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Community Structure, Microhabitat Use, Sex Ratio and Sexual Dimorphism in the Agamid Lizard, *Agama agama spinosa*

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Abstract: Community structure, microhabitat use, sex ratio and sexual dimorphism were investigated in the lizard, *Agama agama spinosa* from the north western coast of Egypt. This species is a rock-dwelling and occupy different, but overlapping crevices of rocks and old buildings. All individuals prefer the horizontal crevices on which they can perch in close proximity to the crevices. The proportion of males in the adult sample is 45%. Irrespective of sex, there were 60.2% adults and 39.8% juveniles in the total sample. Generally, the group size ranged from five to eight individuals sharing the same crevice included one adult male at least. Males apparently reach larger body sizes than females and also have larger heads and longer tails. The observed dimorphism in body and head sizes may therefore not necessarily be the result of sexual selection, but could be the result of differential energy allocation by females.

Key words: Community structure-sex ratio-sexual dimorphism-agarnidae

Introduction

The community structure is a frequent focus of studies on interspecific competition in lizards (Schoener, 1977; Toft, 1985; Hussein, 1994). Many lizard species have distinct preferences for particular substrates, perch shape, vegetation densities or other aspects of habitat structure (Heatwole, 1977; Moermond, 1979; Jaksic *et al.*,1980; Arnold, 1987; Hussein, 1994; 2000). Similarly, many temperate- zone species actually spend only a few hours each day above ground and thus spend most of the day in different retreats depending on the thermal properties of the retreat site (Huey, 1982).

The aggregation of individuals in such retreats usually considered to be of thermoregulatory significance (Ruby, 1977; Congdon *et al.*, 1979). Group size and sex ratio were differed among lizard species. Skinks in the coldest part of Australia are, for example, occasionally found in hibernation aggregations of up to fifty individuals (Rawlinson, 1975; Powell *et al.*, 1977). The Australian skink, *Egernia stokessi*, is reported to live in groups of up to sixteen individuals which remain together for several years (Johnston *et al.*, 1977). Branch (1988) report that the lizard members of the genus *Platysaurus* were occur in communities with normally one male up to ten females and juveniles sharing the same retreats. Lemos-Espinal *et al*. (1997) describe *Sceloporus mucronatus mucronatus* also as a social species and up to nine individuals may be found sharing a crevice for a long period. Such groups normally consists of an adult pair with juveniles. They conclude that aggregation in this species may have a social function.

One potential source of variation in habitat selection among reptiles is the variation in dietary composition and social structure (Slatkin, 1984; Shine, 1989). Sex differences in feeding habits are widespread among reptiles, suggesting that selection for niche divergence may contribute substantially to the evolution of sexual dimorphism (Slatkin, 1984). Even if sexual selection is responsible for the initial morphological divergence in body and head sizes, ecological factors may act either to constrain or amplify this initial sexually selected difference (Shine, 1989; 1991). The role of ecological factors in the evolution of sexual dimorphism has been controversial not because of faulty logic or contradictory evidence, but because the hypothesis of "niche divergence" is less amenable to testing than is the idea of sexual selection (Jacobs, 1974; Houston and Shine, 1993).

In this study the community structure was investigated in the agamid lizard, *Agarna agama spinosa.* The sex ratio and sexual dimorphism in body and head sizes were also reported. The nature of sexual dimorphism, if present, may be informative of the social system in this species.

Materials and Methods

Study area and organism: As the group size, sex ratio, habitat selection and sexual dimorphism may vary geographically, the study was restricted to relatively small geographical area of two km^2 at the north western Mediterranean coast of Egypt. The study site was ElOmayed region located between 29°.00'-29°.30N, 31°.30'W (Fig. 1). This site represents the topography of the area and have different structural habitats such as rocky ridges, depressions, sandy plain and eroded land. The area was considered the richest part of the Egyptian deserts in vegetation and flowering plants owing to its relatively high rainfall. The most common plant communities are *Ammophila arenaria, Ononia vaginalis* and *Crucianella maritime* (Ahmed, 1982). The reptilian fauna of the study site consists of 25 species belonging to 19 genera (Michael *et al.*, 1992). Gekkonid, lacertid and agamid lizards in addition to colubrid snakes are the most abundant species in the study site. The climate is characterized by a rainy unstable winter and stable warm dry summer. The average annual precipitation averaged 17.77 mm falling only in winter.

