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Activity patterns and interspecific interactions of free-roaming, domestic cats in managed Trap-Neuter-Return colonies

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ABSTRACT

There is very little information on the activity and experiences of stray cats living in managed Trap-Neuter-Return colonies. We explored this issue on a barrier island in the southeastern USA. We analyzed activity patterns relative to both individual cat and colony variables. We used 645 h of point-of-view (Kittycam) video from 26 cats to determine that cats spent an average of 89.5% of time in inactive states (resting, sleeping), 9% of time roaming, 0.6% eating or drinking at colony feeding stations and 0.9% of time hunting wildlife. The averages did not differ by sex nor did activity levels differ by colony location (close to developed or undeveloped island habitat). A total of 142 interspecies interactions were recorded between 29 TNR colony cats and local wildlife. Non-predatory encounters were primarily comprised of interactions with four species: raccoons, black vultures, white-tailed deer, and Virginia opossums. All interactions occurred at cat feeding stations, the majority within 2 h of the daily feeding time. Understanding stray cat activity patterns may provide insight into the welfare of domestic cats in the environment, including their exposure to injury and disease from interacting with other animals.

1. Introduction

Domestic cats (*Felis catus*) are a common sight in urban and suburban neighborhoods throughout the world and their numbers continue to grow (American Pet Products Association, 2016). Domestic cats may be feral (stray, unfriendly, often untamed and unsocialized), stray but somewhat or completely tame, or pets (outdoor “barn cats” and, more commonly, indoor-outdoor house cats). Stray cats roam free in the environment without supervision and current numbers estimate up to 70 million in the U.S. (Loss et al., 2013). Unowned cats present a variety of population management concerns to wildlife managers, public health officials, and veterinary epidemiologists (Slater, 2001; Gerhold and Jessup, 2013; Loss et al., 2013).

Trap-Neuter-Return (TNR) programs have received significant attention as a means of both managing cat populations and avoiding lethal alternatives (Levy et al., 2014). In theory, this management program reduces stray cat populations by limiting recruitment through reproductive control. Cats are reintroduced into resident colonies following their capture and sterilization, with the expectation that population growth will be halted without resorting to euthanasia (Levy et al., 2003). Cats subjected to TNR reside in colonies that are fed and monitored by volunteers on a regular basis, often attracting newcomers to an area where they can be trapped and sterilized (Slater, 2004).

Understanding stray cat activity patterns may provide insight into the welfare of cats in the environment, including their exposure to injury and disease from roaming in the environment or interacting with other animals and people. Stray cats serve as reservoirs or facilitate the transmission of potentially important zoonotic pathogens like raccoon variant rabies virus, *Toxoplasma gondii*, *Bartonella henselae*, plague, tularemia, and various nematode parasites (Campagnolo et al., 2014). Disease, pathogen, and parasite prevalence in free-roaming cats is well-documented (Yamaguchi et al., 1996; Nutter et al., 2004; Hill et al., 2000; Akucewich et al., 2002) but varies by region and colony size. Cat roaming and foraging behavior have important implications for pathogen exposure and transmission, and concerns extend to people and wildlife (Lepczyk et al., 2015). Unfortunately, cat colonies with subsidized food may also attract wildlife that artificially aggregate at higher densities than normal (Jessup, 2004) and interact with cats.

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Wildlife that visit feeding stations may be more likely to come into contact with people because they will forage outside of their natural activity patterns (e.g. raccoons feeding during the day) to take advantage of subsidies.

To date, most studies of stray cat activity have been limited to determinations of range on remote islands (Apps, 1986; Barratt, 1997; Konecny, 1987). These studies found male home range to be larger than female and nocturnal activity to be greater than diurnal. Activity levels of cats in Brooklyn, New York correlated with season and variation in weather (increasing with increasing temperature, decreasing with rain) (Haspel and Calhoon, 1993). Habitat use, range and activity levels of stray cats in exurban Champaign-Urbana Illinois revealed that habitat preference changed seasonally as did percent of time spent in higher levels of activity (Horn et al., 2011). There is very little information on activity and experiences of stray cats living in managed colonies, where cats are neutered, vaccinated, and fed by caretakers. Research from TNR cats on Catalina Island, California suggests that even sterilized cats roamed across large areas, often entering sensitive natural areas far away from feeding stations (Guttilla and Stapp, 2010). Large numbers of stray cats in the USA today visit feeding stations or receive some care from caretakers, yet their primary activities while away from the colony or while roaming are unknown.

To create successful and socially acceptable management plans for stray cats and to understand their interactions with wildlife, it is critical to understand cats' daily behavior patterns. Time budget analyses are normally achieved using data obtained from small parts of the day when humans are able to observe the subjects in their natural habitat. Understanding how often and what time of day cats engage in specific activities will help inform management decisions and also has implications for cat welfare, wildlife health, and pathogen transmission among cats, wildlife and people.

