

DIET OF THE FALSE SMOOTH SNAKE, *MACROPROTODON CUCULLATUS* (SERPENTES, COLUBRIDAE) IN THE WESTERN MEDITERRANEAN AREA

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Based on the analysis of the digestive tracts of 158 specimens, the diet has been established for *Macroprotodon cucullatus*, one of the European colubrid species with poorly-known biology. The specimens belong to three subspecies, *M. c. ibericus* (Iberian Peninsula), *M. c. brevis* (Morocco) and *M. c. mauritanicus* (Balearic Islands). The species feeds exclusively on vertebrates, mainly reptiles, and mostly long-bodied prey which are burrowers or live under rocks (*Blanus*, *Chalcides*). Some aspects of its morphology and feeding habits, in addition to our general field observations, suggest that it is not nocturnal, but rather lives under rocks. In comparison with other Mediterranean colubrids, this species feeds with very low frequency, taking relatively long prey with great biomass. In the specimens from the Balearic Islands the body length and feeding habits appear to have changed in a brief period, now being the largest of the distribution area of the species and basing its diet on small mammals. In the Iberian Peninsula and in northwestern Africa, there is no appreciable ontogenetic or sexual variation in the diet, since the different ages and sexes feed principally on amphisbaenians.

INTRODUCTION

The false smooth snake, *Macroprotodon cucullatus*, inhabits the Mediterranean Basin from southern Palestine to western Morocco, including relict populations in the Hoggar (Algeria) and Rio de Oro (Morocco). It also inhabits the southern half of the Iberian Peninsula and some islands in the Western Mediterranean, such as Mallorca, Menorca, Lampedusa and the Galita Islands (Busack & McCoy, 1990). It is the smallest Mediterranean colubrid and, until some years ago, one of the least known species, probably because of its secretive habits. Recently Wade (1988) has studied the scalation and pattern of the species, and has differentiated the northern Algerian populations to the subspecies level. Busack & McCoy (1990) have studied this species morphologically throughout its range, differentiating the population from the Iberian Peninsula to the subspecies level. There are also some works dealing with its distribution and scalation (Almeida & Almeida, 1986; Gisbert & García-Perea, 1986; Malkmus, 1992).

Nevertheless, there is still little information about its biology, particularly its feeding and reproductive habits. Most information on diet is non-quantitative data taken from few individuals, either in nature (Dumeril, Bibron & Dumeril, 1854; Bons & Bons, 1959; Bons, 1960; Lanza & Bruzzone, 1960; Bons & Saint-Girons, 1963; Hiraldo, 1974; Vericad & Escarré, 1976; Almeida & Almeida, 1986; González de la Vega, 1988; Wade, 1988; Busack & McCoy, 1990), or in captivity (Wade, 1988). Only Bons (1967) offers a rather extensive list of prey in Morocco, although this author includes no quantitative data. The general opinion is that the false smooth snake feeds almost exclusively on long-bodied reptiles, mainly amphisbaenians (Bons & Saint-Girons, 1963; Almeida & Almeida, 1986; Wade, 1988).

Here we report the diet of the species as judged from a broad sample of specimens from northwestern Africa, the Iberian Peninsula, and the Balearic Islands. The diet has been studied in relation to the size and sex of the specimens. In addition, attention is given to the geographical variation in the diet. The inclusion of the Balearic population offers information on the biology of a continental species introduced in historical times into an island environment. That indigenous lizards are still common on the snake-free Balearic Islands, and absent from the snake-present islands, suggests that the indigenous species, *Podarcis lilfordi*, was extirpated from Mallorca and Menorca Islands by the false smooth snake (Eisentraut, 1949; Mayol, 1985). Regardless of the accuracy of the latter comment, if continental populations of *M. cucullatus* feed mainly on reptiles, and if *P. lilfordi* was the only indigenous lizard, the question remains as to what path the false smooth snake followed in the Balearic Islands to adapt and survive.

