useful to the EMC and California practitioners efficiently.

Budget justification

To provide increased flexibility, we provide 3 options for consideration, each with an estimated budget and justification under 200 words. We order these from most complex and costly to least, please also see detailed budgets within.

Option 3: Forest carnivores, vegetation, and fuel characteristics; $315,388: We request funds to expand efforts to multiple landowners to collect GPS data on fishers in areas with current slash piles as well as collect vegetation data to evaluate both coastal marten and fisher use. Funding largely would be

allocated to staff for multiple field and data endeavors [pre-trapping surveys (cameras in kind), trapping and collaring, telemetry (receivers/antennas in kind), data processing] and vegetation surveys at both the previously determined marten sites and newly collected fisher locations. Staff time and fringe benefits would cost approximately $278,888 over 3 fiscal years (see budget below and supplemental). Supplies, GPS collars, would cost $14,500 and travel (vehicle + fuel) would cost approximately $19,500. We would collect vegetation data with added work to collect understory fuel and fire related metrics (e.g., modified Brown transects) which would seamlessly allow for fire modeling for assessing risk given current practices. Indirect costs to the NCASI Foundation would be 10% on the first $25,000 for a total of $2,500. Our total estimated cost to the EMC would be $315,388 with an estimated project cost, including in-kind support, of $508,477.

Option 2: Fisher GPS data and vegetation surveys; $262,784: We request funds to expand efforts to multiple landowners to collect GPS data on fishers in areas with current slash piles as well as collect vegetation data. Funding largely would be allocated to staff for both fisher endeavors [pre-trapping surveys (cameras in kind), trapping and collaring, telemetry (receivers/antennas in kind), data processing] and vegetation surveys at both the previously determined sites and newly collected fisher locations. Staff time would cost approximately $229,284 over 3 fiscal years (see attached budget). Supplies, GPS collars, would cost $14,500 and travel (vehicle + fuel) would cost $16,500. Indirect costs to the NCASI Foundation would be 10% on the first $25,000 for a total of $2,500. Our total estimated cost would be $262,784 with an estimated project cost, including in-kind support, of $430,877.

Option 1: Fuel, slash, vegetation surveys and analysis with pre-existing data from coastal martens; $74,862: We request funds to collect vegetation data to evaluate vegetation conditions on private lands focused on coastal marten use. We would expend approximately $67,862 on field crew expenses to measure vegetation characteristics at previously collected known marten rest, den, and random locations and analyze data to better describe characteristics to inform fuel treatments and possible restoration activities. We would spend approximately $4,500 on travel (vehicle and fuel). Indirect costs to the NCASI Foundation would be 10% on the first $25,000 for a total of $2,500. Our total estimated cost would be $74,682 with an estimated project cost, including in-kind support, of $113,267.

6. Project Deliverables

For all options, we expect at least 2 scientific presentations at professional society conferences and additional presentations as requested for either landowners or the EMC board. Moriarty, Bailey, and Munro have a strong track record for peer-reviewed publications. We anticipate at least 1 publication from any of the described options. As displayed in the timeline table below, we also will provide annual progress reports.

OPTION 3	FY 2024/25			FY 2025/26				FY 2026/27		
Task	Oct '24	Jan '25	Apr '25	Jul '25	Oct '25	Jan '26	Apr '26	Jul '26	Oct '26	Jan '27
Identify marten rest areas from recent GPS collar data (*in kind)*										
Coordinate study design with partners		EMC								EMC
Pre-trapping camera surveys										
Trap, collar fisher, identify rest and den locations		START								END
Measure vegetation characteristics										
Summarize/analyze data			PR1		PR2		PR3		PR4	
Compile final report										
OPTION 2	FY 2024/25			FY 2025/26				FY 2026/27		
Task	Oct '24	Jan '25	Apr '25	Jul '25	Oct '25	Jan '26	Apr '26	Jul '26	Oct '26	Jan '27
Coordinate study design with partners		EMC							EMC	
Pre-trapping camera surveys *(initially in kind, continues with award)*		START							END	
Trap, collar fisher, identify rest and den locations										
Measure vegetation characteristics										
Summarize/analyze data			PR1		PR2		PR3			
Compile final report										
OPTION 1	FY 2024/25			FY 2025/26				FY 2026/27		
Task	Oct '24	Jan '25	Apr '25	Jul '25	Oct '25	Jan '26	Apr '26	Jul '26	Oct '26	Jan '27
Identify marten rest areas from recent GPS collar data (*in kind)*										
Coordinate study design with partners		EMC			EMC					
Measure vegetation characteristics										
Summarize/analyze data			PR1							
Compile final report										

