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Effect of a landfill on the home range and group size of coyotes (*Canis latrans*) in a tropical deciduous forest

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Abstract

The effect of an open landfill and the seasonality of a tropical deciduous forest in Jalisco, Mexico, was tested on the home range and group size of coyotes *Canis latrans* under the Resource Dispersion Hypothesis (RDH), which proposes that in social carnivores dispersion of patches of limited resources determines home-range size, whereas independently, abundance of resources affects group size. The predictions in this study were that coyotes using the landfill, where food is available all year due to the continuous arrival of food wastes that are concentrated in a single patch, would have smaller, seasonally constant home ranges than coyotes living outside, where food is distributed in several patches. In this area, coyotes would increase their home ranges during the dry season due to seasonal changes in resource availability. Also, a larger coyote group size should exist in the landfill, where food abundance is greater. Home-range size and group size of coyotes living in and outside the landfill were estimated by radio-tracking. Home ranges of coyotes in the landfill varied from 0.9 to 9.5 km^2, whereas home-range sizes of coyotes outside the landfill varied from 10.9 to 43.7 km^2. Seasonality had no effect on the home-range sizes. We identified a group of four adult coyotes in the landfill and no group formation in coyotes outside. These results support the predictions about home-range and group size of coyotes in relation to landfill presence, and indicate that under the circumstances of our study, coyotes follow the postulates proposed by the RDH.

Key words: *Canis latrans*, home range, group size, landfill, tropical deciduous forest

INTRODUCTION

Coyotes *Canis latrans* exhibit great intraspecific variation in their home-range size and social behaviour, both between populations and within the same population, seasonally and annually (Moehlman, 1989). The adult breeding pair is the typical social unit in most coyote populations, where subadults usually disperse in their first year. In some populations, however, subadult coyotes delay dispersal until subsequent litters are born, favouring the formation of packs composed of three or more members (Bekoff, 1977). This group size variation has been linked in canids to allometric traits (Bekoff, Diamond & Mitton, 1981; Moehlman, 1989) and to patterns of resource availability (Geffen *et al.*, 1996). For coyotes, this behaviour has been usually explained as an adaptation for food defence (Bekoff & Wells, 1981; Bowen, 1981), as a response to high coyote densities that produce habitat saturation (Andelt, 1985) and sometimes as a consequence of food resource abundance and distribution (Gese *et al.*, 1988*a*,*b*; Mills & Knowlton, 1991 but see Patterson & Messier, 2001).

Typically in social carnivores, when group size increases via recruitment of additional members, home range must be enlarged to meet the increased metabolic requirements. However, contrary to these theoretical predictions, under some circumstances territory size does not increase when more members are added to the group (e.g. red fox *Vulpes vulpes*; Macdonald, 1983). This phenomenon has been explained by the Resource Dispersion Hypothesis (RDH; Macdonald, 1983), which states that there is no correlation of territory or home-range size with group size – i.e. home range is constrained by the distribution of patches of available food (or other resources), increasing its size when resource patches are more spread out, whereas the number of group members that can be sustained in a group is limited

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independently by richness of available patches and its pattern of availability (see Johnson *et al.*, 2001; 2002 for a review). Several studies have tested the RDH under the assumption that blocks of different habitat types in the environment can be interpreted as resource patches (e.g. Geffen *et al.*, 1992). Such an assumption is rarely tested satisfactorily because it may be false that overall food availability is necessarily different between habitat types, and resources may be spatially aggregated within one habitat type (Johnson *et al.*, 2001). Because coyotes are opportunistic carnivores known to feed on food discarded by humans (e.g. McClure, Smith & Shaw, 1995; Fedriani, Fuller & Sauvajot, 2001) and receive a direct benefit in areas where carrion protein, and consequently energy, is abundant (Rose & Polis, 1998), a small habitat patch with substantially more concentrated resources compared to the surrounding ones, like an operational landfill, can be used as a practical model to test the RDH. Additional food can change the spatial ecology of coyotes, as documented by Shrago (1988, cited in Bounds & Shaw, 1997), or increase their densities (Fedriani *et al.*, 2001) probably because they have access to a wide range of foods of human origin, including garbage.

