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ORIGINAL PAPER

Feeding activity and dietary composition of roe deer at the southern edge of their range

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Abstract We studied feeding activity and dietary components of hand-reared European roe deer (*Capreolus capreolus*) in Israel. Our ultimate goal was to assess habitat suitability for future reintroduction of the species, which has been locally extinct for nearly a century. Activity patterns, diet composition, and body mass of four does were monitored in two (fenced) typical east Mediterranean habitats: mature forest and scrubland recovering from fire. Food supplements were provided between trials. Throughout the year, the deer exhibited diurnal and nocturnal activity, mostly at dawn and dusk. Diet composition varied considerably between seasons and habitats, demonstrating the opportunistic flexibility of the deer. In both habitats, the deer fed on over 85% of the plant species but preferred a particular plant species or parts. In summer and early autumn, fruits and seeds became the dominant portion of their diet. In our semi-natural experimental setup, deer maintained body mass through the winter and spring. Weight loss occurred as the dry season advanced, but the animals rapidly regained mass when annuals and grasses became available following the first rains. In the east Mediterranean habitats, water availability seems more problematic for deer survival than food availability.

Keywords Diet composition · Hand-reared · Mediterranean forest · Reintroduction

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Introduction

The European roe deer (*Capreolus capreolus*) has been locally extinct from the east Mediterranean since the beginning of the twentieth century, apparently due to over-hunting and habitat loss (Aharoni 1943; Harrison and Bates 1991; Quemsiyeh et al. 1996). A small-scale (few individuals) reintroduction program has been initiated in Israel, with deer imported from Europe (Wallach et al. 2007a, b) where they are common and widespread (Andersen et al. 1998). The natural history of the lost east Mediterranean roe deer that survived in these hot and dry habitats is unknown. Moreover, reintroductions carried out at the edge of a species range have lower probabilities of success, mainly due to poor habitat quality (Griffith et al. 1989; Wolf et al. 1996). At the southern limit of their west Palaearctic range (the xeric forests of Spain), habitat constraints restrict roe deer numbers and distribution, in which they prefer the mesic-forested mountains (Tellería and Virgós 1997; Virgós and Tellería 1998). Tellería and Virgós (1997) suggested that roe deer that reach the Mediterranean region are spillovers from more suitable mesic habitats. Therefore, the reintroduction of roe deer to the former edge of their range may require careful site selection.

Since habitat quality is considered the most important factor determining reintroduction success (Griffith et al. 1989; Wolf et al. 1996), a research may help determine whether the local dry Mediterranean ecosystem can provide the habitat requirements of roe deer year round. Recently, we showed that availability of free water is a major constraint for roe deer in this region (Wallach et al. 2007b). Another largely unknown important determinant of habitat quality is the availability of sufficient resources that meet the dietary requirements (here, the ability to maintain or regain body mass) of the deer in the east Mediterranean (Bartolomé et al. 2002). Nevertheless, even the basic information on the diet composition of deer in these habitats is limited. The roe deer's feeding behavior and nutritional requirements have been studied mostly in Western and Northern Europe (Tixier and Duncan 1996; Duncan et al. 1998; Cornelis et al. 1999).

The browsing roe deer has low energy reserves (Holand 1992). Females invest heavily in their offspring (Andersen et al. 1998; Duncan et al. 1998), especially when lactating. Although roe deer are polyphagic, availability of preferred vegetation species has been shown to influence fawn body mass and survival, hence, strongly influencing roe deer population dynamics (Pettorelli et al. 2003).

Potentially, several nutritional constraints may limit habitat quality for roe deer in the East Mediterranean. Birth, lactation, and the rut all occur in summer when conditions in Israel are dry and hot. It has been suggested that roe deer are maladapted to the consumption of sclerophyllous vegetation (Tellería and Virgós 1997), which is common in this region (Dafni 1991).

The reintroduction of roe deer into Israel may be challenging for imported animals (Wallach et al. 2007b, Wallach et al. 2008). In this paper, we aimed to determine the composition of the roe deer's diet and the ability of the species to maintain body mass throughout the year under local conditions. We also assessed deer activity and microhabitat selection in dry Mediterranean habitats.