PR - Progress report deliverable

7. Requested Funding

Option 3 - EMC request: $315,388			*Estimated project cost:*		*$508,477*			
			2024-2025		2025-2026		2026-2027	
	Cost per Unit		**Number Units - Year 1**	**Total - Year 1**	**Number Units - Year 2**	**Total - Year 2**	**Number Units - Year 3**	**Total - Year 3**	**Total - All Years**
Personnel (4% raise per year included in sum)									
Jessica Buskirk, project manager and fi	$4,600 / month		4	18,400	10	47,840	6	29,808	96,048
Alyssa Roddy, trained capture lead	$4,200 / month		3.5	14,700	7	30,576	2.5	11,340	56,616
Mark Stevens, trained capture	$4,000 / month		3.5	14,000	7	29,120	2.5	10,800	53,920
Total Salary				**$47,100**		**$107,536**		**$51,948**	**$206,584**
Fringe benefits									
Jessica Buskirk, project manager and fi	0.35	35%		6,440		16,744		10,433	33,617
Alyssa Roddy, trained capture lead	0.35	35%		5,145		10,702		3,969	19,816
Mark Stevens, trained capture	0.35	35%		4,900		10,192		3,780	18,872
Total Fringe				**$16,485**		**$37,638**		**$18,182**	**$72,304**
SALARY & FRINGE COSTS				**$63,585**		**$145,174**		**$70,130**	**$278,888**
Operating expenses/supplies									
Lotek GPS collars	1450 / collar		0	0	10	14,500		0	14,500
Total Supplies & Services				**$0**		**$14,500**		**$0**	**$14,500**
Travel									
Vehicle 1 - rental from NCASI	$800 / month		4	3,200	7	5,600	2	1,600	10,400
Vehicle 1 - fuel	$700 / month		4	2,800	7	4,900	2	1,400	9,100
Total Travel Costs				**$6,000**		**$10,500**		**$3,000**	**$19,500**
TOTAL DIRECT COSTS				**$69,585**		**$170,174**		**$73,130**	**$312,888**
Indirect costs: NCASI Foundation 10% overhead on first $25,000				2,500					
EMC Funding Requested				**$72,085**		**$170,174**		**$73,130**	**$315,388**
Principal Investigators *(in-kind)*									
Katie Moriarty	$7,750 / month		0.75	5,813	0.5	4,030	0.75	6,278	16,120
John Bailey	$10,833 / month		0.25	2,708	0.25	2,817	0.5	5,850	11,375
Holly Munro	$7,750 / month		0.25	1,938	0.5	4,030	0.75	6,278	12,245
Total Salary *(in-kind)*				**$10,458**		**$10,877**		**$18,405**	**$39,740**
Fringe benefits									
Katie Moriarty	0.35	35%		2,034		1,411		2,197	5,642
John Bailey	0.35	35%		948		986		2,048	3,981
Holly Munro	0.35	35%		678		1,411		2,197	4,286
Total Fringe Estimate *(in-kind)*				**$3,660**		**$3,807**		**$6,442**	**$13,909**
SALARY & FRINGE COSTS *(in-kind)*				**$14,119**		**$14,684**		**$24,847**	**$53,649**
Operating expenses/supplies *(in-kind)*									
Lotek GPS collars	1450 / collar		0	0	2	2,900		0	2,900
Field computer, external hard drives	1500 /computer		1	1,500	1	1,500	1	1,500	4,500
Field packs, GPS, measurement tools,	800 /person		3	2,400	3	2,400	3	2,400	7,200
Cameras *(in-kind)*	200 / camera		100	20,000	100	20,000		0	40,000
Lithium batteries *(in-kind)*	16 / 8 batteries/ came		800	12,800	800	12,800		0	25,600
Total Supplies & Services				**$36,700**		**$39,600**		**$3,900**	**$80,200**
Travel									
Vehicle 2 - rental from NCASI	$800 / month		4	3,200	7	5,600	2	1,600	10,400
Vehicle 2 - fuel	$700 / month		4	2,800	7	4,900	2	1,400	9,100
Total Travel Costs				**$6,000**		**$10,500**		**$3,000**	**$19,500**
TOTAL IN-KIND COSTS				**$67,277**		**$75,660**		**$50,152**	**$193,089**
Project Cost				**$139,362**		**$245,834**		**$123,282**	**$508,477**