Opportunistic tropical carnivores may vary the way resources are used relative to availability (Ray, 1998). According to the RDH, our first prediction was that if group and home-range sizes of coyotes in a tropical area are determined by availability of food resources, then coyotes living in a landfill area, where food is abundant and clumped in a single patch that could cover their metabolic needs, would have smaller home-range sizes than coyotes living outside the landfill, where food is dispersed in several patches. In relation to group size, coyotes in the landfill area would live in a larger group than coyotes outside the landfill, because the abundance of food in the landfill patch is greater than in any other patch outside.

In the tropical deciduous forests of our study area, the net primary productivity (Martínez-Yrízar & Sarukhán, 1990), and therefore the food resources for animals undergo substantial temporal and spatial fluctuations, between seasons (wet and dry) and years (Lister & García, 1992; Valenzuela & Macdonald, 2002). Carnivores inhabiting this area modify their home-range size as a response to resource scarcity of the dry season (e.g. Nuñez, Miller & Lindzey, 2002; Valenzuela & Macdonald, 2002). Because coyotes may respond to changes in resource abundance as documented in other areas (Mills & Knowlton, 1991), our second prediction was that coyotes outside the landfill would increase their home-range size during the dry season due to the seasonal changes in resource availability, but that home ranges of landfill coyotes would not change due to the continuous arrival of food resources during that season.

Most information on coyote home-range size has been reported from individuals living within the northern range of this species. In Mexico, studies on coyote home-range size have been conducted in temperate areas like pine-oak forests and grasslands (Servín & Huxley, 1995; List, 1997) or in subtropical deserts and shrublands (Hernández, Delibes & Ezcurra, 1993; Carreón, 1998). Very little is known about coyotes in tropical forests, even though this species is distributed widely in these areas, and coyote populations are likely to expand with deforestation and other human activities (Vaughan, 1983; Sosa-Escalante *et al.*, 1997). Our paper represents the first analysis of home range and group size of coyotes in a tropical environment.

Our objective in this paper was to evaluate the influence of a landfill and the seasonality of a tropical environment on the home range and group size of coyotes, under the RDH postulates.

MATERIAL AND METHODS

Study area

The study was conducted in an area of approximately 250 km^2 that included the Chamela-Cuixmala Biosphere Reserve (Ch-CBR) and surrounding areas to the north and south. The area is located on the Pacific coast of the State of Jalisco, Mexico (19°30′ to 19°33′ N; 105°00′ to 105°04′ W). Climate in the region is warm sub-humid with an average temperature of 18 °C in the coldest month and 24 °C in the warmest. Annual average precipitation is approximately 750 mm concentrated in a relatively short, wet season (July–October). Elevation varies from 0–500 m above sea level (Bullock, 1988). The most abundant tree species are *Cordia alliodora, Caesalpina eriostachys, Lonchocarpus* spp., *Jatropha chamelensis, Bursera* spp., *Guapira* sp. and *Croton* spp. (Bullock, 1988; Lott, 1993). Tropical deciduous forest is considered the most endangered tropical ecosystem in the world (Janzen, 1988). The second most widespread vegetation type in the area is the tropical semideciduous forest, located in valleys and riparian areas. This system is dominated by *Brosimum alicastrum, Sciadodendron excelsum, Astronium graveolens*, *Tabebuia donnell-smithii, Ficus* spp. and *Thouindium decandrum* (Bullock, 1988; Lott, 1993). Around the Ch-CBR, some areas of the tropical deciduous forest have been converted to plantations of corn *Zea mays*, papaya *Carica papaya*, mango *Manguifera indica* and coconut *Cocos nucifera*. Other important habitat types are open areas with induced grasslands for cattle grazing covered mostly by exotic grasses (e.g. *Panicum maximum*) and costal sand dunes dominated by *Opuntia excelsa*, *Acacia* spp. and *Mimosa* spp. Tourists are important to the area with several 5 star hotels distributed along the coast.