Materials and methods

Study site

The study site was a 10-ha dry Mediterranean maquis, located in the Hai-Bar Nature Reserve on the Carmel ridge (32º45′N; 35º00′E). The site covered two typical habitats, separated by a fence: a 2-ha early succession scrubland recovering from fire, where *Cistus salviifolius* and *Calycotome villosa* are abundant (young habitat), and an 8-ha mature maquis, dominated by *Quercus calliprinos* and *Pistacia lentiscus* (mature habitat). The study site was fenced and did not allow other large mammals to enter (apart from an occasional wild goat that jumped the fence). The two habitats were separated by a gated fence. The deer had access to both habitats or confined to one habitat at a time depending on experimental needs. The climate in this region is dry Mediterranean, characterized by two main seasons: hot and dry summer (June–October) and cool and rainy (annual precipitation approximately 530 mm) winter (January–March), and two transitional seasons: spring (April–May) and autumn (November–December). Spring is the season of irregular rains and rising temperatures. During autumn, temperatures gradually drop and infrequent rain follows.

Study animals

Roe deer are secretive and flighty animals, and because food selection is largely an innate behavior (Tixier et al. 1997, 1998), four roe deer were hand-reared (two in 2001 and two more in 2002) and closely monitored for 2 years in this semi-free-range study site (Wallach et al. 2007a). Male and female roe deer have similar food preferences (Mysterud et al. 1999), so, we chose to work with females to avoid the danger of male aggressive behavior (Prior 1995). Throughout the hand-rearing process, natural forage was available at all times. When the deer matured (6–8 months), they were released into the study site. During the trials (periods in which the deer were monitored according to an experimental design described below and presented in Table 1), the deer fed only on the natural vegetation and were supplied with water ad lib. Food supplements were provided ad lib during periods between trials (Table 1) to maintain the deer's health and reduce the possibility of overgrazing inside the fenced study site. In total, supplements were withheld for over 4 months of the year in 2003, and 6 months in 2004. The animals were weighed at the beginning and end of each trial (sheep scales, AB100P, Shekel, Israel).

Feeding activity

To determine their feeding patterns, we followed the deer throughout the entire 24-h cycle. Observations were divided into day and night sessions (12–14 h each), apart from one 25-h continuous observation. Six 24-h sessions were conducted in the summer and early autumn, and three in the winter. The activity of the deer was recorded and ranked every 10 min on a scale of 0 to 3 (0 = sleep, 1 = rest, 2 = forage/movement, and 3 = play/fight/run). The deer were considered active when the average activity value of the four deer was ≥1.5 and as resting when it was <1.5. During bouts of activity, we monitored the proportion of time spent feeding by repeatedly observing 10 min of activity at all hours of the day and night. We defined the

Table 1 Flow of experimental trial and observations carried out during 2003–2004

Month/year	Trials					
	Feeding activity	Habitat selection	Diet composition		Body weight	
			Young habitat	Mature habitat	Young	Mature
Jan 2003						
Feb 2003					x	x
March 2003						
April 2003					x	
May 2003						x
June 2003	x					
July 2003						
Aug 2003			x		x	
Sept 2003				x		x
Oct 2003	x					
Nov 2003			x	x	x	x
Dec 2003						
Jan 2004			x		x	
Feb 2004	x			x		x
March 2004	x	x				
April 2004				x		x
May 2004			x		x	
June 2004						
July 2004						
Aug 2004		x	x	x	x	x
Sept 2004			x	x	x	x
Oct 2004			x	x	x	x
Nov 2004			x	x	x	x
Dec 2004						

Note that diet composition and body weight were monitored both in young and mature habitats (see text). Food supplements were withheld for 3-week periods during the diet composition and body weight trials. Between August and November 2004, supplements were withheld continuously. When the trial in one habitat ended, the deer received supplements for 3 days before starting another trial

deer as *actively feeding* when they were consuming food (not counting the time spent searching for food), as opposed to *active* (or engaged in *activity*) when they were engaged in any behavior in a standing position (including feeding).

