MORRO BAY
NATIONAL ESTUARY PROGRAM

Community Grant Program Application

Submit application by email to staff@mbnep.org or mail to the Morro Bay National Estuary Program's offices by 4pm on the due date. **Please be sure to include the summary coversheet below, the Priority Issue check list and Action Plan summary, and the Narrative Information Section.**

Project Title: San Luis Obispo Mountain Lion Research Project

Applicant: Jordan Heiman

Address: 54325 McKinley Grove Road, Shaver Lake, CA 93664

Contact Person(s): Jordan Heiman

Phone: 913-908-8526 **Fax:**

Email: jordanheiman89@gmail.com

Grant Amount Requested (*cannot exceed $5,000*): $5,000

Total Estimated Project Cost: $100,000

Amount & Source of Other Funding (if relevant): California Deer Association: $50,000
Part of statewide mountain lion project funded with about $500,000 for entire state

Project Description Summary (fill in here or attach additional document; word limit 300):

Attached Seperately

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Check off the Comprehensive Conservation and Management Plan Priority Issue(s) addressed by the proposed project:

- [ ] Sedimentation.
- [ ] Bacterial contamination.
- [ ] Elevated nutrient levels.
- [ ] Toxic pollutants.
- [ ] Scarce freshwater resources.
- [x] Preserving biodiversity.
- [ ] Environmentally balanced uses.

The proposed project must work to implement, at a minimum, one of the Action Plans that address the Priority Issues listed above. Please list the relevant Action Plans that will be addressed by this project below. The Action Plans are detailed within the Management Plan which can be found at MBNEP.org or from the Estuary Program's office.

Relevant Action Plan list is attached with Project summary

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Email: jordanheiman89@gmail.com
Grant amount requested: $5,000
Total Estimated Project Cost: $100,000
Amount and source of other funding: California Deer Association $50,000; part of state-wide mountain lion project funded with about $500,000 for the entire state

Project Description Summary:

The vital role of top predator in many ecosystems is played by mountain lions (*Puma concolor)*. In the area surrounding San Luis Obispo, the population of mountain lions may be even more important by serving as a source population for surrounding areas. Placed squarely between the Santa Cruz and the Los Angeles mountain lion projects this project would serve to determine the importance of mountain lions in the northern section of the Los Padres National Forest and lands surrounding the city of San Luis Obispo. As a top predator they could be serving as a cornerstone of biodiversity. While keeping grazing animals like deer in check from becoming overpopulated the mountain lions are helping to preserve the diversity of plant species, which may in turn increase the diversity of other animals that use these plants. The mountain lions may also be helping to control the large population of feral pigs in the area, which can cause destructive and erosive effects with their foraging behaviors.

Through this project we aim to monitor at least 12 mountain lions by means of GPS wildlife collars. With the GPS locations from these collars we will visit potential kill sites of the mountain lions and collect data on the prey species and habitat of the kill site. We will also use the location data in collaborating with the California Department of Fish and Wildlife's state wide effort to analyze mountain lion habitat use. In addition, we will be collaborating with the city of San Luis Obispo to provide location data to help guide future development of the city.

The combination of these efforts will be the focus of the Los San Luis Obispo Mountain Lion Research Project and will lead us to a better understanding of mountain lions along the central coast and throughout the state.

Check list of Comprehensive Conservation and Management Plan Priority Issues:
Preserving biodiversity

List of action plans:

ECR13 - Better shared understanding of population dynamics of special status species
LP1 - Protect special habitats and species
LP3 - Strategic urban development
LP5 - Enhance public recreation opportunities
MON5 - Monitoring partners
MON6 - Support research activities
ECR4 - Identify most valuable wetlands
ECR11 - Activities to restore and conserve balance of ecosystem function
ECR12 - Support conservation of upland habitats
ECR16 - Develop, update and implement invasive species action plan
USE5 - Urban development
EO3 - Nature center and related displays

San Luis Obispo Mountain Lion Research Project

There are many factors that can affect the movement patterns and distribution of predator species. Factors such as habitat, topography and the time of year have all been well studied in regards to their effect on mountain lion (*Puma concolor*) home ranges.[1,2] In general, these factors all are directly related to the location of native prey species such as deer (*Odocoileus spp.*). For example, in 2003 Laundré and Hernández showed that habitats frequented by deer were also favored by mountain lions.[2] However, to date there has been very little research on how non-native prey species can change the movement patterns and population density of native predators including mountain lions.[3] In order to fully understand mountain lion movement and habitat selection it is necessary to look at the effects of all significant prey species in their diet. Although within populations individual mountain lions can vary their diets greatly, studies in California have shown that mountain lion diets can contain between 5% and 38% feral pigs (*Sus scrofa*).[3,4,5] This could result in a considerable effect on mountain lion behavior in order to hunt feral pigs.

