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THE DOMESTIC CAT AS A PREDATOR OF ISRAELI WILDLIFE

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ABSTRACT

Predation of wildlife by domestic cats was studied in Israel. Analysis of stomach contents and data provided by observers revealed that many domestic cats enriched the diet provided by their owners with many species of wild animals, including 12 mammals, 26 birds, 18 reptiles, and one amphibian, and scavenged from garbage. The proportion of manufactured cat food and garbage dump food in the diet of urban cats decreased from 70% of stomach volume among those living in rural settlements to 44% among cats living in open areas, with the rest of the stomach contents consisting of wild animals. Of the wild animals hunted by cats, the most common category was mammals (75% of the stomach volume), followed by amphibians (10%), birds (9%), and reptiles (6%).

Most cats do not wander more than 200 m away from either a food source or cover. Female cats living in (southern) desert settlements do not leave the inhabited area and have very small home ranges, while those living in the Mediterranean region (central and northern) wander outside under the cover of trees and bushes and have significantly larger home ranges. The mean distance traveled daily by females from their center of activity was 51.3 m and 103.4 m for the southern and northern populations, respectively. Males were studied only in the Mediterranean region, and their travel distances were greater than those of females.

Although our results of predation are mainly qualitative, this study supports those done elsewhere in the world where the cat was shown to be a generalist predator whose potential impact on some species, especially endangered ones, may be considerable.

Keywords: domestic cat, *Felis catus*, wildlife, predation, Israel

INTRODUCTION

Cats (*Felis catus*) were fully domesticated in Egypt about 4000 years ago (Bradshaw, 1992; Serpell, 2000), and have become the most common mammalian pet in the world (Turner and Bateson, 2000). The estimated number of pet cats in western Europe, central Europe, the USA, Australia, and Japan, is 42.7, 32.7, 56.1, 2.6, and 7.2 million, respectively, which is 6–25 domestic cats per 100 persons (Turner and Bateson, 2000). These

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estimates do not include stray cats that live in human settlements but do not belong to any household, or feral cats that live mainly in the wild. These two latter categories are more common in countries with a mild climate, such as Mediterranean countries.

There are two estimates of the number of domestic cats in Israel—140,000 pet cats in 1996 (Turner and Batson, 2000), and 208,000 (Terkel and Doron, 1998). These numbers do not include stray and feral cats, whose numbers are seemingly very large. For example, a study in the city of Jerusalem estimated an exceptionally high density of 2,300 adult stray cats per km^2 (Mirmovitch, 1995) in comparison to 229 cat/km^2 in Bristol and the UK (Baker et al., 2005; see also Natoli et al., 1999). There are several reasons for this. First, in Israel organic waste is often not properly treated. Food remains are found everywhere near garbage containers, in yards and parks, readily available for cats. Second, feeding stray cats is a widespread phenomenon in Israeli towns and villages. Individuals providing food for dozens and even close to a hundred cats are not uncommon. Third, Israel has a mild climate and regularly-fed cats easily survive the winter.

The domestic cat is known as an avid and efficient predator whose hunting and killing drives do not differ from those of its wild ancestor (Leyhausen, 1979; Tabor, 1983; Bradshaw, 1992; Bradshaw et al., 1999; Fitzgerald and Turner, 2000). Although, to our knowledge, there are no direct data on the impact of cat predation on wild prey populations, predation of wildlife by cats is well documented (Liberg, 1984; Churcher and Lawton, 1987; Crook and Soule, 1999; Pontier et al., 2002). Woods et al. (2003) showed that 986 pet cats in England brought home 14,370 prey items in five months and extrapolated that the 9 million domesticated pet cats in Britain consume as many as hundreds of millions of wild animals every year. Similar results were reported for Hungary (Biro et al., 2005), Sweden (Liberge, 1984), and the United States (Mitchell and Beck, 1992; Dunn and Tessaglia, 1994; Coleman and Temple, 1996; Crook and Soule, 1999; Kays and DeWan, 2004).