MATERIALS AND METHODS

The gut contents of 171 *M. cucullatus* specimens from the western Mediterranean area have been analyzed. The specimens belonged to three of the four subspecies recognized for this species: the entire range of *M. c. ibericus* (116 individuals, Iberian Peninsula), the entire range of *M. c. brevis* (32 individuals, Morocco) and island populations of *M. c. mauritanicus* (23 individuals, Balearic Islands).

The specimens examined were obtained from following institutions: Museo Nacional de Ciencias Naturales (Madrid); Estación Biológica de Doñana (Seville); Instituto Pirenaico de Ecología (Zaragoza); Mus. Bocage (Lisbon, Portugal); Mus. de la Naturala de les Illes Balears (Majorca); Mus. de Zoologia (Barcelona);

Dep. Biología Animal (Univ. of Granada); Dep. Biol. Animal (Univ. of Málaga); Dep. Biol. Animal (Univ. of Badajoz); Dep. Biol. Animal (Univ. of Balearic I.); Dep. Biol. Animal (Univ. of Salamanca); Dép. Biol. Animale (Tetuan, Morocco).

We have examined the gut contents of specimens in alcohol, considering for each specimen: size, body mass, sex, prey type, body size and body mass of the prey. For body size, snout-vent length (SVL) was recorded in *M. cucullatus* and its prey; in predators and prey, SVL has been calculated to the nearest mm and biomass to the nearest 0.1 g. Because of the lack of complete data of some museum specimens before fixation, SVL and biomass were measured from preserved ones, and only well-preserved specimens were considered. Specimens with a difference in body mass exceeding 5% before fixation and when studied, were rejected. Also, we avoided all specimens suspected to have died by starvation before fixation. Then, 72 museum specimens studied were rejected in the diet analysis, but some of them used in the morphological analysis. Prey were identified to species. Nevertheless, the tables indicate the genus level, and comparisons also list only the genera involved; in this way, we have tried to avoid the appearance of important geographical differences in diet due simply to prey species which were vicariant to both sides of the Strait of Gibraltar, and thus of similar sizes and habits. Specimens were sexed by examination of gonads after dissection.

For the analysis of ontogenetic shifts in diet, we have considered three artificial SVL classes. Diet-niche breadth was calculated using Levins's index (Levins, 1968) and overlap between sexes in diet composition by the Pianka's symmetrical index (Pianka, 1973). To calculate these indices, we used prey frequency. To calculate the diet niche breadth and overlap, the specimens without gut contents or with unidentified prey were not considered.

For comparing populations in terms of size, we have used mean SVL in each population and mean SVL for the 10 largest specimens in each population. The latter method is less sensitive to differences in sample size and change in age structure when comparing populations (Schwaner & Sarre, 1990). All variables compared were normally distributed.

RESULTS

TAXONOMIC COMPOSITION AND GENERAL DIET ANALYSIS

Of the 171 guts examined, only 42 had prey; that is, less than 25% of the sample contributed to the diet information of this species (Table 1). Among the specimens with prey, most had a single item (95.2%), only one had two (two *Psammmodromus algirus*), and another had three (three *Chalcides mionecton*).

The populations of *M. cucullatus* from the western Mediterranean fed almost exclusively on reptiles, while small mammals represented only a small portion of the

Prey	Frequency		Biomass	
	<i>n</i>	%	g.	%
<i>Blanus</i>	15	33.3	47.1	29.6
<i>Psammmodromus</i>	10	22.2	28.0	17.6
<i>Podarcis</i>	2	4.4	10.6	6.6
<i>Mesalina</i>	1	2.2	1.5	0.9
<i>Chalcides</i>	8	17.8	39.6	24.9
<i>Malpolon</i>	1	2.2	5.0	3.1
Unid. reptiles	5	11.1		
<i>Mus</i>	3	6.7	27.5	17.3
Prey number			45	
Snakes with prey			42(24.6%)	
Prey class			7	
Diet niche breadth			3.96	

TABLE 1. Diet composition and basic data of trophic analysis of 171 specimens of *M. cucullatus* in the western Mediterranean area. Unid. reptiles, unidentified.

diet (Table 1). *Blanus* was the most consumed prey; other numerically important prey were *Psammmodromus* and *Chalcides*. Long-bodied prey and prey that burrow or live under rocks (*Blanus* and *Chalcides*) represented more than 50% of the diet. Analysis of the biomass which each prey type contributed to the diet, shows the importance of the classes of prey (Table 1).