In the study area, coyotes are known to feed primarily on small mammals and cultivated fruits (Hidalgo-Mihart *et al.*, 2001). Scent station surveys have shown that coyotes are more abundant in induced grasslands and croplands, and scattered in the interior of forested areas (Cantú-Salazar, Hidalgo-Mihart & López-González, 1998).

The landfill area

In the central part of the study area an operational open landfill of approximately 2 ha surrounded by an area of induced grasslands of about 3 km^2 has been in use since 1980. The landfill receives trash from several sources including the town of Careyes, the recreational area of Rincón de Careyes and occasional discharges from other nearby towns. The landfill provides services every day to at least 110 local inhabitants (Instituto Nacional de Estadística, Geografía e Informática, 2000), and from November to April of each year, it receives the trash of more than 600 persons/day from the 2 resorts in the area. Estimated daily average garbage production in Mexico for 2000 was 1.03 kg/inhabitant. Of this, food remains make up 31.6 % (Instituto Nacional de Ecología, 1997). Using this figure as a base, we estimated that at least 35.8 kg of food remains become available to scavengers daily, and during the peak of the tourist seasons this could increase up to 231 kg of food remains per day. This elevated amount of food available for scavengers contrasts with the surrounding areas of tropical deciduous forest, where the net primary productivity has been calculated as 9500 kg per ha by year (Martínez-Yrízar *et al.*, 1996). Besides coyotes, the scavenger community of the landfill consists of a permanent group of at least 15 feral dogs *Canis familiaris* (M. Hidalgo pers. obs) as well as black vultures *Coragyps atratus* and feral cats *Felis cattus*.

Capture and radio-telemetry

Coyotes were trapped from January to May of 1996, 2000 and 2001 using number 3 'Victor' soft-catch leg-hold traps with neoprene protection to reduce damage to animals (Olsen *et al.*, 1986). Traps were placed in trails and road intersections and baited with commercial coyote attractants (coyote gland lure and coyote urine; Lenon Animal Lures, Manistique, Michigan). To avoid the capture of small and non-target animals, tension devices were fitted on the traps and set to catch animals larger than 8 kg. Traps were covered during the day and opened again at night to avoid capture of animals during diurnal hours, as recommended by the Animal Care and Use Committee of the American Society of Mammalogists (1997). Once captured, coyotes were immobilized with a mixture of Ketamine hydrochloride (4.5 mg/kg) and Xilacine hydrochloride (1.8 mg/kg; Servín, Huxley & Veneces, 1989). Conventional measurements and mass were obtained. Coyotes were aged (adult or subadult) depending on size, tooth wear and dental condition. Individuals were ear tattooed with progressive numbers and fitted with radio-collar transmitters recommended for coyotes by Wildlife Materials, Inc., Carbondale, Illinois. After recovery from the anaesthesia, coyotes were immediately released in the capture site. In the 3 coyotes that were re-captured, there were no abrasions caused by the collars.

In 1996 trapping efforts were concentrated inside an area of preserved tropical deciduous forest in the Ch-CBR, but due to low capture success (5 coyotes in 2050 trap/nights), during 2000 and 2001, traps were set in induced grasslands, coastal dunes and croplands. Trapping during these years was concentrated in 3 areas, the landfill and its vicinity (with an effort of 850 trap/nights), an area of induced grasslands and agricultural lands located 8 km north of the landfill (with 860 trap/nights), and a mosaic of coastal dunes and induced grasslands located 9 km south of the landfill (with a trapping effort of 1240 trap/nights).