As far as we know, there is no study of predatory habits of domestic cats in Israel, and the aim of this study is to provide these data. This is important for the management of cats inside and outside settlements, and is particularly important for nature conservation.

MATERIALS AND METHODS

We used three methods to study cat predation of wildlife:

1. *Examination of stomach contents*. Carcasses of road-killed cats or cats that were culled during rabies control operations by local veterinarians and rangers of the Israel Nature and National Parks Authority during 2004–2005 were brought to the laboratory at Tel Aviv University. Every individual was weighed to an accuracy of 5 g and its total body and tail length were measured to an accuracy of 5 mm. The stomach was removed and preserved in 70% ethanol, and its content was divided into six categories: mammals, birds, reptiles, amphibians, invertebrates, and other material. The last category is comprised of the remains of human food, cat food, and trash and will be referred to as "trash". Prey items were identified to the lowest taxonomic level possible. The remains

of mammalian and reptilian prey items were found largely intact in the stomach and were usually identified at the species level. Birds were identified by macroscopic comparison of feather remains with a reference collection at Tel Aviv University's Zoological Museum. The volume of prey items was measured to an accuracy of 5 ml by adding the content of the stomach to a known volume of water in a measuring cylinder and recording the change in volume.

All stomachs were divided into three categories according to their origin: (1) urban settlements, (2) rural settlements (relatively isolated settlements, villages, and army camps), where cats have unlimited access to human-provided food sources, and (3) open areas, both cultivated and natural. The results are presented in two ways: percent occurrence and relative volume of each prey category in the stomach contents. The first method portrays the quantity of prey items in each category but underestimates the importance of large prey items to the cat's diet (Fitzgerald, 1988) because large and small items are scored the same. We use both methods in order to present data about the frequency of prey in the cat's stomach and the importance of each prey category to the cat's diet (Bloomer and Bester, 1990).

2. *Survey of prey brought home by cats*. We distributed a letter requesting information (species, locality, and date) about prey items brought home by cats. The letter was sent to rangers of the Israel Nature and National Parks Authority, guides of the Society for the Protection of Nature in Israel, workers in zoos, and other people who expressed their interest. It was also distributed among students and staff of relevant departments at universities and participants in ISRAEBIRDNET, a network of amateur and professional Israeli ornithologists. The respondents were requested to either send us the prey item or its photo, and if these were not available, the respondents were requested to identify the prey item by asking a knowledgeable person to do so. The information was collected during 2003–2005. Although the information gathered by this method is qualitative, it provides information on the scope of prey consumed or caught by domestic cats. In addition, a biologist (H. Goldstein) of the Israel Nature and National Parks Authority who lives in northern Israel (Metulla, 33°16′N, 35°34′E) provided information of the total number of prey items brought home by her castrated male cat during 12 months between October 2003 and December 2004.

3. *Studying home ranges of cats*. In order to study home ranges of cats, we attached radio transmitters to cats and followed these individuals for a period of 5 days for a total of 40–50 hours each. The study was conducted between February and June 2005, in five sites that are adjacent to natural areas. These settlements were selected because they have a population of stray cats, are small and relatively isolated (the nearest settlement was at least 1 km away), and the cats have an unlimited food source in the form of garbage or people who feed them regularly. The selected settlements were on two extremes of the climate gradient that exists in Israel: the southern ones (Kibbutz Samar, 29°50′N, 35°01′E, 11.4 ha[2]; Kibbutz Elifaz, 29°47′N, 35°01′E, 7.3 ha; and Uzvat Edom army camp, 29°35′N, 34°55′E, 229 ha) were in the desert of the southern Arava Valley, an area where natural vegetation exists mostly in creek beds, while the northern ones were in the Mediterranean region in the north of Israel. One of the latter settlements (Mt. Meron

Field Study Center, 33º00′N, 34º25′E, 8 ha) is on the border of Mt. Meron Nature Reserve, where there is a low oak forest, and the other (Kidmat Zvi, 33º01′N, 35º41′E, 19.9 ha) is on the Golan Heights, where the natural vegetation consists of low shrubs and grasslands. In these two regions, mean annual rainfall is 25 and 800 mm, respectively, and mean August temperature is 32 ºC and 24 ºC, respectively (Jaffe, 1988).

