EMC-2018-007

Project Title

Effects of Experimental Site Exclusion on Pacific Martens (*Martes caurina*)

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Collaborators

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Critical Question Themes and Rules or Regulations Being Tested

Theme 9 (Wildlife Habitat: Cumulative Impacts); 14 CCR § 919 (939, 959)

Timeline

August 2019-January 2020

Background and Justification

Pacific martens are members of the weasel family associated with older complex forests in western North America, including two subspecies in California (Sierran, Humboldt). Humboldt martens are designated as "Endangered" in California and have been proposed as federally Threatened, yet California does not have Forest Practices Rules (FPRs) specific to marten habitat. We will evaluate marten fitness in relation to experimental rest structure loss, to mimic loss that would follow timber harvest.

Objectives and Scope

Pacific martens commonly occupy older, structurally-complex forests typified by increased overhead cover, multi-layered canopies, and abundant woody material in the form of large-diameter green trees, snags, and logs (Spencer et al. 1983, Bull et al. 2005, Slauson et al. 2007, Thompson et al. 2012). Vertical and horizontal structural complexity provides martens with cover to avoid predators (Hargis and McCullough 1984, Drew 1995) and improves foraging opportunities (Thompson and Colgan 1994, Andruskiw et al. 2008). Individual woody structures provide den and rest sites critical to fulfilling life history requirements (Bull and Heater 2000). At broader spatial scales, marten populations may be negatively affected by forest management practices that fragment contiguous forest stands (Chapin et al. 1998, Hargis et al. 1999), reduce overhead cover (Thompson 1994, Fuller and Harrison 2005), or simplify forest structure (e.g., thinning, Moriarty et al. 2016). While harvested forest stands are often considered to be lower- or poor-quality marten habitat, such stands may remain suitable if sufficient structural complexity is retained (Baker 1992, Payer and Harrison 2003, Porter et al. 2005).

At finer spatial scales, some have speculated that marten populations may be limited by a lack of suitable trees, snags, logs, and other structures that provide den and rest sites (Ruggiero et al. 1998, Porter et al. 2005), yet this hypothesis has never been empirically tested. Similar to nest and roost sites for some avian species of concern in California (e.g., northern spotted owl; *Strix occidentalis caurina*), structures used as den and rest structures by martens are frequently in the largest-diameter size classes available (Wilbert 1992, Raphael and Jones 1997, Sanders et al. 2017) and are often centuries old (Ruggiero et al. 1998, Slauson and Zielinski 2009). The length of time required to recruit new structures of this size can lead to temporal imbalances in availability of structures following timber harvest or high intensity wildfire (e.g., Lindenmayer et al. 2012). For species such as northern spotted owls, loss of nesting sites in the form of large trees and snags as a legacy of timber harvest appears to be influencing population declines in the Sierra Nevada mountains in California (Jones et al. 2018). The effects of similar processes on marten populations are unclear, but could be detrimental, given that martens require similar structures as owls for resting and denning; for example, martens in California appear to be cavity-denning obligates (Moriarty et al. 2017a).

We intend to assess whether experimentally limiting the availability of rest structures affects marten fitness, and to what extent marten may exhibit plasticity in rest structure selection. Given the emerging conservation status of the Humboldt subspecies in particular, at both state and federal levels, our results will provide necessary baseline data that can act as a foundation for determining marten habitat requirements in the context of timber operations. Both subspecies of Pacific marten (Sierran, Humboldt) are known to occur on privately-owned timberlands in California (Self and Kerns 2001, Slauson et al. 2018). Unlike northern spotted owls, however, California Forest Practices Rules (FPR) do not provide specific requirements for protection of martens or marten rest and den structures during timber operations.

Critical Questions and Relevant Forest Practice Regulations

The Effectiveness Monitoring Committee (EMC) strategic plan indicates that "…a number of FPRs have long warranted monitoring for their effectiveness in ensuring timber operations do not cause or aggravate significant direct or cumulative effects…" on terrestrial wildlife habitat, and that "…there is a paucity of information collected on the FPRs effectiveness regarding direct and cumulative effects on terrestrial wildlife resources." While timber harvesting is generally considered to negatively impact marten populations (e.g., Soutiere 1979, Chapin et al. 1998, Fuller and Harrison 2005), previous studies have focused on broad-scale processes, such as forest fragmentation and removal of canopy cover. Significant uncertainty remains about the smaller-scale effects of retaining or removing individual structures required by martens. However, this is typically the spatial scale at which FRPs are most influential – for example, in protection of individual spotted owl nests.

Our research intends to address this uncertainty by investigating the effectiveness of Theme 9 (Wildlife Habitat: Cumulative Impacts) in protecting Pacific marten habitat during timber operations. This theme is specific to regulation 14 CCR § 919 (939, 959), which requires that timber operations shall be planned and conducted to maintain suitable habitat for wildlife species. In particular, our research addresses the critical monitoring question of whether the FPRs and associated regulations are effective in characterizing and describing terrestrial wildlife habitat and ecological processes.

