Measuring Density and Activity of Feral Cats Using Camera Traps on San Clemente Island, CA

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ABSTRACT: Feral cat (*Felis catus*) predation has negative impacts on native species, especially in island ecosystems (Vitousek 1988, Dowding and Murphy 2001, Bonnaud et al. 2011, Doherty et al. 2016). Feral cats are prolific opportunistic carnivores that prey upon whatever food source is most abundant and preferred (Parsons et al, 2019). They are the cause of extinctions of a plethora of species world-wide. Feral cats on San Clemente Island (SCI) are non-native predators to various endemic species that include the San Clemente Island deer mouse (*Peromyscus maniculatus*), Island night lizard (*Xantusia riversiana*), San Clemente Island Bell's sparrow (*Artemisiospiza belli clementeae*), and the San Clemente Island loggerhead shrike (*Lanius ludovicianus mearnsi*) (Biteman et al 2015). Feral cats on SCI also compete for prey items with a subspecies of the Island fox (*Urocyon littoralis clementae*) that is naturalized to San Clemente. Understanding the feral cat's activity patterns and estimating their density are important to improve the efficacy of feral cat management efforts. Camera traps are used to quantify activity patterns and population sizes of a variety of species world-wide, but have seldom been used to address these questions with feral cats, and no study has been done on SCI.

We used camera traps on SCI to quantify activity patterns, identify high density areas, and determine feral cat population size. Our study took place from November 2018 to March 2019. We had 75 stations with two cameras at each (Figure 1). We checked each trap every two weeks to maintain bait, batteries, and SD cards. Cameras at a station were placed 5 m apart and were facing each other. Stations were always set on a game trail. We used two bait types (i.e. feline and general mammalian predator) at each station, with one piece of bait in front of each camera. Photos from SD cards were manually sorted; photos with no wildlife in them were deleted. Photos were uploaded to a camera trap photo processor called Timelapse2, which extracted date and time, and gave a unique identifier to each photo. We manually entered the species seen in each photo. We used N-mixture models to calculate density, activity, and population data for feral cats. We used program R to run these statistics. We found 114 individual cats identified on 75 cameras over the 4 months of testing. We estimated the population at 319 to 331 cats (95% CI). Activity peaks were found at 1:30 pm and 7:30 pm daily (Figure 2). Spatial density varied but most of the dense areas were located far from roads (or at least outside of shooting distance) and also in exclusion zones (Figure 1).

We think multiple factors contributed to the daily patterns. Winter climate in southern California is rainy and rainy conditions likely forced cats into more daytime activity for better thermoregulation. We have been conducting nighttime control of feral cats on the island for 20+ years; nighttime hunting pressure may have shifted their activity toward a daytime peak. Both of the activity peaks we calculated are during hours, when we have not had full firearm access (e.g., limited to 40 yards and closer), and our usual method of identifying cats (by spotlighting) is ineffective. Spatial density is another factor: San Clemente is a valuable and heavily used training ground for the U.S. Navy, so there are areas on the island we cannot access at certain times, or ever. Due to firearms range, terrain, and access time, efforts have been focused along roads, but cat "hot spots" are far off the roads, in or around exclusion zones, or a combination of the two. All this results in large areas where predator control cannot be carried out. More efforts to hike and hunt are being made to extend our reach, giving better data and the ability to remove cats efficiently from high density areas where they have been unchecked. Efforts to hunt during the day should be considered. Other control efforts elsewhere have used air rifles (which do not qualify as firearms), that could be used during the day. We could also use sit-and-wait methods (i.e., use attractants to lure cats in; then remove the cats). We conclude that our efforts could be doubled by adding day hunting in high density areas off the road.

KEY WORDS: camera trap, *Felis catus,* feral cat, island, invasive predator management

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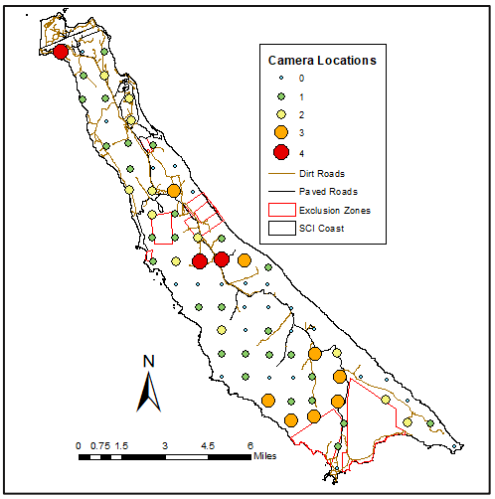

Figure 1. Map of all camera trapping stations (circles) on San Clemente Island, CA in 2018. Larger sizes indicate more cats per camera station with a maximum of 4 cats on one camera (largest circles).

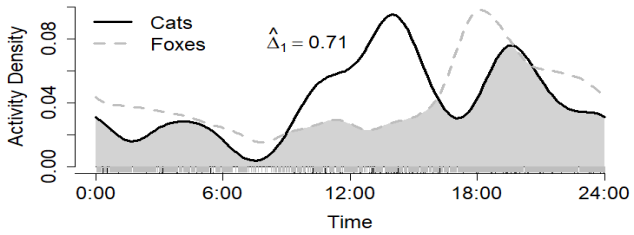

Figure 2. Daily activity of feral cats and foxes on San Clemente Island, CA in 2018. Two peaks for cats are seen at 1:30 pm and 7:30 pm with a low at 8 am. Shaded portion is the overlapped activity time between the two species.

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