Habitat selection

In winter and summer, the deer had access (gate open) to both habitats on the study site. Habitat selection was determined by recording daily the deer's location at the time of the observer's arrival (24 and 31 days in winter and summer, respectively). The deer did not travel long distances within the study site but chose a different patch every day. They were inconspicuous in both the mature and the young habitat and only emerged from the dense vegetation when the observer was close by (Wallach 2005). We also monitored the selection of microhabitats within the study site once every hour, during the 24-h observations described above. We compared the amount of time the deer chose to spend in dense vegetation of trees and bushes (given the value 1) vs open areas, i.e., bare ground or with (if presence) grasses and annuals (given the value 0).

Diet composition

Diet composition was determined by direct observations, during each season and habitat separately. The deer were restricted to one habitat at a time for a period of ca 3 weeks in each of the four seasons (Table 1). Within a day after being restricted to a given habitat, foraging time for each plant species and part was determined by direct observation from a distance of less than 5 m. The plants eaten were identified to species, apart from annuals (dicotyledons) and grasses (annual and perennial monocotyledons). Active feeding was observed for periods of ≥10 min/deer/day. This time period was determined from preliminary data by plotting the number of plant species eaten against the time span of the observation followed by a regression test. The number of experimental days needed in each habitat (ca 2 weeks) was determined for each trial according to a coefficient of variance test. The observation time of actively feeding deer totaled 109 h (approximately 3.4 h/season/habitat/deer). Each individual was observed for a similar amount of time. Diet composition was only observed during daylight hours. Personal observations (ADW) during the 24-h trials indicate that their feeding pattern at night was apparently unchanged. Diet composition was expressed as the proportion of time spent foraging on a plant species or a plant part in each habitat and season.

Body mass fluctuations

At the beginning and end of each diet composition trials (described above), the deer were weighed to determine whether the local vegetation satisfied their nutritional demands, i.e., maintained body weight. The deer received supplements for 3 days before starting a new trial. Measurements of body mass were conducted in each habitat and season in 2003 and 2004 except for spring, which was monitored only in 2004. High quality food is expected to be scarce at the end of summer and beginning of autumn in dry Mediterranean regions. Therefore, in 2004, we withheld food supplements from the end of the breeding season (August) until the beginning of the growing season (November, with the appearance of new annuals). During this period, the deer had access to both habitats, and we monitored their weight approximately every 5 days.

Statistical analysis

Activity levels (number of hours active) in winter and summer were compared with a paired *t* test. The daily fluctuations in activity patterns in the two seasons were compared with a one-sample *t* test. Significance level was lowered by a factor of 10 (from 0.05 to 0.005), because the same animal was continually monitored, so each activity-level point was not independent of other points (Sokal and Rohlf 1998). We determined habitat preference with a combined probability chi-square test (Sokal and Rohlf 1998). We used two-way and repeated-measures analysis of variance (ANOVAs) to examine whether seasonality affected feeding pattern (grazing or browsing) and plant composition, respectively. Paired *t* tests were computed to compare diet composition in the two habitats. Body mass in different habitats was compared by paired *t* tests within seasons and repeated-measures ANOVAs among seasons. Statistical analysis was carried out with Statistical Package for the Social Sciences 13 for Windows. Proportions were converted with arcsine (√X) transformation.

Results

Feeding activity

The 24-h observations revealed that the deer were similarly active in summer and in winter (47% and 48% of the day, respectively), but they spent 7.5 h actively feeding in the winter and only 5.5 h in the summer (paired $t = 6.07$, df = 3, $p < 0.01$). In both seasons, the deer alternated seven times between periods of activity and rest during the day and were most active at dawn and dusk (Fig. 1). A smaller peak of activity appeared during the afternoon and two peaks during the night at 3–4 and 7 h after sunset (Fig. 1). There was no significant difference between the activity in winter and summer (one-sample $t = 0.41$, df = 143, NS).