Coyotes were radio-tracked using 4-element yagi handheld antennas and permanent null-peak systems. We obtained point locations at random times during the day and night, and most radio-collared coyotes were located > 5 times/week. Frequency of locations was similar in the landfill area and elsewhere. We assumed independence of successive observations for locations separated by > 6 h (Swihart, Slade & Bergstrom, 1988). Data were categorized by season, to reflect important changes in resource availability produced between them. For coyotes outside the landfill influence, the wet season (July–October) and dry season (November–June) corresponded to periods when resource abundance was high and low, respectively. We estimated home-range size and boundaries by the Adaptive Kernel Method (Worton, 1989) with 95% utilization distributions (Shivik & Gese, 2000) using CALHOME software (Kie, Baldwin & Evans, 1996). We only calculated home-range size for coyotes that had > 20 locations per season. Coyotes were classified as residents, transients or dispersals according to the movement pattern observed during the study. We considered resident coyotes those that remained within one main activity area for > 3 months. Transient coyotes were defined as coyotes that never remained in any area > 3 months (Atkinson & Shackleton, 1991). Dispersers were those that abandoned the area during the study period.

Statistical analyses

We divided the studied coyotes in 2 categories depending on their relationship to the landfill. Coyotes influenced by the landfill (hereafter called landfill coyotes) were those whose home ranges included any portion of the landfill, and coyotes not influenced (hereafter called outside coyotes) were those whose home ranges did not include any portion of the landfill.

To determine if there were differences in home-range sizes due to the seasonality of the study area, and presence of the landfill (dry season *vs*. rainy season; landfill coyotes *vs*. outside coyotes), we used a Repeated Measures Analysis of Variance (Zar, 1999). Small sample size precluded us from only using data of coyotes present in consecutive seasons; therefore we combined data of coyotes that were present in different years of the study. Even though these results allow us to determine if the seasonality of the area had an influence on the home-range size of the coyotes, it is important to note that differences resulting from inter-annual variations could not be tested and remained in the analysis as part of the mean square of the error.

Most studies on coyotes had not found differences in home-range sizes between males and females (see for a review Gridner & Krausman, 2001). However, to evaluate

Table 1. Seasonal home-range size (km^2) estimated with the 95% Adaptive Kernel (ADK) of coyotes *Canis latrans* radio-tracked on a landfill area and outside it during 1996, 2000 and 2001 in a tropical deciduous forest of Mexico. M, male; F, female; [a], transient during the season

			Home-range size (km^2)					
			1996		2000		2001	
Sex	Radio-tracking period	Status at the end of study	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season
			Coyotes outside the landfill					
M1	01/96–12/96	Death 12/96	17.7	10.0				
M2	01/96–12/96	Unknown	28.1[a]	23.9		16.8		
	06/00–11/00							
M3	01/96–6/96	Unknown	13.9					
M4	01/00–11/01	Alive			88.5[a]	111.5[a]	43.7	10.9
M5	01/00–10/01	Alive			18.0	35.5	22.8	18.0
M6	07/00–11/00	Dispersed				29.5		
M7	05/00–12/00	Death 12/00				32.8		
F1	01/96–06/96	Unknown	16.7					
F2	01/96–12/96	Death 12/96	13.4	19.1				
F3	02/00–08/01	Alive			14.1	29.1	40.9	
F4	03/01–07/01	Unknown					22.9	
			Coyotes inside the landfill					
M8	02/00–11/01	Alive			5.5	7.7	3.6	2.9
M9	12/00–11/01	Alive					2.5	0.9
M10	03/01–07/01	Death 07/01					21.3[a]	
F5	02/00–08/01	Dispersed			3.1	4.2	31.0[a]	
F6	06/00–11/01	Alive				9.5	7.1	2.2

the possible consequences of sex on our prediction of the effect of the landfill on the home-range size, we simultaneously determined the influence of the landfill and the sex of the resident coyotes, using an Unbalanced Factorial Analysis of Variance (landfill coyotes *vs*. outside coyotes; males *vs.* females), following the procedure described by Milliken & Johnson (1992). We used this method because the number of landfill coyotes was not equal to the number of outside coyotes.