Our research will occur on the Lassen National Forest (Sierran subspecies), which has a decades-long history of marten research (e.g., Ellis 1998, Kirk 2007, Kirk and Zielinski 2009, Zielinski et al. 2015), and where > $1 million has recently been invested in determining how martens respond to forest management (e.g., Moriarty et al. 2015, Moriarty et al. 2017a, Credo 2017, Tweedy 2018). Given that Pacific martens appear to require large diameter trees and snags for resting and denning wherever they occur in western North America (Spencer 1987, Raphael and Jones 1997, Ruggiero et al. 1998, Bull and Heater 2000, Slauson and Zielinski 2009), we expect our results to be applicable across the distribution of the Pacific marten, including the Humboldt subspecies, and on both public and private timberlands. Our results will be informed by fine-scale, LiDAR-based vegetation metrics such as basal area and trees per acre (see Tweedy 2018 for details); we are currently partnering with the Conservation Biology Institute (CBI), using similar metrics and an innovative algorithm (FastEmap; Huang et al. 2016) to develop marten habitat suitability and connectivity models for the Lassen National Forest.

Our project represents a collaboration between the National Council for Air and Stream Improvement (NCASI) and the USDA Forest Service (Pacific Northwest Research Station and Lassen National Forest). These and additional partners (National Fish and Wildlife Federation and CBI) are currently executing research (Dec 2018-Jun 2019) to evaluate marten movements in relation to a large wildfire event in the Lassen National Forest. This research is expected to continue through summer 2019, which presents an opportunity for increased project efficiency by transitioning field crews that are already trained and vetted. Our proposal includes $38,121 in in-kind expenses and builds on a wealth of previous marten GPS and VHF data (n=71 individuals, 194 captures) that will be used to interpret our results in terms of marten fitness. Further, NCASI has previously been successful executing landscape-scale manipulative experiments to inform best management practices in relation to wildlife species (e.g., Kroll et al. 2017, Stokely et al. 2018).

<u>Research Methods</u>

Our research will investigate the effects of reduced availability of rest structures on marten fitness, using paired GPS radio collar (LiteTrack 20g, Lotek Wireless, Newmarket, Ontario) deployments on individual martens and experimental exclusion of those martens from used and potential rest structures. Exclusion of martens would occur within the home range of randomly-selected adult martens in areas the size of a typical harvest unit (i.e., 40 acres). Exclusion of rest structures will simulate the effects of reducing structure availability (e.g., via timber harvest) without physically removing the structures. We predict that if reduced availability of rest structures negatively impacts marten fitness, individual martens will exhibit increased movement (e.g., distance moved and time spent moving) and territory size, and decreased body mass. Conversely, if structure availability is not correlated with marten fitness, we predict that martens will exhibit similar movement and territory size and maintain body mass. We will execute a Before-After-Control-Impact (BACI) design where we will obtain pre-treatment data on all individuals, randomly implement our treatment for a subset of individuals, and evaluate results following treatments.

An initial GPS collar deployment will provide baseline data for individual martens. Martens will be captured twice, first to attach a GPS collar, and again to retrieve the collar; martens will be weighed at both captures to determine body mass. GPS data will provide information on territory size (e.g., Moriarty et al. 2017b) and movement patterns. We will use VHF telemetry and GPS data from collared martens, combined with a wealth of data from previous research efforts (Moriarty 2014, Moriarty et al. 2017a) to identify "important" rest structures for each collared marten – those to which martens exhibit higher fidelity, i.e., are used on a frequent basis (Moriarty et al. 2017a). VHF telemetry will be used to identify individual rest structures, while GPS data will be used to identify "rest zones", or clusters of potential rest structures, using a novel method recently tested on fishers (*Pekania pennanti*; Moriarty et al. 2018).

Following an initial evaluation of marten fitness, we will install large metal bands ("squirrel bands") around the bole of trees and snags identified as "important" rest structures as described above, as well as any adjacent trees that would allow canopy travel into rest structures. Aluminum or tin metal bands of 4' width will be placed to prevent martens from climbing tree and snag boles, effectively excluding them from using identified rest structures. We expect diameters of excluded structures to range from 40-180 cm, based on sizes of rest and den structures previously identified on the Lassen National Forest (Moriarty et al. 2017a). The second GPS collar deployment will occur immediately after installation of all metal bands. Similar to the initial collar deployment, martens will be captured twice to attach and remove collars, and weighed at both captures. GPS data will again be used to determine territory size and movement patterns, after which we will remove bands from structures. For animals in each group (treatment, control), we will compare body mass, territory size, and movement patterns before and after the experiments. The proposed effort represents a novel experimental approach for martens to inform effects of rest structure removal.

Paired GPS deployments and exclusion experiments will be conducted within-season in fall (August-December), with each deployment lasting approximately one month, which is roughly the battery life of each GPS collar. This period would follow the period when female martens may have dependent kits, as kit dispersal typically begins in August (Johnson 2008). Deploying GPS collars after dispersal would prevent direct effects on females and their kits of exclusion from potential den structures. Given the relatively short battery life and light weight (20g) of the GPS collars, we do not expect collar deployments to directly impact marten survival, although we may observe indirect effects on marten fitness per our predictions. We may consider conducting GPS collar deployments and exclusion experiments on male martens only if we have an adequate sample for the treatment and control group, to avoid any adverse impacts to female martens. Previous research has observed no difference in male and female marten movement patterns, speed, or behavior (e.g., Moriarty et al. 2016, Moriarty et al. 2017b).