Habitat selection

In both winter and summer, the deer chose the mature habitat. They were found there in 76 out of 80 observations in the winter (combined probability χ^2, $p < 0.0001$) and in 34 out of 41 observations in the summer (combined probability χ^2, $p < 0.01$). Microhabitat selection, within each habitat, was also similar in summer and winter. The deer chose the open habitats at dawn and dusk during their peak activity hours but spent the remainder of the day and night in dense vegetation. In summer and winter, respectively, the deer spent 77% and 78% of the day hidden in dense vegetation.

Diet composition

The deer fed on over 85% of 88 plant species identified in the study site. Almost all plant parts were eaten apart from roots, bulbs, and bark. Their diet occasionally included soil, feces (e.g., goat, Eurasian jay *Garrulus glandarius*, and their own), fungi, and aphid galls. Non-plant material was a small but constant part of their diet (0.03–1.6%) throughout the year. The deer were not averse to plant species generally considered toxic or unpalatable. A notable example is the frequent consumption of flower heads of the geophytes *Anemone coronaria*, which deter local ungulates (wild and domestic). The deer's feeding habits varied significantly from season to season (Tables 2 and 3). They rapidly changed food items such as leaves, grasses, seeds, flowers, and fruits, depending on availability. In late autumn, winter, and spring, the deer were both browsers and grazers. In

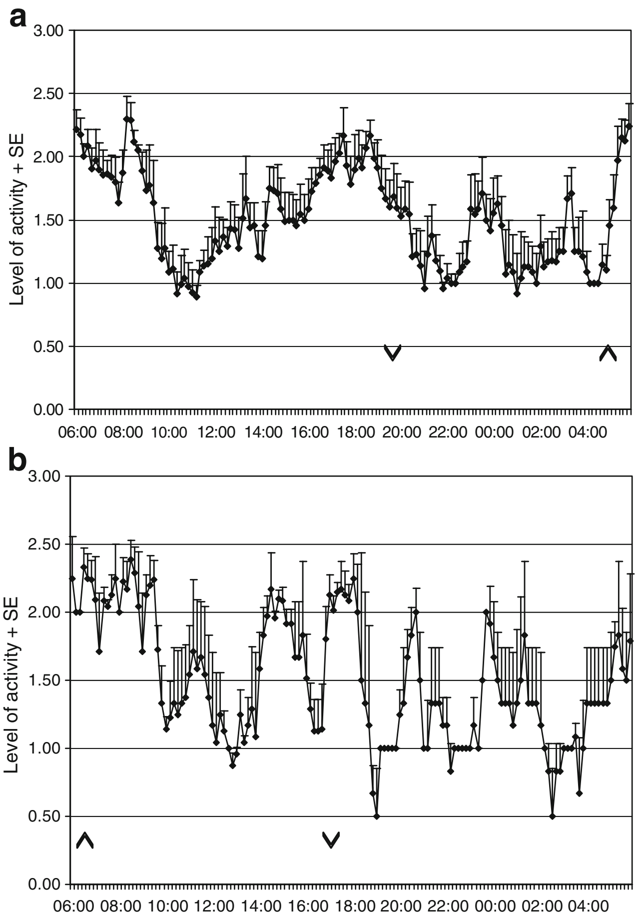

Fig. 1 Activity pattern of hand-reared does in (**a**) summer and (**b**) winter. The *arrows* mark the approximate time of sunrise (*up arrow*) and sunset (*down arrow*). See text for explanation of level of activity estimation

summer, fruit and seeds became the dominant diet components (Table 3). Their feeding habits were similar in the two habitats, except in autumn, when feeding on grasses was more frequently recorded in the mature habitat (paired $t = 4.76$, df = 3 (four deer), $p < 0.05$), following the first rain of the season and the consequent burst of new growth.

On average, in both habitats during the summer and winter, 32.6 ± 1.9 food items were consumed, out of which, 9.5 ± 0.9 items made up 91.23 ± 1.24% of their diet (Table 4). Similar selectivity patterns were apparent in spring and autumn (data not shown). Each season was characterized by a different composition of plant species. For example, *Q. calliprinos* constituted different portions of the deer's diet in each season (repeated-measures ANOVA $F_{1,3} = 11.52$, $p < 0.01$).