The false smooth snake consumes prey ranging in sizes between 24 and 211 mm SVL; the extremes are represented by *Psammmodromus hispanicus* and *Malpolon monspessulanus*, respectively. The mean prey size was 92.7 mm SVL (SD = 52.0, $n = 38$); the relative prey size (prey/predator SVL ratios, SVLR) was very high, SVLR = 0.30 (SD = 0.18, $n = 38$).

The prey biomass ranged between 0.3 and 13.0 g, the extremes represented by *Psammmodromus hispanicus* and *Mus spretus*, respectively. The mean prey biomass was 4.1 g (SD = 2.8, $n = 37$). The relative biomass of the prey (prey/predator weight ratios, WR) was also high, WR = 0.21 (SD = 0.11, $n = 37$), although less than the SVLR. This indicates that *M. cucullatus* feeds primarily on prey with large SVL, although not a commensurate biomass, i.e. long-bodied prey. In the 19 cases where we could determine the position of the prey (most were *Blanus*), the majority (18) were swallowed head-first.

GEOGRAPHICAL VARIATIONS IN DIET

There was a little difference in diet between the two continental populations, *M. c. ibericus* and *M. c. brevis* (G test = 14.09, $df = 5$, $P < 0.05$). The population from

Ssp.	<i>ibericus</i> (Iber. Pen.) (n=116)		<i>brevis</i> (Morocco) (n=32)		<i>mauritanicus</i> (Balearic I.) (n=23)	
	n	%	n	%	n	%
<i>Blanus</i>	13	50.0	2	14.3		
<i>Psammodromus</i>	7	26.9	3	21.4		
<i>Podarcis</i>			1	7.1	1	20.0
<i>Mesalina</i>			1	7.1		
<i>Chalcides</i>	2	7.6	6	42.9		
<i>Malpolon</i>	1	3.8				
Unid. Reptiles	3	11.5	1	7.1	1	20.0
<i>Mus</i>					3	60.0
Prey number	26		14		5	
Snakes with prey	24 (20.7)		12 (37.5)		5 (21.7)	
Diet niche breadth	2.37		3.31		-	

TABLE 2. Diet composition of the three subspecies of *M. cucullatus* present in the study area. The prey species are: *Blanus cinereus* (Iber. Pen.), *B. tingitanus* (Mor.); *Psammodromus algirus* (Iber. Pen. and Mor.), *P. hispanicus* (Iber. Pen.); *Podarcis hispanica* (Mor.), *P. sicula* (Bal. I.); *Mesalina olivieri* (Mor.); *Chalcides bedriagai* (Iber. Pen.), *Ch. mionecton* and *Ch. polylepis* (Mor.); *Malpolon monspessulanus*; *Mus spretus*.

Morocco had more specimens with prey in their guts (G test = 5.58, $df = 1$, $P < 0.03$), and the diet-niche breadth was higher than in the sample from the Iberian Peninsula (despite a smaller sample size, Table 2). In *M. c. brevis*, *Blanus* loses importance as a prey item with respect to the Iberian specimens (G test = 6.28, $df = 1$, $P < 0.02$), while the importance of lizards increases (G test = 7.52, $df = 1$, $P < 0.01$; Table 2).

More differences exist between the diet of the population in the Balearic Islands and the continental populations: *M. c. mauritanicus*/*M. c. ibericus* (G test = 22.90, $df = 6$, $P < 0.01$), *M. c. mauritanicus*/*M. c. brevis* (G test = 15.80, $df = 6$, $P < 0.05$). The fundamental difference is that while the continental populations feed exclusively on reptiles, in the island population more than half of the diet was composed of small mammals.