Project Deliverables

We expect several project deliverables. First, we intend to address a basic, but unanswered question of marten ecology – does reduced availability of rest structures influence marten fitness? Our results will provide necessary baseline information at the level of individual structures and can guide recommendations for structure retention specific to marten habitat requirements. For example, California FPRs currently provide guidelines for snag retention during timber operations (14 CCR § 919.1, 939.1, 959.1); however, green trees may be as important as snags for marten rest structures, and particularly as den structures, as 5 of 7 marten natal dens (e.g., the location of parturition) in the Lassen National Forest were located in live trees (Moriarty et al. 2017a).

A secondary deliverable of our project will be to describe the physical characteristics of individual structures used by martens, as well as the vegetative characteristics surrounding structures. This information may guide variable retention methods to benefit marten habitat, with respect to retention types (aggregated or dispersed), appropriate densities, and spatial arrangement of retained structures. Physical characteristics of individual structures will be determined via on-the-ground plot measurements, whereas broader vegetative characteristics may be determined remotely (e.g., LiDAR). Finally, we intend to incorporate our results into a peer-reviewed publication as a third deliverable.

Timeline

August-December 2019: Field work (duration may vary for individual martens based on capture dates)

- capture and monitor marten
- deploy field experiment following initial baseline fitness and GPS data collection
- recollar martens for post-treatment information
- remove collar, collect final fitness metrics, remove experiment from that marten's home range

January-February 2020: Finish analyses, report

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Experimental evaluation of rest structure loss and vegetation characteristics in Lassen National Forest

	Months	Overhead Actual	Used rate	Daily rate	Monthly rate	ntCosts/Expense	Subtotal	Total Requested
Personnel								
Field crew lead (Matthew Delheimer, PNW) August to January	5.0			235.00	5,170	5,170	$ 31,020.00	$ 31,020.00
Technician, Alyssa Roddy (NCASI), August to mid-December	4.5			160.00	3,520	6,811	$ 22,651.20	$ 22,651.00
Volunteer stipend (PNW), August to November	4.0				1,100	880	$ 5,280.00	$ 5,280.00
Personnel (PI, Study Design, Permits, Data Management, Crew Training, Qualtiy Control, Analysis)							$ -	$ -
Dr. Katie Moriarty (NCASI)	0.25				9,425	0	$ 2,356.25	$ 2,356.00
Dr. Katie Moriarty (NCASI)	1.00				9,425	0	$ 9,425.00	In kind match
Dr. Jake Verschuyl (NCASI)	0.25				10,200	0	$ 2,550.00	In kind match
Subtotal							***$ 73,282.45***	***$ 61,307.00***
								$ -
Project Vehicle (2 needed, 1 supplied by USFS)		Months	Number		MonthlyMile:	Monthly	Annual	Annual
NCASI Vehicle ($325/month + .32/mile)		4.50	1.00		1500	325	$ 3,622.50	$ 3,622.50
Subtotal							***$ 3,622.50***	***$ 3,622.50***
								$ -
Field Supplies		Quantiy	Cost					$ -
Tree bands		100.0	24.95				$ 2,495.00	$ 2,495.00
Lotek GPS collars with activity and remote download		5	1,325			300	$ 6,925.00	$ 6,925.00
Lotek GPS collar refurbishment		15	994			300	$ 15,210.00	$ 15,210.00
Lotek PinPoint Command Unit and Remote download		1	1,000				$ 1,000.00	In kind match
Field computer for GPS setting and download (Microsoft Surface Pro)		1	1,350				$ 1,350.00	In kind match
Bait (chicken, gusto)		150	2				$ 300.00	$ 300.00
AA Batteries and misc. camera mounting supplies (in kind)		100	12				$ 1,200.00	In kind match
Tomahawk traps with modified cubby (in kind)		40	42				$ 1,680.00	In kind match
Samsung Tab A 7" and case (in kind)		2	200				$ 400.00	In kind match
Remote cameras, SD cards, lithium batteries (in kind)		200	100				$ 20,000.00	In kind match
Subtotal							***$ 50,560.00***	***$ 24,930.00***
Subtotal - all							**$ 127,464.95**	**$ 89,859.50**
PNW overhead (included in salary estimate)	**6050.0**							
10% overhead rate incoming to NCASI							$ 12,746.50	In kind match
Total Estimate							**$ 140,211.40**	**$ 89,859.50**

In kind match **$ 38,376.50**

Notes
PNW overhead 20%, includes data QA/QC, data summarization
PNW overhead 20%
Movement analyses and report writing
Publication, training, climbing certification
Data interpretation and guidance
QA/QC+ estimate = $300, 10 collars purchased prior and 5 would be refurbished
Refurbish 10, plus 5 initially