To assess the level of association between coyote pairs and its pertinence to a group, we examined the temporal interactions among coyotes with overlapping home ranges using the Dynamic Interaction Test proposed by Doncaster (1990). This is a non-parametric procedure that evaluates the simultaneous movements of 2 individuals. The test determined if 2 coyotes radio-tracked simultaneously during a time interval were located within a critical distance more or less often than expected if the 2 animals were moving independently (Doncaster, 1990). Observed separation distances between pairs of coyotes were calculated from paired *x, y* coordinates within a 15-min interval. Expected differences were estimated from all possible combinations of unpaired coordinates. The distance at which coyotes become aware of conspecifics is unknown; therefore, we established 500 m as the critical distance to the test as done by Chamberlain, Lovell & Leopold (2000) for coyotes in a forest environment. A significant positive interaction occurred if observed frequencies (paired) were significantly greater than expected (unpaired) frequencies for each distance interval. A significant negative interaction occurred if expected frequencies (unpaired) were significantly greater than observed (paired) frequencies. Two coyotes were considered to be associated with each other when the observed frequencies of locations were significantly greater ($P < 0.05$) than the expected frequencies. We used Chi-square 2×2 test to identify positive and negative interactions. We classified the interactions between coyotes depending on their status to the landfill as interactions of landfill coyotes, interactions of outside coyotes and interactions between landfill coyotes with outside coyotes. We determined that coyote pairs with significant positive dynamic interaction were part of the same group.

RESULTS

Home-range size and landfill presence

Sixteen coyotes were radio-tracked during the study (five in the landfill and 11 outside it), but the number of animals varied during years, sites and seasons (Table 1). Seasonal home ranges of coyotes in the landfill varied from 0.9 to 9.5 km^2, whereas home-range sizes of coyotes outside the landfill varied from 10.9 to 43.7 km^2 (Table 1, Figs 1 & 2).

The coyote's home-range size exhibited an intense effect of the landfill ($F_{(1,8)} = 42.99$, $P < 0.001$) and no effect of the seasonality of the area ($F_{(1,8)} = 0.05$, $P = 0.99$) or the interaction between the seasonality and the landfill ($F_{(1,8)} = 0.02$, $P = 0.99$). Similarly, the home-range size differed markedly between the landfill and the outside ($F_{(1,10)} = 15.68$, $P = 0.003$), but there was no effect of