Opportunistic feeding was evident in the specific consumption of plant parts in each season (Fig. 2). For example, in the young habitat in summer, the between-seasons difference between the various plant parts in the deer's diet was significant (Fig. 2), with the strongest effect caused by the notable fruit and seed consumption (young habitat: repeated-measures ANOVA, $F_{1,3} = 30.45$, $p < 0.001$). In the summer, fruit-feeding was significantly higher in the young habitat than in the mature habitat (paired $t = 3.73$, df = 3, $p < 0.05$); whereas, in the winter, a fruit diet was significantly more pronounced in the mature habitat (paired $t = 4.62$, df = 3, $p < 0.05$).

A rapid change in feeding activity and diet composition was apparent during the transition from summer through autumn and into winter. Feeding activity increased by 32% immediately following the first rains and by another 22% when fresh grasses became available 11 days later (repeated-measures ANOVA $F_{1,2} = 27.83$, $p < 0.01$). During this transitional period, which lasted about a month, diet composition rapidly changed from fruit and seeds to fresh grasses and annuals (repeated-measures ANOVA for browsing, $F_{1,3} = 32.84$, $p < 0.001$; Fig. 3).

Body mass fluctuations

Deer body mass varied significantly throughout the year, and a marked drop was recorded in autumn (repeated-measures ANOVA $F_{1,2} = 4.84$, $p < 0.05$; Fig. 4). In 2003, the deer did not lose weight in any season or in either habitat, except for autumn in the young habitat (percent loss of body mass: $\Delta Mb = -6.46 \pm 0.42\%$, paired $t = 14.14$, df = 3, $p < 0.01$). In the mature habitat, weight loss also occurred but was not significant ($\Delta Mb = -3.05 \pm 1.47\%$, paired $t = 2.401$, df = 3, $p = 0.096$). However, in 2004, when we withheld food supplements throughout the summer and autumn months continuously, the deer lost 5.6% of their body mass (autumn, paired $t = 4.81$, df = 3, $p < 0.05$) even though we allowed access to both habitats. They recovered their body mass rapidly, immediately after

Table 2 Two-way ANOVA analyses of food type consumption during summer and winter in the young and mature habitat

Source	SS	DF	*F* value	*p* value
Young habitat				
Season	0.312	1	0.001	NS
Food type	4,490.65	2	31.64	<0.01
Season × food type	13,127.28	6	30.83	<0.01
Error	2,554.19	36		
Total	73,349.09	48		
Mature habitat				
Season	6.16	1	4.76	<0.01
Food type	56.04	2	65.00	<0.01
Season × food type	240.36	6	92.88	<0.01
Error	15.52	36		
Total	1,606.02	48		

Table 3 Feeding habits in the young and mature habitats during four seasons (mean percent of their diet ± SE in parenthesis)

	Winter		Spring		Summer		Autumn	
	Young	Mature	Young	Mature	Young	Mature	Young	Mature
Browsing (feeding on leaves)	64.16 (5.23)	37.85 (3.68)	39.68 (3.97)	44.03 (4.29)	39.35 (3.9)	63.30 (8.91)	44.03 (7.52)	18.22 (3.31)
Fruit/seed/flower consumer	4.13 (0.52)	11.85 (1.85)	18.53 (6.41)	11.41 (3.42)	59.84 (3.63)	38.97 (7.71)	16.42 (3.07)	3.63 (0.82)
Grazing (feeding on grasses, annuals, and geophytes)	31.53 (4.82)	49.67 (3.29)	41.66 (4.91)	44.40 (5.71)	0.33 (0.26)	0.00	39.75 (7.57)	**78.16** (3.8)

The high grazing value in autumn, in the mature habitat (*bold*), coincided with a short period when new grass became available following the first rains

the first rains of the season when fresh grasses became available (beginning of December).

Discussion

As in Europe, the roe deer in dry Mediterranean habitats are polyphagic upon availability of resources (Duncan et al. 1998). They adjust rapidly to a changing environment and immediately make use of new available resources. The feeding pattern of the deer is based on grazing or browsing, and the animal showed a high preference for fruits and seeds in the summer (Table 3). They exploit different parts of plant species in different seasons, which further demonstrate their season-dependent feeding behavior: opportunistic feeding on numerous plant species, but they may be temporarily selective for a particular plant species or specific plant organs.