Option 2 - EMC Request: $262,784			Estimated project cost:		$430,877			
			2024-2025		2025-2026		2026-2027	
	Cost per Unit		Number Units - Year 1	Total - Year 1	Number Units - Year 2	Total - Year 2	Number Units - Year 3	Total - Year 3	Total - All Years
Personnel (4% raise per year included in sum)									
Jessica Buskirk, project manager and fi	$4,600 / month		4	18,400	9	43,056	3	14,904	76,360
Alyssa Roddy, trained capture lead	$4,200 / month		3	12,600	6	26,208	2	9,072	47,880
Mark Stevens, trained capture	$4,000 / month		3	12,000	6	24,960	2	8,640	45,600
Total Salary				**$43,000**		**$94,224**		**$32,616**	**$169,840**
Fringe benefits									
Jessica Buskirk, project manager and fi	0.35	35%		6,440		15,070		5,216	26,726
Alyssa Roddy, trained capture lead	0.35	35%		4,410		9,173		3,175	16,758
Mark Stevens, trained capture	0.35	35%		4,200		8,736		3,024	15,960
Total Fringe				**$15,050**		**$32,978**		**$11,416**	**$59,444**
SALARY & FRINGE COSTS				**$58,050**		**$127,202**		**$44,032**	**$229,284**
Operating expenses/supplies									
Lotek GPS collars	1450 / collar		0	0	10	14,500		0	14,500
Total Supplies & Services				**$0**		**$14,500**		**$0**	**$14,500**
Travel									
Vehicle 1 - rental from NCASI	$800 / month		3	2,400	6	4,800	2	1,600	8,800
Vehicle 1 - fuel	$700 / month		3	2,100	6	4,200	2	1,400	7,700
Total Travel Costs				**$4,500**		**$9,000**		**$3,000**	**$16,500**
TOTAL DIRECT COSTS				**$62,550**		**$150,702**		**$47,032**	**$260,284**
Indirect costs: NCASI Foundation 10% overhead on first $25,000				2,500					
EMC Funding Requested				**$65,050**		**$150,702**		**$47,032**	**$262,784**
Principal Investigators *(in-kind)*									
Katie Moriarty	$7,750 / month		0.75	5,813	0.5	4,030	0.5	4,185	14,028
John Bailey	$10,833 / month		0.1	1,083	0.1	1,127	0.5	5,850	8,060
Holly Munro	$7,750 / month			0	0.25	2,015	0.75	6,278	8,293
Total Salary *(in-kind)*				**$6,896**		**$7,172**		**$16,313**	**$30,380**
Fringe benefits									
Katie Moriarty	0.35	35%		2,034		1,411		1,465	4,910
John Bailey	0.35	35%		379		394		2,048	2,821
Holly Munro	0.35	35%		0		705		2,197	2,902
Total Fringe Estimate *(in-kind)*				**$2,414**		**$2,510**		**$5,709**	**$10,633**
SALARY & FRINGE COSTS *(in-kind)*				**$9,309**		**$9,682**		**$22,022**	**$41,013**
Operating expenses/supplies *(in-kind)*									
Lotek GPS collars	1450 / collar		0	0	2	2,900		0	2,900
Field computer, external hard drives	1500 /computer		1	1,500	1	1,500	1	1,500	4,500
Field packs, GPS, measurement tools,	800 /person		3	2,400	3	2,400	3	2,400	7,200
Cameras *(in-kind)*	200 / camera		100	20,000	100	20,000		0	40,000
Lithium batteries *(in-kind)*	16 / 8 batteries/ came		800	12,800	800	12,800		0	25,600
Total Supplies & Services				**$36,700**		**$39,600**		**$3,900**	**$80,200**
Travel									
Vehicle 2 - rental from NCASI	$800 / month		3	2,400	6	4,800	2	1,600	8,800
Vehicle 2 - fuel	$700 / month		3	2,100	6	4,200	2	1,400	7,700
Total Travel Costs				**$4,500**		**$9,000**		**$3,000**	**$16,500**
TOTAL IN-KIND COSTS				**$57,405**		**$65,453**		**$45,234**	**$168,093**
Project Cost				**$122,455**		**$216,156**		**$92,266**	**$430,877**