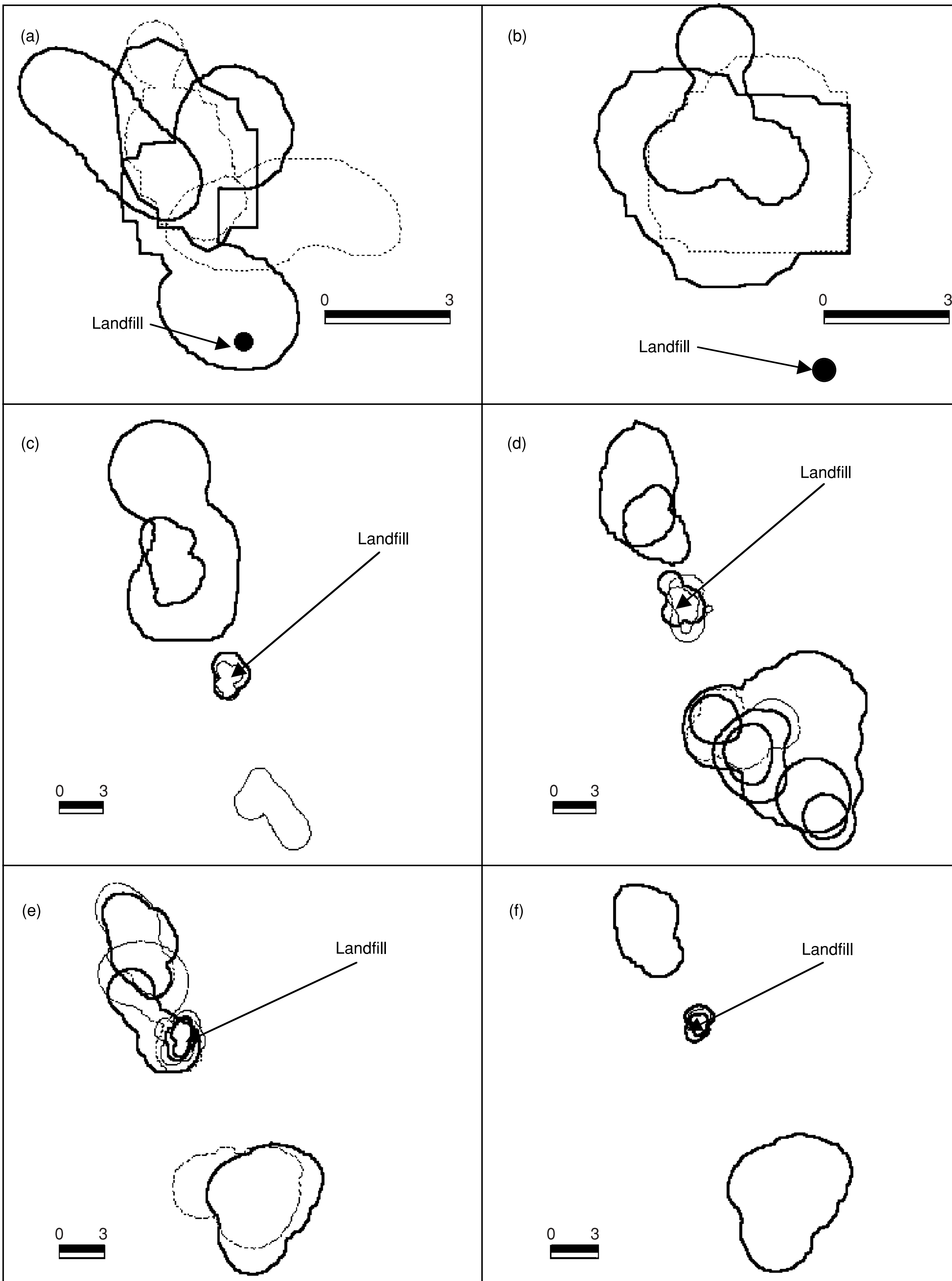

Fig. 1. Home range configuration of coyotes *Canis latrans* radio-tracked during 1996, 2000 and 2001 relative to the presence of a landfill in a tropical deciduous forest of Mexico. (a) Dry season 1996; (b) rainy season 1996; (c) dry season 2000; (d) rainy season 2000; (e) dry season 2001; (f) rainy season 2001. Bold lines represent males and dashed lines females. Scale is 0–3 km.

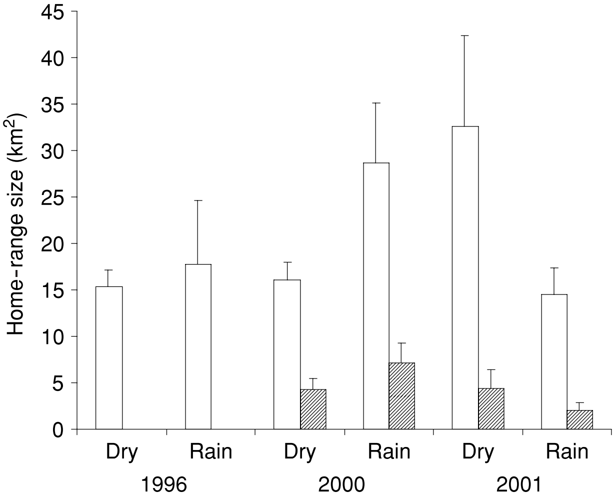

Fig. 2. Mean seasonal home-range size (km^2), estimated with the 95% Adaptive Kernel, of coyotes *Canis latrans* radio-tracked on a landfill area and outside it during 1996, 2000 and 2001 in a tropical deciduous forest of Mexico. Lines on the top of the bars represent one standard deviation. White bars represent the coyotes outside the landfill and dashed bars the coyotes inside the landfill area.