Mammalian species, including deer, often shift to nocturnal activity in hot seasons (e.g., Hayes and Krausman 1993), so, we expected primarily nocturnal activity by the deer during the hot summer months. However, the roe

Table 4 Major dietary plant species and parts (≥2%) in two habitats during summer and winter in 2004

Species	Part (most common)	Young	Mature
Summer			
Annuals	Seeds	14.00 ± 3.83	12.60 ± 3.14
Ceratonia siliqua	Fruit	36.89 ± 5.37	5.63 ± 1.78
Cistus salviifolius	Leaves	0.04 ± 0.03	2.80 ± 2.49
Olea europaea	Fruit and leaves	13.86 ± 1.35	3.23 ± 1.54
Phillyrea latifolia	Fruit and leaves	2.65 ± 0.55	25.46 ± 4.33
Pistacia lentiscus	Fruit	1.16 ± 0.29	4.05 ± 3.28
Pistacia palaestina	Leaves	0.08 ± 0.06	4.45 ± 1.60
Rhamnus palaestinus	Leaves	1.69 ± 0.20	6.29 ± 0.95
Rubia tenuifolia	Leaves with stem	12.28 ± 0.96	14.59 ± 2.99
Smilax aspera	Leaves	5.91 ± 3.20	14.16 ± 2.36
Urginea maritime	Dry leaves	4.34 ± 2.03	4.07 ± 1.17
Winter			
Annuals	All above ground	7.11 ± 2.27	15.98 ± 5.15
Asparagus aphyllus	Young leaves	3.03 ± 1.17	1.11 ± 0.22
Calycotome villosa	Young leaves and seeds	7.40 ± 1.59	11.21 ± 1.93
Cistus salviifolius	Young leaves and flower	8.20 ± 0.85	2.99 ± 0.33
Eryngium creticum	Young leaves	0.00	3.07 ± 0.89
Fumana arabica	Leaves	2.34 ± 1.03	7.96 ± 1.15
Geophytes	Young leaves	12.21 ± 2.69	8.92 ± 1.65
Grasses	young leaves	12.55 ± 2.22	28.37 ± 6.60
Quercus calliprinos	Acorns	0.18 ± 0.16	5.53 ± 1.50
Rubia tenuifolia	Leaves	15.18 ± 5.32	2.37 ± 0.33
Sarcopoterium spinosum	Leaves, flowers, and fruit	25.14 ± 3.79	7.37 ± 2.02

Values are presented as the mean proportion in their diet ± SE (see Wallach 2005 for full account of diet composition)