Feral pigs were first introduced to mainland California in the late 1700s when domestic pigs were allowed to freely range around Spanish settlements.[3,6] Around 1925 feral pigs began interbreeding with Eurasian wild boar that had been released in Monterey County.[3] By 1996, their range had reached at least 25% of California's total area.[6] Research on their interaction with the native invertebrates and habitats have shown both positive and negative impacts.[3] Despite these interactions being studied extensively, not much is known about their effect on mountain lions and other native predators. Understanding the ways in which feral pigs change the behavior of mountain lions could lead to better management of both species. It is predicted that if some individuals of a mountain lion population are specializing on feral pigs, those individuals will have smaller home ranges because feral pigs would generally be more densely populated than deer. These smaller home ranges could allow for a higher density of mountain lions. Such intra-specific niche differentiation could also reduce competition, thereby providing for more overlap of territories by means of individuals each filling a different food niche in a particular area.[7]

In order to determine the effect of feral pigs on the movement patterns of individual mountain lions, we will monitor and track 12 individual mountain lions using GPS enabled wildlife collars. Using location data and kill site visits from these individuals, the study will assess (1) individual variation in prey selection and (2) the ways in which prey preference alters the movement patterns and home range characteristics of each individual.

Fieldwork for this research will be supported by the state of California's effort to collect statewide information on mountain lion densities in relation to various habitats. The research will focus on mountain lions collared in the Los Padres National Forest and the surrounding public and private land in the central coast region of California. Mountain lions will be captured primarily by means of trained hounds and fitted with GPS enabled wildlife collars following a state approved protocol. GPS points received from these collars will be used to locate and visit kill sites to collect data on prey selection and home range.

Aim 1: Individual prey selection Kill sites will be searched for evidence of what prey was killed by each individual. Information about various prey species killed by each individual will be compiled and compared among individual mountain lions in the population to determine if there is a significant difference in prey selected by each mountain lion. The data will also be used to determine if any individuals show a preference for feral pig. This analysis will be

performed using the indices of individual specialization, which compare individual resource use against resource use of the individual's population.[8]

Aim 2: Home range characteristics and movement patterns Using the GPS location data from each mountain lion, individual home ranges will be calculated and movement patterns will be analyzed with Brownian Bridge and kernel models.[9,10] Home ranges will be analyzed for habitat composition, topography and other characteristics. These results will be compared between individuals in conjunction with their individual prey selection data in order to determine the effects of prey selection on home range and movement patterns.

Management Implications By studying the effects of feral pigs on mountain lion movement and home range, more comprehensive conservation or management plans can be designed for each species. As a non-native species, feral pigs could be having devastating effects on native species. Previous research has shown that the population can be harmful to crops, native species and habitats. As a prey species, however, the population may also be kept in check by large predators such as mountain lions. This research will help better understand this relationship and provide a better basis to build a management plan for feral pigs.

As a large predator, mountain lions are also of concern. They are often involved in human-wildlife conflict by preying upon livestock and pets. Their movements through urban areas can cause alarm among residents. These movements and hunting behaviors are a direct result of the type of prey each individual prefers. In conducting this research we will gain a better understanding of the prey species that the mountain lion population in the area is favoring. We will also be able to see how preying upon feral pigs is changing the mountain lion population. When combined with studies on mountain lions in other parts of the state, these results could also help to understand larger scale variation in mountain lion populations throughout the state of California. Feral pigs as a prey source could allow mountain lions to maintain smaller home ranges, causing mountain lions to exist at higher densities. In this way the variation in mountain lion population density across California could be related to feral pig abundance.

Studies have also shown that Florida panther (*Puma concolor coryi*) diets contain up to 59% feral pigs.[3] Results from this study may also apply to the recovering population of Florida panthers. If the non-native feral pig is helping to sustain the fragile Florida panther population, any efforts to eradicate the feral pig population should take this into consideration.

Human-Wildlife Interaction The Los Padres National Forest, where this study will mainly focus, sprawls across the densely populated south-central coastal region of California. Cities such as San Luis Obispo have been growing and beginning to see the effects of encroaching on the natural habitat. Over time human-wildlife conflict could become more and more prevalent with this growth. Throughout the course of this study location data will regularly be collected from the GPS collars worn by the study population. This data can be used to analyze mountain lion movements through areas of potential development. With the assistance of habitat models also built from the location data, city expansions could be planned to avoid areas of high importance to the mountain lion population in the area. In this way, further development can minimize human-wildlife conflict and create a safer environment for both the mountain lions and humans.

Community Engagement During the data collection process of this project, employees and volunteers from the San Luis Obispo may be able to assist in visiting kill sites of mountain lions and collecting evidence of prey selection. Through this collaboration with the city of San Luis Obispo, data from the project will also be available for future research and public education about mountain lions in the central coast region.

Benefits The Morro Bay estuary is a complex ecosystem consisting of hundreds of different species. Each species in the system is related to every other either indirectly or directly. By better understanding the direct relationship between feral pigs and mountain lions, biologists can further understand the relationships between all the species in the estuary. For example, if the availability of prey in the form of feral pigs is causing a rise in the mountain lion population and thus putting pressure on other prey species, it may benefit the estuary to better manage the feral pig population.