Cats were trapped near garbage dumpsters or feeding sites in box traps (105 × 30 × 30 cm) baited with tuna. Each cat was anesthetized with Ketamine HCl (1 mg/kg body weight) and fitted with an HLPM 2380 radio collar (Wildlife Materials Inc.). The collar weighed 50 g and transmitted at 151–152 MHz. After a collar was fitted, the cats remained in the trap for 3 h until fully recovered, and then were released. Each collared cat was followed for 5 days between 3 pm and 1 am, and during this period we made an effort to locate each cat every hour to obtain a total of 40–50 fixes for each cat. The cats were located using a three-element Yagi hand-held antenna connected to a Telonics TR-2 radio receiver and their positions were determined by direct observation and a Garmin Geko 101 GPS unit. In cases in which an individual could not be observed, its location was determined by triangulation from known locations. After the tracking period, every cat was caught again, its collar removed, and it was released at the capture site.

Home range was estimated by the 95% adaptive kernel method (Worton, 1989) using the program Ranges 6 (version 1.06; Kenward et al., 2002). Kernel methods do not require making any assumptions about the underlying distribution of the data, are insensitive to autocorrelation and robust for small sample size, and are a more accurate means of estimating home-range size than the alternatives (Worton, 1995; Blundell et al., 2001). Kernel estimators determine the utilization distribution of an individual by assessing the probability of occurrence at each point in space (Worton, 1989), and can be used to define areas within the range that are heavily used by the animal (center of activity). Further, for each cat we calculated a buffer zone at intervals of 100, 200, and 300 m from day refuge locations, feeding sites, and human-related structures. The buffer edge implies an equal given distance to the nearest refuge location or feeding site or human habitation. Buffer calculations were done by ARC-GIS (version 8.2, ESRI).

RESULTS

1. STOMACH CONTENTS

We analyzed stomachs of 191 cats. Sixty-five were empty, and we analyzed the contents of the remaining 43, 59, and 24 from urban settlements, rural settlements, and open areas, respectively. The proportion of empty stomachs was significantly lower ($\chi^2_{(2)}$ = 5.83, $p = 0.05$) among cats from open areas (36.8%, 38.5%, and 11.1%, in urban settlements, rural settlements, and open areas, respectively).

We did not find any animal remains in stomachs of urban cats, and the stomachs containing food had either domestic food or cat food. Of 83 cats from rural settlements and open areas whose stomachs contained food, we recorded the volume of each food category (Fig. 1). There was a significant difference in the volume of mammals and trash

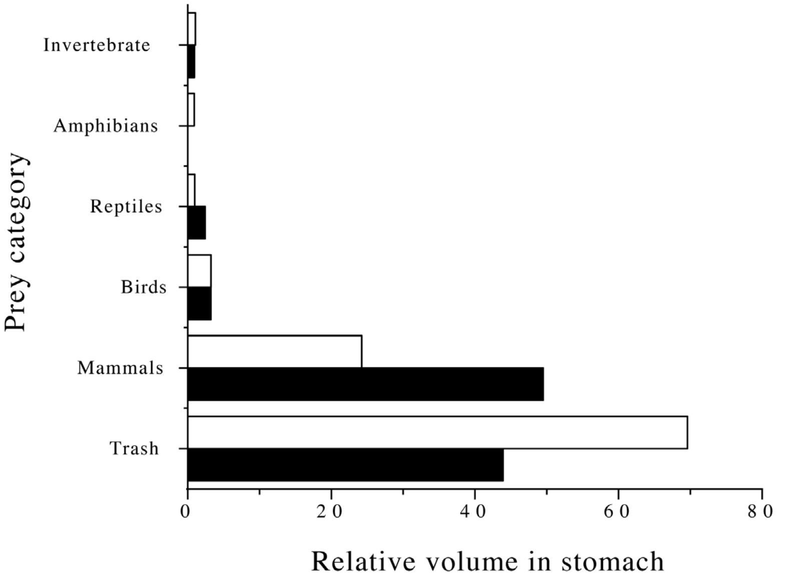

Fig. 1. Relative (%) volume of different prey categories in the stomachs of domestic cats collected in rural settlements (white bars; n = 59 cats) and from open areas (black bars; n = 24).