sex ($F_{(1,10)} = 0.02$, $P = 0.96$), and no interaction between sex and the landfill (ANOVA $F_{(1,10)} = 0.28$, $P = 0.61$).

Coyote group size and landfill presence

To determine the coyote group size in the landfill and outside the landfill, we did not use data from 1996, the dry season of 2000 and the rainy season of 2001 because there were a small number of coyotes with functioning radio-collars. We only found significant positive dynamic interactions on the landfill coyotes (Table 2). We did not find any positive interaction between outside coyote pairs or in landfill coyote pairs with outside coyotes. According to our definition of group, the landfill coyotes were forming a group of three adults – two females (F5 and F6) and one male (M8) – during the rainy season of 2000, and a group of four adults – two females (F5 and F6) and two males (M8 and M9) – during the dry season of 2001. During this last season, the four individuals of the landfill were located together several times in the same area in which we suspected was a common den.

DISCUSSION

Landfill presence and home-range size of coyotes

The results support our prediction that differences in food availability may produce differences in the home-range sizes of coyotes. According to the RDH, territory size may be affected by changes in the spatial distribution of patches of available food (Macdonald, 1983). In this study, coyotes outside the landfill may have access to a greater number of patches compared with landfill coyotes. However, these patches do not have the same amount of food as in the landfill. The greater availability of patches with less food may cause the enlargement of territories, because coyotes in these areas have to use a greater number of patches to attain their energy requirements. Coyotes in the landfill may satisfy their energy requirements in a single patch because of the large quantity of food available, thus

Table 2. Temporal interactions among coyotes *Canis latrans* with overlapping home ranges during the rainy season of 2000 and the dry season of 2001 related to the presence of a landfill in a tropical deciduous forest of Mexico. The value of the Chi-square test (obtained in the 2 × 2 test)[a] was obtained using the Dynamic Interaction Test proposed by Doncaster (1990) with a critical distance of 500 m. M, male; F, female; *, $P < 0.05$; **, $P < 0.01$; *n, negative interaction $P < 0.05$

	Landfill coyotes			Coyotes outside the landfill			Landfill coyotes and coyotes outside the landfill		
Season	Interaction		Value[a]	Interaction		Value[a]	Interaction		Value[a]
Rain 2000	F5	F6	19.4**	F3	M4	0.7			
		M8	4.1*		M7	0.4			
	F6	M8	5.1*	F3	M6	0.2			
				M2	M5	1.3			
				M4	M6	0.0			
					M7	0.8			
				M6	M7	0.1			
Dry 2001	F5	F6	5.0*	F3	M4	1.5	F4	F5	1.7
		M8	4.1	F4	M5	3.3		M10	0.2
		M9	4.6				M5	F5	0.7
	F6	M8	53.1**					M10	0.2
		M9	36.7**						
	M8	M9	48.8						
	M10	F5	0.01						
		F6	4.4*n						
		M8	1.8						
		M9	0.2						

reducing their home-range size. This probably represents the extreme condition of the territory postulate of the RDH. Under these circumstances, it would be interesting to test the hypothesis that removal of the landfill patch may render the territory untenable for the group of coyotes that depend on it.

Our second prediction, that home-range size of coyotes would increase in response to the seasonality of the area, was rejected. The absence of a seasonal effect on the home-range size of outside coyotes could be explained by the fact that they feed mostly on cotton rats *Sigmodon mascotensis*, which are associated strongly with induced grasslands, and whose greatest densities have been observed in the dry season (A. Miranda, Fundación Ecológica de Cuixmala, pers. comm.), and cultivated fruits, especially papayas which are available throughout the year because of irrigation during the dry season (Hidalgo-Mihart *et al.*, 2001).