There were differences in SVL among the populations studied (two-tailed ANOVA, $F = 4.08$, $df = 2, 204$, $P < 0.018$, males and females pooled; Table 3); the Balearic specimens, had a longer SVL than the Iberian and Moroccan specimens when the 10 largest individuals from each population were considered (Iberian versus Balearic, Scheffé F -test $F = 3.33$, $P < 0.05$; Moroccan versus Balearic, $F = 7.10$, $P < 0.01$). The results from biomass comparisons are even clearer

	Total sample			10 largest specimens	
	n	Mean	SD	Mean	SD
<i>SVL (mm)</i>					
Iber. Penin.	111	285.7	81.4	429.2	45.7
Morocco	69	314.9	68.2	407.0	16.4
Balear. I.	27	328.9	133.6	477.2	53.3
<i>Biomass (g)</i>					
Iber. Penin.	68	14.6	9.3		
Morocco	13	18.3	12.2		
Balear. I.	13	33.5	27.9		

TABLE 3. Body size (SVL) and biomass of *M. cucullatus* in the populations studied. Note: here we use a greater sample size than in the diet analysis.

(ANOVA, $F = 10.40$, $df = 2, 111$, $P < 0.001$, males and females pooled; Table 3); the Balearic specimens are heavier than the Iberian and Moroccan specimens (Iberian versus Balearic, Scheffé F -test $F = 10.40$, $P < 0.01$; Moroccan versus Balearic, $F = 4.02$, $P < 0.05$). There were no differences between Iberian and Moroccan populations, either in SVL (Scheffé F -test = 2.46, NS), or biomass ($F = 0.395$, NS; in both comparisons, the total sample has been considered; Table 3).

ONTOGENETIC AND SEXUAL SHIFT IN DIET

To compare these dietary aspects of *M. cucullatus*, we have pooled the specimens of the three populations studied. We obtained no discordant results when the population from the Balearic Islands was removed from the calculations.

When we analyzed the diet of *M. cucullatus* in the three classes of size separately, no marked trends appeared between body size and the percentage of specimens with prey or the different types of prey consumed (Table 4). Nor are there any differences in the frequency of the prey consumed (small/medium, G test = 12.38, $df = 6$, $P > 0.05$; medium/large, $G = 8.06$, $df = 6$, $P > 0.05$; small/large, $G = 5.74$, $df = 4$, $P > 0.05$). *Blanus* proved to be the most frequent prey among the three groups. In this sense, both in the Iberian Peninsula and in Morocco, the smallest specimens of *M. cucullatus* invariably consumed *Blanus*. Prey of greater size, such as *Chalcides* and *Malpolon*, were consumed only by the medium or large groups.

There was no relationship between the size (SVL) of *M. cucullatus* and that of its prey ($r = 0.18$, $n = 36$, $P > 0.26$), nor between the absolute SVL of the snake and the relative prey size (SVLR, $r = -0.23$, $n = 36$, $P > 0.16$). Nevertheless, if instead of comparing linear di-

Body-size of snakes SVL (mm)	Small		Medium		Large	
	123-250 (n=50)		251-340 (n=66)		341-524 (n=55)	
Prey	n	%	n	%	n	%
<i>Blanus</i>	6	42.9	3	25.0	6	31.6
<i>Psammodromus</i>	4	28.6	1	8.3	5	26.3
<i>Podarcis</i>	1	7.1			1	5.3
<i>Mesalina</i>			1	8.3		
<i>Chalcides</i>			5	41.7	3	15.8
<i>Malpolon</i>			1	8.3		
Unid. reptiles	3	21.4			2	10.5
<i>Mus</i>			1	8.3	2	10.5
Prey number Snakes with prey	14		12		19	
	14	(28.0)	12	(18.2)	16	(29.1)
Prey class	3		6		5	

TABLE 4. Diet composition of *M. cucullatus* according to body size (three subspecies pooled).

mensions, we compare biomass, we do find a significant and positive relationship between the biomass of the colubrid and its prey ($r = 0.68$, $n = 36$, $P < 0.001$).