among cats from these two areas (Wilcoxon signed rank test, Z = 2.06, $p = 0.04$), i.e., the proportion of mammals was larger and trash smaller among open areas cats in comparison with cats from rural settlements. There was no difference in the proportion of prey mammals between male and female cats (45 females, 34 males; $\chi^2_{(1)} = 0.56$, $p = 0.45$).

There were 108 identifiable vertebrate prey items (for species list, see Appendix). Mammals comprised 75% of the prey items and were found in 37 stomachs, birds 6% (in 8 stomachs), reptiles 9% (in 5 stomachs), and amphibians 10% (all in one stomach). By volume, mammals also formed the largest proportion of the cats' diet (69%). Birds (19%), reptiles (10%), and amphibians (2%) were consumed at a much lower rate (Appendix). Invertebrates were found in 14 stomachs, but their relative volume in stomachs was very low (Fig. 1).

2. PREY BROUGHT HOME BY CATS

A list of the various species seen caught or brought home by cats is given in the Appendix. Birds were the most diverse group with 26 species belonging to 8 orders, followed by reptiles (17 species of lizards and snakes) and mammals (10 species of rodents, insectivores, and bats). Two of the above species (*Lacerta trilineata* and *Dryomys nitedula*) are categorized as locally endangered and two (*Micrelaps mulleri* and *Gerbillus allenbyi*) as locally vulnerable and internationally vulnerable, respectively (Dolev and Perevolotzky, 2002).

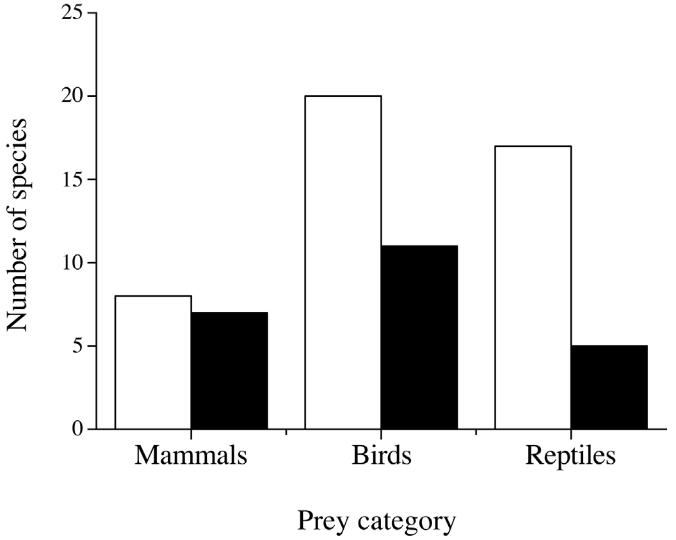

Fig. 2. Number of mammal, bird, and reptile species found in the stomachs of domestic cats collected from rural settlements (white bars; n = 83 cats) and urban settlements (black bars; n = 43).

The number of vertebrate prey species brought home by rural and urban cats is shown in Fig. 2. We did not detect a significant difference among the constituent species within each prey class (mammals, birds, and reptiles; $\chi^2_{(2)} = 2.35$, $p = 0.31$). Mammalian species composition differed somewhat between urban and rural cats: both urban and rural cats caught commensal species such as shrews, rats (both *Rattus rattus* and *R. norvegicus*), and house mice, but each group also caught other species. In addition to the above species, rural cats also caught *Acomys russatus, Spalax ehrenbergi,* and *Apodemus mystacinus,* and urban cats caught *Gerbillus allenbyi, Microtus socialis,* and *Rousettus aegyptiacus*. This different pattern between urban and rural cats may be explained by the fact that in our sample most urban settlements were from the coastal plain, while rural ones were from farther north in the Galilee, as well.