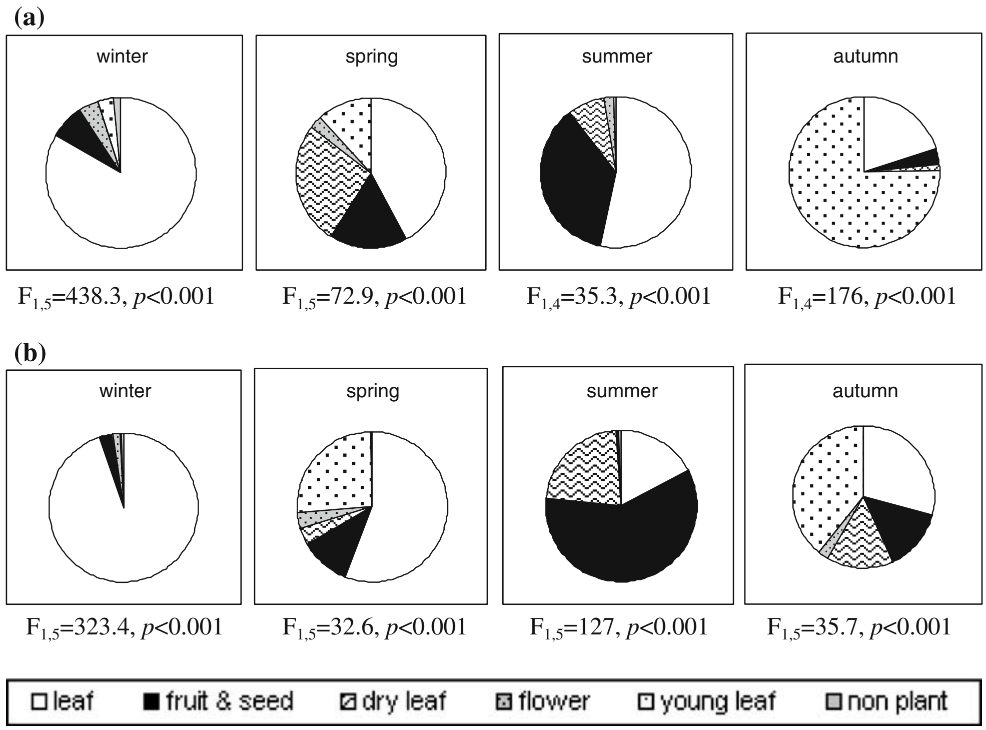

Fig. 2 Phenological diet composition of roe deer in (**a**) the mature and (**b**) the young habitat. Repeated-measures ANOVA comparing plant parts within season and habitat (for each habitat and season) are presented at the bottom of each chart, and signify that selection of different plant parts occurred within each season and habitat. The df of the ANOVA are 5 or 4, corresponding with the number of plant parts consumed that may differ among habitats or seasons

deer's activity pattern in the Mediterranean habitat proved similar to that exhibited in Central and Northern Europe (Danilkin 1996; Chapman et al. 1993), suggesting strong innate behavior. As in Europe, daily activity periods were not affected by season (Fig. 1, Chapman et al. 1993, but see Danilkin 1996), indicating a tolerance of the heat and dryness of the east Mediterranean climate. This adaptability and flexibility is probably an important factor that promotes the roe deer's wide range (Andersen et al. 1998). Another behavioral similarity to the deer in Europe (Danilkin 1996) was the significantly higher feeding activity when conditions were cool and wet, especially during the transitional period in late autumn. Habitat selection at our study site matched the roe deer's preference for a mosaic of mixed woodlands in open landscapes in Europe (Danilkin 1996; Hewison et al. 1998). However, human and predator activity, and the availability of free water, might strongly affect habitat selection under free-range conditions (Wallach et al. 2007b).

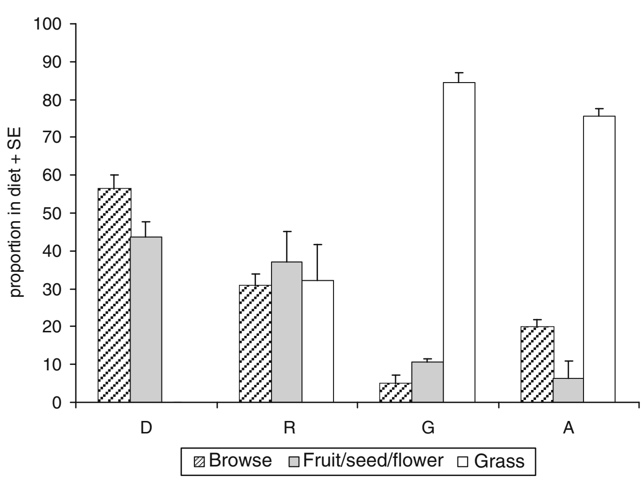

Fig. 3 Feeding strategy of the roe deer during the transitional autumn season. *D* dry period at the beginning of autumn (30 October 2004 – 17 November 2004); *R* first rain events, few fresh annuals become available (18–29 November 2004); *G* fresh annual grasses become widely available (30 November 2004 – 19 December 2004); and *A* both monocot and dicot annuals are available (20 December 2004 – 15 January 2005)