We detected no differences in prey frequency (G test = 11.72, $df = 6$, $P > 0.05$), prey size (t -test = 0.97, $df = 36$, $P > 0.1$) or biomass of the prey ($t = 0.50$, $df = 36$, $P > 0.5$) between the sexes, and overlap of the trophic niche between the sexes being high, (0.72). Table 5 indicates that the percentage of specimens with prey is less in the males (G test = 5.54, $df = 1$, $P < 0.05$). Females consumed less *Blanus* than did males (G test = 4.80, $df = 1$, $P < 0.05$), this prey being substituted for others also of long bodies, such as *Chalcides*. This, together with the consumption of a greater number of prey types in the females, caused the breadth of the female diet niche to be clearly greater (Table 5). Because in this species the ontogenetic shift in diet is of little importance, in the sexual analysis of the diet we have considered all the specimens, even the immature individuals. By comparing the 10 largest individuals for each sex, we have detected no sexual differences in SVL (t -test = 0.59, $df = 18$, $P > 0.1$) and biomass ($t = 1.56$, $df = 18$, $P > 0.05$).

DISCUSSION

The previous dietary information (but not quantitative data) indicates that *M. c. ibericus* feeds on *Blanus cinereus* (Hiraldo, 1974), *Anguis fragilis* (Almeida & Almeida, 1986), *Psammodromus algirus* (Busack &

Prey	Males (n=92)		Females (n=79)	
	n	%	n	%
<i>Blanus</i>	9	52.9	6	22.2
<i>Psammodromus</i>	4	23.5	6	22.2
<i>Podarcis</i>	1	5.8	1	3.7
<i>Mesalina</i>			1	3.7
<i>Chalcides</i>			7	26.0
<i>Malpolon</i>			1	3.7
Unid. reptiles	2	11.7	3	11.1
<i>Mus</i>	1	5.8	2	7.4
Prey number	17		27	
Snakes with prey	16	(17.4)	26	(32.9)
Prey class	4		7	
Diet niche breadth	2.28		4.51	

TABLE 5. Diet composition of *M. cucullatus* according to sex.

McCoy, 1990), undetermined small mammals (Vericad & Escarré, 1976), orthopterans, slugs, spiders and colubrids (González de la Vega, 1988). *M. c. brevis* feeds on *Blanus mettetalis*, *Trogonophis wiegmanni*, *Tarentola mauritanica*, *Agama bibroni*, *Chalcides mionecton*, *Acanthodactylus erythrurus*, *A. pardalis*, *Mesalina olivieri*, *Lacerta pater* and *Psammodromus algirus* (Bons & Bons, 1959; Bons & Saint-Girons, 1963; Bons, 1967; Wade, 1988; Busack & McCoy, 1990). Except for the case of a cockroach regurgitated by a young specimen (Mayol, 1985), there is no previous information on the diet of wild *M. c. mauritanicus* in the Balearic Islands.

Qualitatively, our results on the diet in the specimens from the western Mediterranean substantiate previous information. The only difference is that we have found no invertebrates in the diet. It is clear that *M. cucullatus* is an almost exclusively reptile feeder, at least in the western part of its distribution area. In addition, our results confirm the preference that this species shows for amphisbaenians (Bons & Saint-Girons, 1963; Almeida & Almeida, 1986; Wade, 1988).