A total of 48 prey items was brought home by a single castrated male cat from Metula (a settlement in northern Israel) over a period of 12 months (4 items/month; Appendix). They include 4 species of mammals (25 individuals), 5 birds (9), 8 reptiles (11), as well as various invertebrates (a mantis, a moth, and a grasshopper).

The total number of species brought home or found in stomach contents in all the domestic cats we sampled was 12 mammals, 26 birds, 18 reptiles, and one amphibian.

3. DISTANCE TRAVELED AND SIZE OF HOME RANGE

Radio collars were attached to 26 cats (22 females, 4 males) in 5 settlements located in two geographical regions, namely, extreme desert and Mediterranean region. The

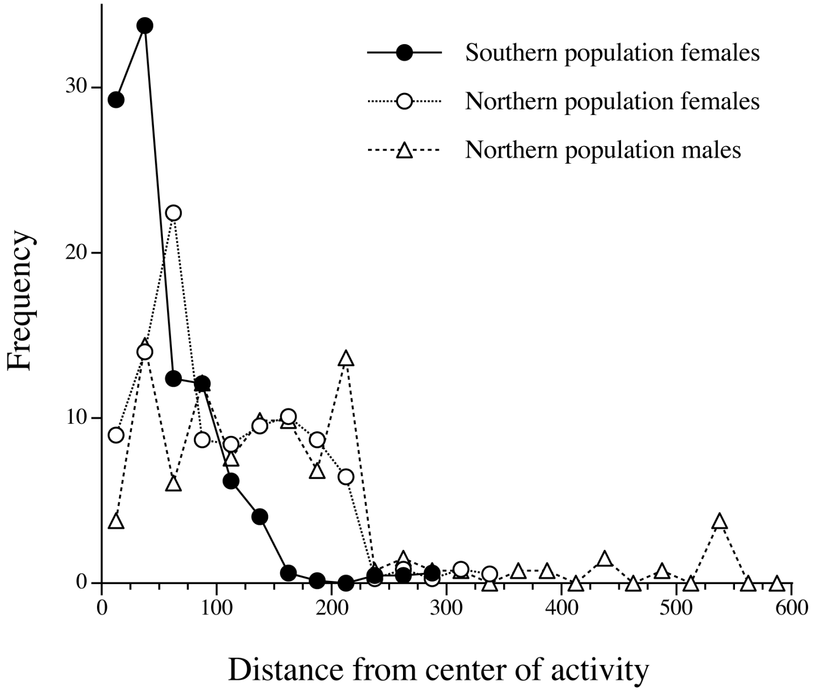

Fig. 3. Frequency distribution of distances from center of activity (m) of each individual in southern population females (solid circle), northern population females (empty circle), and northern population males (empty triangle).

average number of fixes collected per individual (±SD) was 46.1 ± 2.0 and 40.7 ± 7.6 for the southern and northern populations, respectively. In Mt. Meron, the only site where we tracked both sexes, the average number of fixes collected per male and female (±SD) was 42.0 ± 3.5 and 33.0 ± 7.7, respectively. The mean distance traveled daily by females from their centers of activity (±SD) was 51.3 ± 30.1 m and 103.4 ± 26.2 m for the southern and northern populations, respectively. Individual northern females traveled significantly longer distances (nested ANOVA, $F_{(1,17)} = 28.0$, $p = 0.013$). Maximum distance traveled daily from the centers of activity by northern population females was also greater, but not significantly so, than from those in the south (218.5 ± 70.2 and 140.0 ± 79.0, respectively; nested ANOVA, $F_{(1,17)} = 6.3$, $p = 0.087$). Males traveled significantly greater distances than the females of both regions, with mean daily distance from center of activity (±SD) of 244.2 ± 147.8 m (nested ANOVA, $F_{(1,23)} = 14.8$, $p = 0.0008$) and maximum daily distance of 1524.9 ± 814.8 m (nested ANOVA, $F_{(1,23)} = 49.7$, $p = 0.0001$). The frequency distribution of distances from center of activity collected at each region shows that for female cats this approaches zero at distances greater than

150 m in the southern population and 225 m for both males and females in the northern population (Fig. 3).