The lizard *Agama agama spinosa* (Reptilia, Agamidae) was chosen as the abundant agamid species in the study site (Marx, 1968). It was noticed to be active through the months from March to November and disappears in winter months for hibernation. It is diurnal lizard possessing a major period of activity from 7.00 to 17.00 h. During activity, the animals basked on the rocks, perched inside or near the rock crevices. The animal is characterized by high and short head which covered with small spiny scales. Eyes are provided with well developed movable eyelids and

Table 1: Morphometric measurments of head, tail and snout-vent length of male, female and juvenile *agama agama spinasa*

Measurement	Male (Mean ± S.E)	Female (Mean ± S.E)	juvenile (Mean ± S.E)	P
Head width	37.4 ± 1.02	23.8±0.19	20.2 ± 0.72	<0.001
Head length	36.9± 0.98	20.9±0.42	18.8±1.04	<0.001
Head height	16.2 ± 0.41	15.0±0.44	13.2±0.88	<0.001
Tail length	122.4±0.22	113.9 4 1.08	96.4±0.62	>0.05
Snout-vent length	100.2±0.27	88.1 ± 1.11	74.4 ± 0.11	<0.01

Table 2: Statistical analysis comparing the relationship between head and tail dimensions and snout-vent length ❑ of male female and juvenile *Agama agama spinasa*

Statistical Analysis	Head Width			Head length			Head height			Tail length		
	Male	Female	Juvenile	Male	Female	Juvenile	Male	Female	Juvenile	Male	Female	Juvenile
Regression	0.626	0.521	0.882	0.415	0.341	0.887	0.521	0.402	0.847	0.833	0.322	0.891
Frequency	136.00	30.2	599.00	29.8	23.1	397.0	39.7	18.7	179.00	128.00	19.9	579.00
Slope	1.33	0.47	1.11	0.70	0.39	0.79	1.21	0.69	0.99	1.33	0.82	1.09
Significance value	p<0.001	p<0.05	p<0.001	p<0.01	p<0.05	p<0.01	p<0.01	p<0.05	p<0.01	p<0.01	p<0.05	p<0.01

contains circular pupil indicative of diurnal habits. Tail without regular whorls of hard spinose scales and dorsal scales are unequal. There are callous preanal scales; these are absent in young and appear on sexual maturity. Males apparently reach larger asymptotic body sizes than females and also have larger heads and longer tails.

Adult and juveniles were differentiated by morphological inspection of callous preanal scales, and adult lizards were sexed by dissection and inspection of the gonads. For each group of lizards found, the properties of the structural niche such as the shape of the crevice, availability of perching space outside the crevice and the slope of the crevice were observed. Measurements of snout-vent length, tail length, head length (from the tip of snout to the anterior edge of the tympanic opening), head width and head height were taken for each individual caught (Fig. 2). The average number of individuals sharing the same crevice and the sex ratio were also determined as the proportion of males in the adult sample as well as in the total sample. The study area was visited for the collection of animals throughout three different times during two successive years: mid-summer season (July, 1999); mid-autumn season (October, 1999), and mid-spring season (April, 2000).

Significance of differences among sets were analyzed statistically by ANOVA test to test any significant differences were likely. If significant changes were indicated, levels of significance were inferred at $p<0.01$ (Bailey, 1981). Regression analysis for juveniles, adult males and adult females for the various morphometric variables of head and tail dimensions against snout- vent length were also compared.

Results

The average data as shown in Fig. 3, are based on the mean number of individuals sharing the same crevice as a group throughout each observation period.