This study utilized point-of-view cameras to: 1) describe the time budget and activity patterns of stray cats living in managed colonies on a barrier island, 2) determine if there are differences in activity patterns due to cat age, sex, or colony location, and 3) document the frequency, timing, and type of interspecies interactions occurring with cats in colonies managed by TNR. Because younger, male cats are more likely to exhibit risky behavior (Loyd et al., 2013,b), we predicted age (younger) and sex (male) would have an influence on the proportion of time spent roaming. We also predicted that cats residing in colonies close to undeveloped, natural areas would spend more time roaming. Lastly, we hypothesized that cat interactions with other wildlife would happen most often at colony feeding stations and be associated with feeding times.

2. Methods

2.1. Study site

Our research took place on Jekyll Island (31°4′12″N, 81°25′13″W), a 5847 acre barrier island on Georgia's Southeastern coast. Jekyll Island is comprised of numerous habitats, including intermixed maritime hardwood forests (19%), maritime pine and pine-hardwood forests (16%), shrub scrub habitats (6%), marshes dominated by *Spartina* spp. (28%), maintained grass (18%), and paved, impervious urbanized settings (3%) (Fig. 1). Jekyll Island is a Georgia state park known for its beautiful and well-protected natural lands. The weather on Jekyll is moderate with long, hot and humid summers and short, mild winters. The most recent US Census numbers (2014) estimate 621 residents on the island, but this varies seasonally, with peaks during tourist season (May–July).

2.2. Technology

The use of animal borne CritterCams® have been implemented in many studies to provide an "animal-eye view" of behaviors such as hunting and intra- and interspecies interactions (most recently: American Alligators, Nifong et al., 2013; and Bull Sharks, Meynecke et al., 2015). Developed by National Geographic's CritterCam Program, our engineered "KittyCams" monitored stray cats living in colonies managed by TNR. Each camera weighs approximately 90 g, is set in a water-resistant housing, and attached to a breakaway collar (Fig. 2). KittyCams are equipped with VHF transmitters so they could be located if separated from the cats. An ternal motion sensor eliminated most of the recording while the cats were sleeping; however, it was sensitive enough to pick up important activities such as stalking. The cameras included infrared lights, to allow recording of nocturnal activity. After deployment, the camera batteries lasted an average of 24 h at which time the cameras were removed, video downloaded, and units charged for the next deployment.

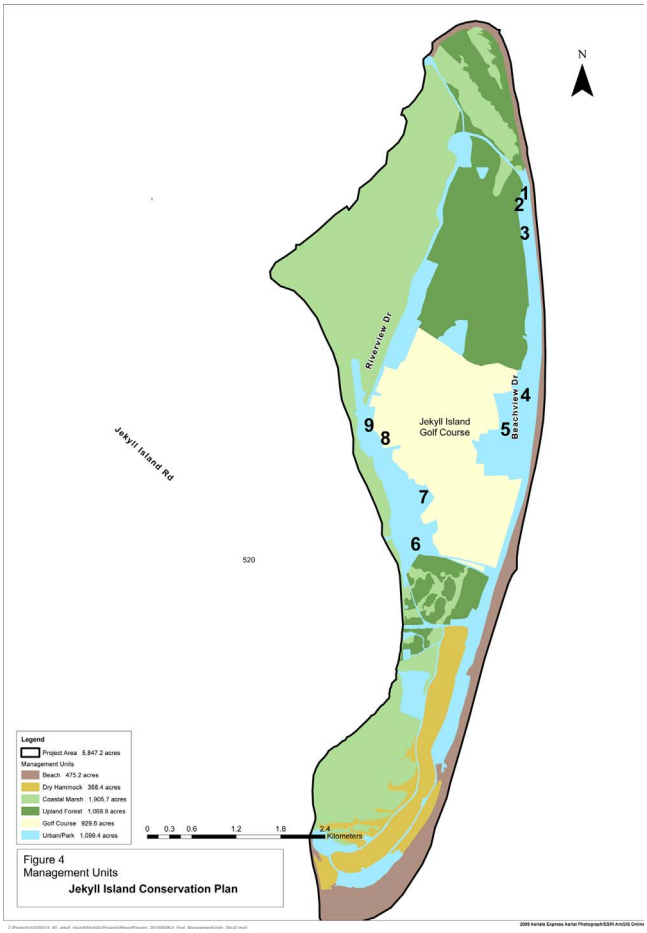

Fig. 1. Map of Jekyll Island, Georgia, USA showing locations of 9 colonies where stray cat activity was monitored in 2014–2015. Sites 1, 2, and 3, are along forest edges and within close proximity to the beach and large expanses of undeveloped, natural area. Sites 4 and 5 are located in neighborhoods. Site 6 is located in the Historic District of Jekyll Island where there are shops, a hotel, restaurants, and significant human activity. Site 7 is located at the golf course maintenance buildings, adjacent to forested habitat. Site 8 is located behind a small church on the edge of dense, old growth oak forest. Site 9 is located in a neighborhood but also adjacent to undeveloped forested land.

2.3. Subjects

There were approximately 120 un-owned stray cats on Jekyll Island at the time of this research. Of those, 50 were managed in a TNR program in 9 colonies primarily concentrated in the northern part of the island (Fig. 1). The TNR program was started by a Jekyll Island resident in 2005 in an attempt to decrease the island's population of free-roaming cats. At its onset, the program involved trapping and removing cats that were ill or injured, and placing cats for adoption whenever