The mean home range size of females (±SD) was 1.59 ± 2.02 and 4.92 ± 3.83 ha for the southern and northern populations, respectively, but did not significantly differ from each other (nested ANOVA, $F_{(1,17)} = 3.1$, $p = 0.176$). Male home range size was significantly greater than those of females in both regions, with a mean of 72.23 ± 128.50 ha (nested ANOVA, $F_{(1,23)} = 6.4$, $p = 0.018$). However, a single male (M1315) had a range that was 11–67 times larger than that of the other males. The difference in range size between the sexes is also supported after excluding the outlier male from the analysis (13.11 ± 9.98 ha; nested ANOVA, $F_{(1,22)} = 9.1$, $p = 0.006$).

No female in southern locations ever traveled outside the boundaries of its settlement. All females had ranges that extended, at most, 150 m away from their day shelter (in most cases, 100 m or less). In the north, females' ranges extended to 200 m from their day shelter. A clear association between permanent food source (dumpster or feeding site) and home range position is observed. The nearest-neighbor distance between cat positions and the nearest food source was significantly clumped (i.e., the observed nearest-neighbor distance was significantly shorter than expected by the random distribution of food source; $p = 0.001$ for Elifaz and Samar, and $p = 0.05$ for Mt. Meron), an indication that these food sources are an important predictor of female movement pattern. Two males showed tight restriction to the settlement boundaries; their range spanned 200 m away from the daytime shelters. The range of the other two males we tracked spanned >300 m from their daytime shelters.

Because females in the southern settlements were restricted to human habitations, they did not utilize any natural habitat. However, this situation was markedly different in the north. The home range of females in Mt. Meron and Kidmat Zvi was composed on average (±SD) of 77% ± 16 and 47% ± 17 of natural habitat, respectively. Male range in Mt. Meron was composed of 78% ± 30 of natural habitat. However, on Mt. Meron about 90% of the range of two females and two males, and 99% of one male was natural habitat (forest of native oak).

Figure 3 shows that utilization decreased as a function of distance from the center of activity. To assess the impact of cats on the natural habitat, we calculated a utilization function using the frequency distribution of distances traveled (Fig. 3). The proportion of area under the cubic curve fitted to the data in Fig. 3 for northern males and females, relative to even utilization across distance, provided a correction factor for the amount of natural area impacted by cats. The cubic function fitted to frequency distribution of distances for northern males and females accounted for 61.7% and 73.7% of the variance, respectively. The correction factor of utilization for northern males and females was 0.304 and 0.232, respectively. Considering a 300 m buffer zone for males and 200 m for females, the total area of natural habitat impacted by males and females is 32.7 ha and 27.0 ha in Mt. Meron and 61.2 ha and 58.9 ha in Kidmat Zvi, respectively. Taking into account the correction for utilization, male and female cats impact an area of 1.24 and 0.78 times the total area of Mt. Meron field school, and 0.93 and 0.69 times the total area of Kidmat Zvi, respectively.

DISCUSSION

We found that domestic cats in Israel enrich the diet provided to them directly or indirectly by humans with many species of wild animals including 12 mammals, 26 birds, 18 reptiles, and one amphibian. The proportion of human-provided food in the diet decreased from urban cats to those living in and around rural settlements and was lowest among cats living in open areas. Although stomach content of the examined urban cats was composed entirely of human-provided food, observations of prey items brought home or hunted by cats indicate that they also kill wild animals. These included mammals, comprising 75% of the stomach volume, followed by amphibians, birds, and reptiles (Fig. 2). However, the high proportion of amphibians is misleading, because all specimens were found in the stomach of one cat, which contained 11 frogs (*Rana ridibunda*), and owing to the small sample size, the amphibians appear as a high proportion of the total diet. The proportion of mammals, birds, and reptiles hunted by cats reported here are within the range reported in other countries (Fitzgerald and Turner, 2000).