Option 1 - EMC Request: $74,862			*Estimated project cost:*		*$113,267*			
			2024-2025		2025-2026		2026-2027	
	Cost per Unit		**Number Units - Year 1**	**Total - Year 1**	**Number Units - Year 2**	**Total - Year 2**	**Number Units - Year 3**	**Total - Year 3**	**Total - All Years**
Personnel (4% raise per year included in sum)									
Jessica Buskirk, project manager and fie	$4,600 / month		3.5	16,100	2	9,568		0	25,668
Alyssa Roddy, trained capture lead	$4,200 / month		3	12,600		0		0	12,600
Mark Stevens, trained capture	$4,000 / month		3	12,000		0		0	12,000
Total Salary				**$40,700**		**$9,568**		**$0**	**$50,268**
Fringe benefits									
Jessica Buskirk, project manager and fie	0.35	35%		5,635		3,349		0	8,984
Alyssa Roddy, trained capture lead	0.35	35%		4,410		0		0	4,410
Mark Stevens, trained capture	0.35	35%		4,200		0		0	4,200
Total Fringe				**$14,245**		**$3,349**		**$0**	**$17,594**
SALARY & FRINGE COSTS				**$54,945**		**$12,917**		**$0**	**$67,862**
Operating expenses/supplies									
Lotek GPS collars	1450 / collar			0		0		0	0
Total Supplies & Services				**$0**		**$0**		**$0**	**$0**
Travel									
Vehicle 1 - rental from NCASI	$800 / month		3	2,400		0		0	2,400
Vehicle 1 - fuel	$700 / month		3	2,100		0		0	2,100
Total Travel Costs				**$4,500**		**$0**		**$0**	**$4,500**
SUBAWARDS									
				0			0		0
Total Subawards				**$0**		**$0**		**$0**	**$0**
TOTAL DIRECT COSTS				**$59,445**		**$12,917**		**$0**	**$72,362**
Indirect costs: NCASI Foundation 10% overhead on first $25,000				2,500					
EMC Funding Requested				**$61,945**		**$12,917**		**$0**	**$74,862**
Principal Investigators *(in-kind)*									
Katie Moriarty	$7,750 / month		0.5	3,875	0.25	2,015		0	5,890
John Bailey	$10,833 / month		0.1	1,083	0.1	1,127		0	2,210
Holly Munro	$7,750 / month			0	0.5	4,030		0	4,030
Total Salary *(in-kind)*				**$4,958**		**$7,172**		**$0**	**$12,130**
Fringe benefits									
Katie Moriarty	0.35	35%		1,356		705		0	2,062
John Bailey	0.35	35%		379		394		0	774
Holly Munro	0.35	35%		0		1,411		0	1,411
Total Fringe Estimate *(in-kind)*				**$1,735**		**$2,510**		**$0**	**$4,246**
SALARY & FRINGE COSTS *(in-kind)*				**$6,694**		**$9,682**		**$0**	**$16,376**
Operating expenses/supplies *(in-kind)*									
Lotek GPS collars	1450 / collar		0	0		0		0	0
Field computer, external hard drives	1500 /computer		1	1,500	1	1,500		0	3,000
Field packs, GPS, measurement tools, l	800 /person		3	2,400		0		0	2,400
Cameras *(in-kind)*	200 / camera			0		0		0	0
Lithium batteries *(in-kind)*	16 / 8 batteries/ camera			0		0		0	0
Total Supplies & Services				**$3,900**		**$1,500**		**$0**	**$5,400**
Travel									
Vehicle 2 - rental from NCASI	$800 / month		3	2,400		0		0	2,400
Vehicle 2 - fuel	$700 / month		3	2,100		0		0	2,100
Total Travel Costs				**$4,500**		**$0**		**$0**	**$4,500**
TOTAL IN-KIND COSTS				**$20,052**		**$18,353**		**$0**	**$38,406**
Project Cost				**$81,997**		**$31,270**		**$0**	**$113,267**

8. Required Forms and Relevant Information

- Full proposal
    - *2024-001_a_MoriartyEt_FullProposal_240719 (this document)*
- Letter of Support - Green Diamond Resource Company:
    - *2024-001_b_LetterOfSupport_GreenDiamond*
- Letter of Support - Humboldt and Mendicino Redwood Company:
    - *2024-001_c_LetterOfSupport_HumboldtMendicino*
- Letter of Support – USFWS
    - *2024-001_d_LetterOfSupport_USFWS*
- Detailed Budgets in Excel
    - *2024-001_e_NCASI-FoundationBudgets*
- Employer Identification Number (EIN) for NCASI Foundation: **31-1745612**
- Sample Resolution for the NCASI Foundation
    - *2024-001_f_NCASIFoundation_SampleResolution*
- Nondiscrimination Compliance Statement
    - *2024-001_g_NCASIFoundation_Nondiscrimination*
- Documentation regarding Federal Funding as applicable
    - *2024-001_h_NCASIFoundation_SAM verification*
- Drug-Free Workplace Certification
    - *2024-001_i_NCASIFoundation_DrugFreeWorkplace*
- Payee Data Record
    - *2024-001_j_NCASIFoundation_PayeeDataRecord*
- Fisher capture detailed methods as approved
    - *2024-001_k_NCASI_InstituteForAnimalUseAndCare_DetailedCaptureMethods*
- Previously approved EMC grant under Bailey as described within for reference
    - *2024-001_l_2023-003_BaileyFullProposal*