Almeida & Almeida (1986) stress the dependence of this snake largely on amphisbaenians because of their sharing of crepuscular and nocturnal habits. Wade (1988) concludes that the false smooth snake is nocturnal in Morocco on finding three ingested diurnal lizard species, one being *Lacerta pater*, a relatively powerful animal, unlikely to be captured when active during the day by the snake. In general, many authors concur that

M. cucullatus is a nocturnal snake (e.g. Mertens, 1926; Lanza & Bruzzone, 1960; Bons & Saint-Girons, 1963).

However, the genus *Blanus* is not nocturnal, but principally diurnal, with individuals which burrow or dwell beneath rocks (Bons & Saint-Girons, 1963; Martín, López & Salvador, 1990, 1991; López, 1993); in a recent study carried out in central Iberian Peninsula on the diel daily activity of *B. cinereus*, Gil, Guerrero & Pérez-Mellado (1993) never encountered individuals active on the surface during the night (see also Busack (1978) for similar findings in the southern part of the Iberian Peninsula). We believe that the false smooth snake, rather than being nocturnal, also dwells under rocks and burrows to some extent. Of the 46 field observations we have recorded for this species in the Iberian Peninsula and North Africa, only three showed crepuscular or nocturnal activity, and 84.8% were under rocks (mostly in galleries). The pure cone retina discovered by Rasmussen (1985:535, Fig. 3) in a specimen from Morocco, indicates that this animal may be diurnal (see also Wade, 1988). Some skeletal aspects of this species, such as the great reduction of the postorbital bone, relatively short anterior portion of the skull, and vertebral morphology, are correlated with fossorial habits and the secretive habits of *M. cucullatus* (Rasmussen, 1979).

Since *M. cucullatus* shelters beneath stones most of the time, and *Blanus* (at least *B. cinereus*) is always beneath stones or tree trunks (Martín *et al.*, 1991; Gil *et al.*, 1993; López, 1993), we suspect that the false smooth snake eats mostly *Blanus* because they share habitat, not nocturnal activity. The importance of other long-bodied prey in the diet, such as *Chalcides* (Sura, 1983) which also adapted to burrowing habits, support this hypothesis. In Australia, Shine (1984) found that some burrowing snakes (Elapidae) ingested primarily burrowing prey (Typhlopidae). *Macroprotodon cucullatus* is probably an ambush hunter which waits beneath stones for passing prey, either from the exterior (small lizards), or from the ground under the stone (amphisbaenians).

Although in its main prey, *Blanus*, the head and tail extremes of the body are very similar, and there are no sharply pointed imbricated scales on the body, *M. cucullatus* looks actively for the head tip to swallow the amphisbaenian. *Macroprotodon cucullatus* is a rear-fanged and poisonous snake, and probably injects the secretion of its Duvernoy's gland into a vital area to kill the prey as soon as possible; to swallow a living *Blanus*, an animal with strong body musculature, would be dangerous for the snake. In the few *Blanus* specimens found in the interior of the digestive tract of *M. cucullatus* in which the head was well preserved, there were signs of the fangs of the snake.

The false smooth snake feeds on higher SVLR and WR prey than do other Mediterranean colubrids (Pleguezuelos, unpub. dat.); high values for the SVLR or WR for the prey favour special immobilization tech-

niques (Greene & Burghardt, 1978; Rodríguez-Robles & Leal, 1993). Thus, the consumption of large prey by *M. cucullatus* is similar to that shown by highly venomous snakes such as elapids and viperids (Greene, 1983).

This study revealed a low frequency of *M. cucullatus* with prey, lower than any Mediterranean snake with diet information (Valverde, 1967; Bruno & Hotz, 1976; Díaz-Paniagua, 1976; Vericad & Escarré, 1976; Bruno, 1977; Cattaneo, 1979; Bea & Braña, 1988; Braña, Bea & Saint-Girons, 1988; Pleguezuelos & Moreno, 1988, 1990), and among the lowest in snakes (see Shine [1986] for a review). Is this low frequency due to its tranquil habits and low activity? Alternatively is *M. cucullatus* prey limited? The very low percentage of specimens found with gut contents during the inactive seasons (autumn-winter, Pleguezuelos, unpub. data), seems to answer the first question; the ambush-hunter habits of the snake (according to our field observations), seems to answer the second. Both hypotheses appear to be true, but we must await further works for more information on the habits and biology of this rare and secretive species. At least, it seems that the false smooth snake has low energy requirements, as is normal in reptiles which live under rocks or lead a fossorial life style. (Kamel & Gatten, 1983).