The data derived from the examination of stomach content were complemented by observation data of animals hunted by cats. The number of mammalian species reported as taken by cats was only somewhat larger than that identified in stomachs, but the number of birds and reptiles reported were much larger. The difference may be due to a larger number of reports by observers (most prey mammals are nocturnal while most birds and reptiles are diurnal) and to difficulties in identification of birds in stomach contents.

The large difference between the number of species brought home by cats and those found in stomachs supports the notion that cats eat only some of the animals they hunt. George (1974) suggests that the proportion is about half, while Kays and DeWan (2004) assume that only a third are brought back home. The single cat for which we have continuous data brought back 48 prey items over a period of 12 months (Appendix). According to the above appraisals, this single cat may have killed between 100 and 150 animals during the year.

An examination of the proportion of species taken by cats of the total number of terrestrial species available to them in Israel as prey among non-volant vertebrates, indicates that the proportion is similar among species and comprises about a quarter of the snakes (a total of about 40 species in Israel), lizards (Lacertilia, about 40), and small mammals (insectivores, rodents, and hares, about 50) that exist in Israel. This may indicate that the domestic cat is a generalist predator that takes any available prey. Among the 26 species of birds hunted, 18 (69%) were either resident or summer breeding species, and the rest were migrants. Israel is located on a major flyway of migratory birds. Migrant birds use the northern, Mediterranean region of Israel as well as agricultural settlements in the southern deserts as resting and refueling stations (Merom et al., 2000), and cats find them an easy prey, mainly when they land exhausted after crossing the Sahara and Arabian deserts during spring migration.

Our data show that domestic cats hunt a great variety of animals, and where such cats are numerous, they may exert considerable pressure on wild animals. However, since we do not have data on the population size of any of the prey species, we cannot provide estimates on the proportion of prey populations taken by cats. Nevertheless, in a densely populated country like Israel, where in its northern and central, Mediterranean half there are hardly any settlements that are farther than 5 km from one another, the potential impact of cats on some species, especially endangered ones, may be considerable. Our data on the home range of cats suggest that most cats do not wander more than 200 m away from either a food source or cover. Hence, while female cats living in desert settlements do not leave the inhabited area and have very small home ranges, those living in the Mediterranean region wander outside it under the cover of trees and bushes and have significantly larger home ranges. Since southern and northern cats were not tracked concurrently (tracking in the desert took place from February and March and in the Mediterranean region from April to June, 2005), we cannot exclude seasonal differences as a reason for the difference between home range sizes. Home range size of male domestic cats is much larger than that of females (Dards, 1978; Fitzgerald and Karl, 1986; Smucker et al., 2000; Say and Pontier, 2004; Biro et al., 2004), and on Mt. Meron some males have home ranges that are an order of magnitude larger than those of females. In addition, one of the males we tracked had an exceptionally large range, was clearly not bound by settlement boundaries, and spent most of its time in the natural oak forest. This behavior is typical of feral cats, which occasionally feed on human garbage but generally seek natural prey.

Our conclusion is that domestic cats in Israel take a wide range of wildlife species. Further studies on the impact of cats on populations of specific threatened species are required in order to quantify its extent. Such studies will have to take into consideration the number of prey taken in proportion to prey population size. However, our results are fully compatible with the trend observed in other detailed studies on the impact of cats. Therefore, we recommend that the various authorities (the Israel Veterinary Service and the Israel Nature and National Parks Authority, as well as regional veterinarians) take steps to control domestic cat populations, especially in the vicinity of settlements, where stray cat populations are constant reservoirs for feral cats. This can be done by eliminating open garbage dumps and other sources of food, forbidding the feeding of domestic cats outside the home, and, ideally, taking steps that will significantly reduce the number of feral cats.