Landfill presence and coyote group size

The data obtained during the rainy season of 2000 and the dry season of 2001 suggest that our prediction that group size of landfill coyotes would be larger than group size of outside coyotes is correct. Although there is a possibility that some coyotes outside the landfill were not captured, and therefore that certain coyote pairs were associated with non-captured residents, we assumed from our intensive trapping that most coyotes were caught. Also, during field work we found no evidence of coyote groups outside the landfill, neither visual observations of grouped coyotes nor tracks of more than two individuals walking together.

We propose two different explanations of group formation in the landfill. First, coyotes are considered to follow an expansionist strategy (Kruuk & Macdonald, 1985), in which benefits obtained by group formation are associated typically with rewards related to cooperative behaviours, such as breeding and food acquisition. Under this strategy, the advantages of the presence of secondary animals are sufficient to compensate the costs of enlarging territories. However, our results suggest that under special circumstances, like abundance of human food waste, the landfill resident pair may have more resources than those needed by them alone and therefore can sustain subordinate coyotes forming a group. This suggests that landfill coyotes in our study area operate as contractors (Kruuk & Macdonald, 1985) and not as expansionists. The contractor strategy explains group formation in animals that maintain a small economically defensible area, which will encompass sufficient resources for a breeding pair and may support additional residents. According to this strategy and the RDH, in these minimum territories the group size is affected primarily by patch richness, indicating that an increase in the amount of food available for each patch, without any concomitant change in patch distribution will affect only group size (Macdonald, 1983). Under these circumstances, it may be possible that a manipulation on amount of trash received by the landfill would produce a parallel change in number of coyotes of the group that depends on it.

A second explanation, alternative to the contractor – expansionist strategy for group formation in the landfill, is the defence of this area from other coyotes or feral dogs. The formation of groups to defend food resources has been previously documented for coyotes (Bekoff & Wells, 1981; Bowen, 1981). In our study area, the landfill represents a continuous food source for coyotes throughout the year, contrasting enormously with the surrounding areas where food resources are limited during the dry season (Valenzuela & Macdonald, 2002). Thus, resident coyotes might need to strongly defend the area from invasions of neighbouring coyotes and the large group of feral dogs that inhabits the landfill. Aggressions of feral dogs to coyotes have been observed in the proximities of the landfill (A. Peña, Fundación Costa Careyes, pers. comm.), thus suggesting that competition for space and food resources between both species could be present. Aggression between canid species are well documented (Palomares & Caro, 1999; Fedriani *et al.*, 2000), and usually explained as a strategy of competitive exclusion. Also, feral dogs are effective scavengers on human food waste and carrion, often displacing native scavengers because of their high plasticity and elevated numbers near human-disturbed areas (Butler & du Toit, 2002).

Coyotes in tropical areas

Human activity has an important effect on the availability and abundance of coyote prey items in our study area (Hidalgo-Mihart *et al.*, 2001). Some authors suggest that food habits of coyotes are influenced strongly by changes in land use associated with agriculture and urbanization (Brillhart & Kaufman, 1994). It also has been documented that coyotes are increasing their range as a consequence of landscape alteration by human activities, creating habitats where coyotes can easily find food (Quinn, 1997). We have little information about the processes involved with the expansion of coyotes in tropical areas. However, deforestation and roadways produced by human activities probably contributed to the establishment of coyote populations in areas like Costa Rica (Vaughan, 1983), the Yucatan Peninsula (Sosa-Escalante *et al.*, 1997) and Belize (Platt, Miller & Miller, 1998) where they were absent only a decade or so ago. The results of this study, where a landfill was strongly beneficial to coyotes, lead us to speculate that populations of this carnivore will tend to increase as a direct consequence of human activities in the tropics.

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