Project Budget This project will be a part of the California Department of Fish and Wildlife's larger project to collect data on the statewide mountain lion project in regards to habitat use. In this way the project will receive some funding assistance through the state in the form of assistance during capture efforts. Some personnel and equipment will be provided during these times. The California Deer Association will likely be providing funding to purchase seven wildlife collars. With funding from the Morro Bay National Estuary Program this project will be able to fund three more wildlife collars as well as efforts to visit kill sites of collared mountain lions and collect more data to understand the local mountain lion population.

Evaluation The success of this project will be centered around the collection and analysis of data. However the first measure of success will be the number of mountain lions that are collared for monitoring. The project looks to collar at least 12 mountain lions. With these lions collared, it would be ideal for them to be monitored for at least two years. During this time success will be measured in the project's ability to identify at least 50 kills from each individual. These kills and the data from them will be used to analyze prey selection of the local mountain lion population. As a last measure of success, the project plans to release at least one scientific paper for publishing in a peer reviewed journal in order to share the information with other biologists.

Schedule Capture efforts for the project will begin in the fall of 2017. Assuming that these are successful, location data from these mountain lions will be continuously collected and potential kill sites from this data will be ready to be visited immediately. A majority of these visits will most likely occurring during the spring and summer of 2018 and 2019. Completion of all the necessary kill site visits will be completed by fall of 2019 with data analysis beginning immediately afterward. By the fall of 2020 a scientific paper will be released from the project for publishing.

Qualifications The California Department of Fish and Wildlife have already been capturing and collaring mountain lions throughout the state. This statewide project is being led by Justin Dellinger, who will also be leading capture efforts in this local project. The local project based in San Luis Obispo will be headed up by Jordan Heiman, who will at the time of the project be a Master's student through the University of California, Davis. This local project

will be the basis of her master's thesis. Prior to this project, she has been a lead field technician on the King River Puma Project based in the Sierra National Forest. On this project she completed similar work, capturing and collaring mountain lions and visiting potential kill sites. Through this project she led the day to day activities of the Kings River Project for a total of 2 years, building and maintaining the database, maps, and collection methods of the project.

References

[1]Dickson, B. G. and P. Beier. 2002. Home-range and habitat selection by adult cougars in southern California. Journal of Wildlife Management 66(4):1235-1245.

[2]Laundré, J. W. and L. Hernández. 2003. Winter hunting habitat of pumas *Puma concolor* in northwestern Utah and southern Idaho, USA. Wildlife Biology 9:123-129.

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[7] Lemos-Costa, P., M. M. Pires, M. S. Araüjo, M. A. M. de Aguiar, and P. R. Guimarães Jr. 2016. Network analyses support the role of prey prefences in shaping resource use patterns within five animal populations. Oikos 125:492-501.

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[9] Horne, J. S., E. O. Garton, S. M. Krone, and J. S. Lewis. 2007. Analyzing animal movements using Brownian bridges. Ecology 88(9):2354-2363.

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MBNEP Community Grant Application Follow-up Questions
Project name: San Luis Obispo Mountain Lion Research Project
Applicant: Jordan Heiman

Upon review of the application, MBNEP staff had a few follow-up questions for the applicant. Here are those questions and the applicant's response.

MBNEP Question 1. As you know, the Estuary Program's work focuses in the Morro Bay estuary and watershed. Can you please describe how the proposed project impacts the watershed?

Our project will be looking at two key species in the watershed, mountain lions and feral pigs. The feral pigs inhabiting the watershed have many affects on the watershed. They can cause damage to native plants, erosion and spread of invasive plants through their foraging behaviors. Other research has also argued their benefits to native ecosystems. In either case their effects may be held in check by the resident population of mountain lions which prey on them. In this way both species can affect many other species down the food chain. They can be altering plant populations, which in turn could be affecting all the herbivorous species in the watershed as well as the soil and water. By better understanding the interactions between these two species we will be able to better understand the interactions within the ecosystem of the watershed as a whole.

MBNEP Question 2. Are any of the tagging locations expected to be in the Morro Bay watershed?

The main portion of our tagging locations is expected to be in the area North of San Luis Obispo, particularly in the Los Padres National Forest but also in the private lands surrounding that northwestern section of the forest. This area could extend as far west as the coast and Morro Bay State Park.

MBNEP Question 3. Are any of the kill sites expected to be in the Morro Bay watershed?

The kill sites are expected to be within this same region. Although we can not know exactly where each mountain lion will travel to once it is collared, we plan to only focus on kill sites within the main section of our trapping area.

MBNEP Question 4. Is there evidence of mountain lions in the Morro Bay watershed?

The best data we have for mountain lions being within the Morro Bay watershed is the issuance of mountain lion depredation permits for the county and reports from locals. In 2015, 11 mountain lions were taken by depredation permits in the county of San Luis Obispo. This is the second highest number taken by county in 2015 and far exceeds the county average of 3.9. There have also been many news covered sightings of mountain lions in the area of San Luis Obispo and the northwestern fork of the Los Padres National Forest.

MBNEP Question 5. If we decide to award a portion of the amount rather than the full amount requested, will that still be helpful to your project?

Any portion of the amount requested would still be very helpful in the completion of my project.