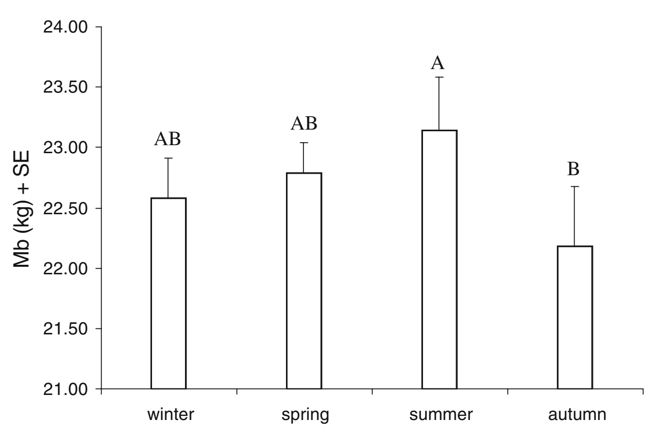

Fig. 4 Mass of four does feeding on Mediterranean vegetation in 2004 (starting on January 2004). No food supplements were provided for a period of 3 weeks prior to measurement. Columns with different letters are significantly different from each other (mean separation, $p < 0.05$)

Our results suggest that the Mediterranean vegetation afforded the roe deer their dietary requirements (indicated by body mass) in winter, summer, and spring, when they did not lose weight. A potential bottleneck might have occurred in autumn, as they lost some weight (5.6–6.5%) in both years; however, they rapidly regained weight (without supplemental food) with the onset of the first rains. This loss of body mass was much less pronounced than mass loss reported for other deer species examined in different conditions (Parker et al. 1993). Mass and body fat fluctuations are minor in roe deer (Holand 1992). The relatively stable mass throughout the year might be explained by the roe deer's polyphagic nature, taking advantage of the availability of fresh forage in the winter, and seeds and fruits in the summer. Although we found no evidence of overgrazing at the study site (Wallach 2005), higher deer density (competition) might limit maintenance of body weight throughout the year. The body mass fluctuation observed in this study may also have been affected by the periods in which the deer were given supplemental food between trials. Further research is needed to determine the nutritional demands of pregnancy and lactation in the Mediterranean environment, especially since energy expenditure rises during pregnancy (Mauget et al. 1997).

Roe deer have been shown to exert a significant impact on the structure and dynamics of vegetation communities (Partl et al. 2002). Thus, roe deer could potentially play a unique ecological role in vegetation community structuring in east Mediterranean forests. An example of the potential unique effects that roe deer may have on local vegetation is its frequent feeding on *A. coronaria*, which is avoided by other herbivores (see Wallach et al. 2009). Their diet, as found in this study, differs markedly from that of other local ungulates. For example, the mountain gazelle, *Gazella gazella*, is a distinct grazer in open habitats (Baharav 1981), and the reintroduced Persian fallow deer, *Dama dama mesopotamica*, is a generalist, high bulk consumer (Dolev 1999). The difference between various large herbivore diets potentially reduces interspecific competition. The goat, *Capra hircus*, is perhaps the most similar to the roe deer in this region (Perevolotsky et al. 1998).

In Israel, availability of free water is clearly a major constraint for deer survival (Wallach et al. 2007b). The dry east Mediterranean habitat appears to be sufficient for supporting roe deer populations in both mature and young (regenerating) maquis. However, several other factors should be taken into consideration in the choice of a reintroduction site (in addition to availability of water). There is a potential nutritional bottleneck in autumn, which may reduce fawn survival as they gradually wean from milk and increasingly depend on vegetation. A reintroduced population may therefore search for alternative sources of food (agricultural areas) during this season. To reduce possible conflicts with farmers, we recommend that they be released into heterogeneous habitats of dense and open landscapes for opportunistic feeding in different plant communities. Furthermore, since the availability of several key plant species may significantly impact their population dynamics (Pettorelli et al. 2003), and since roe deer have limited capacity for storing fat reserves (Holand 1992), it is vital to locate habitats comprising abundant plant species found to be consumed by the deer in summer and autumn (Table 3). Considering that the Mediterranean region is apparently suboptimal for roe deer (Tellería and Virgós 1997), the source population should originate from an area most similar to this habitat.

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