In Israel there is a fierce public debate over the appropriate measures to be taken to reduce the stray cat population. The current regulations do not allow eradication of feral or street cats, except in special cases such as a danger to public health (i.e., spread of diseases like rabies; Supreme Court 4884/00). In light of these circumstances and the potential impact on endangered species by domestic cats, we recommend that the regulations be changed so that cats seen in or near a nature reserve are removed in order to protect wildlife.

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APPENDIX

The number of items of various vertebrate species brought home or found in stomach contents of domestic cats. An asterisk marks four species for which the observer did not report the number of individuals brought home. The last column provides the number of prey items of each species brought home by the single cat in Metulla during a nine-month period.

Scientific name	English name	Brought home	Stomach contents	Single cat
Mammals				
Crocidura sp.	Unidentified shrew	3	4	8
Rousettus aegyptiacus	Egyptian fruit bat	1		
Microtus socialis	Levant vole	3	6	1
Gerbillus allenbyi	Allenby's gerbil	2		
Meriones tristrami	Tristram's jird	1	3	
Apodemus mystacinus	Broad-toothed field mouse		*	1
Rattus rattus and *R. norvegicus*	Rats	4	9	10
Mus musculus	House mouse	17	47	6
Acomys russatus	Golden spiny mouse	1		
Spalax leucodon	Mole rat	1		
Dryomys nitedula	Forest dormouse	*		
Total species: 12				
Reptiles				
Chamaeleo chamaeleon	Chameleon	2	1	1
Hemidactylus turcicus	Mediterranean gecko	7	2	1
Ptyodactylus guttatus	Fan-fingered gecko	1		
Agama stellio	Roughtail rock agama	3		3
Lacerta laevis	Lebanon lizard	1		
Lacerta trilineata	Balkan emerald lizard	*		
Mabuya vittata	Bridled mabuya	1	1	
Eumeces schneideri	Schneider's skink		1	
Typhlops vermicularis	Eurasian worm snake	1		1
Coluber jugularis	Fire racer	3		2
Coluber rubriceps (*najadum*)	Ghamchen snake	1		1
Coluber rhodorhachis	Braid snake	1		
Coluber rogersi	Roger's racer	1		
Spalerosophis diadema	Diadem snake	1		
Natrix tessellata	Dice snake	1	1	

APPENDIX *continued*

Scientific name	English name	Brought home	Stomach contents	Single cat
Reptiles cont.				
Eirenis decemlineatus	Lined dwarf racer	1		1
Micrelaps muelleri	Muller's two-headed snake	1		1
Vipera palaestinae	Palestinian viper	3		
Total species: 18				
Birds				
Falco columbarius	Merlin	1		
Ammoperdix heyi	Sand partridge	1		
Coturnix coturnix	Quail	1		
Gallinula chloropus	Moorhen	1		
Fulica atra	Coot	1		
Crex crex	Corncrake	1		
Hoplopterus spinosus	Spur-winged plover	3		
Scolopax rusticola	Woodcock	1		
Columba livia	Rock dove	6	1	
Streptopelia sp.	Unidentified dove	1		
Streptopelia senegalensis	Laughing dove	8		
Otus scops	Scops owl	1		
Upupa epops	Hoopoe	1		
Hirundo rustica	Barn swallow	*		
Pycnonotus barbatus	Yellow-vented bulbul	2		2
Troglodytes troglodytes	Wren	1		
Erithacus rubecula	Robin	1		1
Luscinia svecica	Bluethroat	1		
Turdus merula	Blackbird	1		1
Prinia gracilis	Graceful warbler	2		
Sylvia atricapilla	Blackcap	1		
Sylvia sp.	Unidentified warbler	1	2	
Phylloscopus collybita	Chiffchaff	2		
Parus major	Great tit	1		
Nectarinia osea	Palestine sunbird	1		3
Lanius nubicus	Masked shrike	2		
Passer domesticus	House sparrow	7		2
Total species: 27				