The false smooth snake is a north African species that reached the Iberian Peninsula probably before the formation of the Strait of Gibraltar (see Bailón, 1991). In Morocco the diet is more diversified, which agrees with the greater number of potential reptile prey on the southern side of the Strait of Gibraltar (more than twice that on the northern side). In the Iberian Peninsula the false smooth snake appears to be more specialized for preying on another north African species, such as *B. cinereus*. Now, the current distribution of this snake in the Iberian Peninsula is close to that of *B. cinereus* (Salvador, 1981), and does not exceed the latter towards the north. We might pose the question of whether the Iberian distribution of the snake is determined by its main prey, or whether the similar range for both species simply reflects similar environmental requirements for two species with the same biogeographical origin.

Moreover, the diet of the few specimens from the Balearic Islands studied here indicates that this species would have plasticity in its feeding habits. The population which inhabits the Balearic Islands was probably introduced during historical time, as is true for many colubrid species in different Mediterranean islands (see Bruno & Hotz, 1976; Lanza, 1983, 1988; Mateo, 1990); this is consistent with the fact that the snake is absent from the fossil record for previous periods (J. A. Alcover, pers. comm.). The Balearic snakes were apparently introduced by people travelling from the nearby coasts of Africa (Busack & McCoy, 1990). At first, following the lizard-eating habits of the North Africa populations (Bons, 1960), the snake could have preyed on the only indigenous lizard species inhabiting the islands, *Podarcis lilfordi*, and was therefore consid-

ered responsible for the extirpation of this species from the two larger islands, Mallorca and Menorca (Eisentraut, 1949; Mayol, 1985).

However, the identification of the causes of the extirpation of *P. lilfordi* is not straightforward. Another lizard-eating animal, the weasel, was introduced around the same time (Vigne & Alcover, 1985; Alcover, 1987), and the effects of competition between the native lizard and the introduced lizard, *P. sicula*, may also be significant (J.A. Alcover, pers. com.). Too few data exist to evaluate this loss with rigor.

In any case, the false smooth snake continued to prey upon other species in the islands, which were also introduced by man. According to our limited results and those of Wade (1988), animals in captivity readily accept mice, which are very rare prey in the diet of *M. c. ibericus* and *M. c. brevis* (only one record, Vericad & Escarré [1976]). Island populations of *Thamnophis sirtalis* have also shown phenotypic plasticity of food habits with respect to mainland populations (Greenwell, Hall & Sexton, 1984).

Another biological trait that has changed in the Balearic population of *M. cucullatus* is the body size. As a result of the lack of potential predators (e.g. *Malpolon monspessulanus* and *Herpestes ichneumon*) or because they feed mainly on mice - large prey with normally more biomass than small reptiles - the populations currently inhabiting Mallorca and Menorca islands are the longest and heaviest in the distribution area of the species. This shift is common in island species (Fretwell, 1978) and has been also observed in some colubrids inhabiting other islands in the Mediterranean area, where predator and/or competitors are lacking, such as *Elaphe scalaris* (Hyeres Islands, Salgues, 1937), *Coluber hippocrepis* (Pantellaria Island, Cattaneo, 1985), and in other snakes inhabiting mainland and islands (Shine, 1987). Working on the tiger snake (*Notechis scutatus*) Schawaner & Sarre (1988) observed that the largest snakes were on islands where large muttonbird chicks were the principal prey.

Our study failed to find major differences in diet selection based on size or sex classes. The absence of correlation between prey size and body size of *M. cucullatus* can be explained because the young also feed on long-bodied prey (*Blanus*) as do the adults. Even so, *Blanus* appears to constitute the first prey consumed by the newborn snakes. The lack of differences in diet between males and females agree with similar SVL and body mass in both sexes (Feriche, Pleguezuelos & Cerro, 1993).

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