Space and Habitat Use of Coyotes (*Canis latrans*) in Suburban Southern California (Abstract)

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ABSTRACT: The ability of coyotes (*Canis latrans*) to exploit resources in human-dominated environments has led them to increasingly come into conflict with people, for example by killing domestic animals or attacking children. Additionally, coyotes in these environments increase their exposure to anthropogenic threats, such as harassment, vehicle mortality, and rodenticides. Effective management of human-coyote conflicts requires a better understanding of how coyotes navigate the developed landscape. As part of a broader study of how the use of urban and suburban areas affects coyotes' exposure to rodenticides, we examined movements and space use of coyotes across gradients of urbanization in Los Angeles and Orange County, California. We affixed GPS radio-collars to 12 coyotes (nine males, three females) and tracked them between August 2022 and December 2023. Radio-collars recorded location information approximately every 15 min, but we restricted our analyses to hourly locations. We used a 95% minimum-convex polygon (MCP) and 95%-kernel density estimate (KDE) to calculate the area used by each animal. Within each utilization area, we calculated the amount of impervious cover and the relative amount of open space and development, using publicly-available GIS data layers (National Land-Cover Database; U.S. Geological Survey 2021). Additionally, for each coyote, we calculated a measure of movement tortuosity (straightness index, SI; Batschelet 1981) to describe its tendency to take directed, straight-line movements or wander less linearly in the habitat. We calculated SI for nine coyotes for which we had hourly location data during the first 28 days after radio-collar deployment. SI values were calculated separately for diurnal and nocturnal movements of each coyote, and then for movements when it was traveling in areas with low (≤19%) vs. high amounts of impervious cover (Wurth et al. 2020), and in areas classified as open space vs. areas with human development. We used paired t-tests to compare mean SI values because movements and habitat use of individual coyotes were not independent.

Utilization areas of coyotes (Table 1) ranged from 0.4 - 136.1 km^2 (95% MCP) and 0.4 - 148.2 km^2 (95% KDE). Excluding three coyotes that displayed wide-ranging, transient movements and considering only five animals that were tracked intensively (151-313 days) during the breeding and dispersal seasons, mean utilization area (95% MCP) was 2.16 km^2 (SD = 1.79), which is our best estimate of home-range size. This estimate is about half the size of that typically reported for urban coyotes elsewhere (approximately 5 km^2; Gehrt 2007, Gehrt et al. 2009, Franckowiak et al. 2019), including in the Santa Monica Mountains of southern California (Riley et al. 2003). However, it is similar to the estimate (2.1 km^2) of Tigas et al. (2002) for coyotes living in fragmented coastal sage scrub and chaparral habitats in Los Angeles and Ventura County, where the urban landscape resembles our study area.

Considering only the five non-transient coyotes that we tracked most intensively, on average, 67.2% of their home range was categorized as open space, whereas 32.8% had some level of human development (low-high intensity categories). On average, 68.3% of their home ranges were in areas with little impervious cover (<19%). In contrast, coyotes that displayed transient movements or that were tracked primarily during the dispersal season used areas with more human development ($\overline{x}$ = 55.5%) and more impervious cover ($\overline{x}$ = 50.8%). Coyotes in our study differed from those tracked by Riley et al. (2003), whose home ranges had only 15.6% developed area. In our study, coyotes still managed to use significant amounts of developed and semi-natural open space, despite the extensive degree of development in the region, although many limited their movements primarily to one or a few fragments of natural or modified open space.

Diurnal movements were significantly more linear (higher SI) than nocturnal ones (t = 3.67, d.f. = 8, P = 0.006; Figure 1), suggesting that coyotes wander more at night, perhaps while foraging and engaged in conspecific interactions, and move in a more directed fashion during periods when people are active. However, for both diurnal and nocturnal movements, SI values did not differ significantly between movements in areas with low vs. high impervious cover, or in areas with large amounts of open space vs. human development. Both Tigas et al. (2002) and Riley et al. (2003) reported greater use of developed areas at night. Inclusion of data from longer time periods or using more refined categories of land use may increase our ability to detect differences in movements.

KEY WORDS: *Canis latrans*, coyote, home range, movements, southern California, straightness index, urbanization

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Table 1. Estimates of 95% minimum-convex- polygon (MCP) and 95% kernel-density estimate (KDE) utilization areas of adult coyotes in southern California tracked in 2022-2023. The number of days tracked is the number of days with at least one confirmed location. Coyotes denoted with asterisks exhibited wide-ranging behaviors that might be characteristics of transients. Biological seasons of coyotes were designated as breeding (B; Jan-Apr), pup-rearing (P; May-Aug), and dispersal (D; Sep-Dec). "Deactivated" indicates that the collar functioned until the end of the study period. "Collar failure" indicates that battery died or the collar lost connection. All "deceased" coyotes were confirmed by the recovery of the collar.

Coyote ID	Sex	Tracking Period	Seasons Tracked	Days Tracked	95% MCP (km^2)	95% KDE (km^2)	Disposition
C11•	M	Aug 2022 - Apr 2023	B, D	221	1.4	1.9	collar failure
C14 •	F	Aug 2022 - Jan 2023	B, D	167	2.6	2.8	collar failure
C10 •	M	Nov 2022 - Nov 2023	B, P, D	151	1.0	1.3	collar failure
C1 •	M	Dec 2022 - Dec 2023	B, P, D	313	0.7	0.5	deactivated
CT43 •	M	Apr - Dec 2023	B, P, D	244	5.1	4.7	deactivated
CT97	M	Jul - Sep 2023	P, D	53	3.6	1.7	deceased
C7	M	Sep - Dec 2022	D	81	4.2	4.2	deceased
C6	M	Nov 2022 - Jan 2023	D	64	2.5	3.0	collar failure
C20	F	Nov - Dec 2022	D	44	0.4	0.4	collar failure
C21*	F	Sep 2022 - Dec 2023	B, P, D	394	31.3	20.7	deactivated
C12*	M	Dec 2022 - Aug 2023	B, P, D	255	97.6	79.7	deceased
CT96*	M	May - Sep 2023	P, D	128	136.1	148.2	collar failure
Mean ± SD (N = 12)					23.88 ± 44.98	22.43 ± 45.5	
Mean ± SD (N = 5) •					2.16 ± 1.79	2.25 ± 1.63	

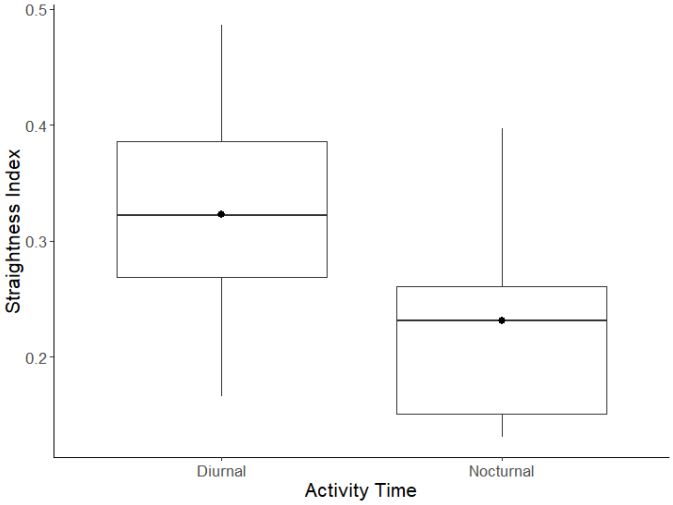

Figure 1. Box plot showing values of the straightness index (SI) for diurnal and nocturnal movements of nine coyotes in Los Angeles and Orange County in 2022-23. Only nine coyotes for which we had hourly tracking data from the first 28 days following capture are included. For reference, an animal moving in a straight line would have a straightness index of 1.0.