Group size ranged from five to eight individuals and groups of more than four individuals were characteristic of all three sampling periods representing at least three seasons of the year. Community structure therefore not a seasonal phenomenon in the agamid lizard, *Agama agama spinosa,* One adult male found sharing a crevice with more than one adult female and a number of juveniles. In some few cases the groups included more than one adult Male. One group of seven individuals, for example included two adult males, three adult females and two juveniles. Generally, the proportion of males in the adult sample recorded during this study is 45% (the total adult sample is 53 individuals contains 24 male and 29 female). In the total sample of 88 individuals, there were 53 adults (60.2%) and 35 juveniles (39.8%).

Among the wide variety of structural microhabitats, all the recorded individuals were found to occupy horizontal crevices rather than sloping or vertical ones throughout the different sampling periods. The active lizards seen were sitting in the crevice opening or on the ledge within a few centimeters of the crevice.

As shown in Fig. 4, the distribution of body size classes (snout-vent length) suggests that males reach larger body sizes than females. Adult males in the sample ranged in size from 82.5 mm to 112.5 mm, while Ault females ranged from 82.1 mm to 100.6 mm. The mear snout-vent length of adult males (100.2 mm ± 4.11 SD; n = 24) was significantly larger ($p<0.01$) than that of adult females (88.1 mm 4.02 SD; n = 29). On the other hand the mean head dimensions recorded for males were significantly larger than those for females ($p<0.001$, Table 1), but no significant difference in mean tail length was recorded ($p>0.05$). Statistical regression analysis of head and tail dimensions against snout- vent length show that the proportional increase in head and tail dimensions with increasing snout-vent length is higher in adult males and juveniles than those in adult females (Table 2).

Discussion

It is clear from the results that the social structure of the agamid lizard, *Agama agama spinosa* and the number of individuals sharing the same microhabitat were not varied seasonally as is found in many lizard species (Burns, 1970; Vitt, 1974; Ruby, 1977; Congdon *et al.*, 1979). These results contradicts the finding of Vitt (1974) who reported that the lizard, *Urosaurus ornatus* form only winter aggregations which is usually colsidered to be of thermoregulatory significance.

In fact, the aggregation of lizards in groups have many advantages such as their males do not have to search for females during the mating season (Van Wyk and Mouton, 1998), the juveniles do not have to disperse until they are much older (Trivers, 1972). An added advantage will be that of 'group vigilance'. By taking advantage of the vigilance of other group members, individuals can reduce their own vigilance (Quenette, 1990; Roberts, 1996).

The properties of the niche structure were observed in this study based on the shape and slope of rock crevices occupied by the lizards *Agama agama spinosa.* Several reports had been published concerning the relation between species and structural characters of microhabitat. Henderson and Fitch (1975), Scott *et al.* (1976) and Moermond (1979)

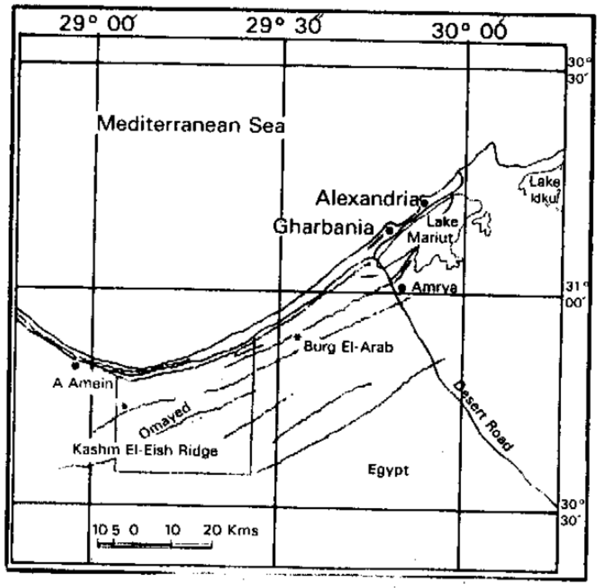

Fig. 1: A location map of the study site

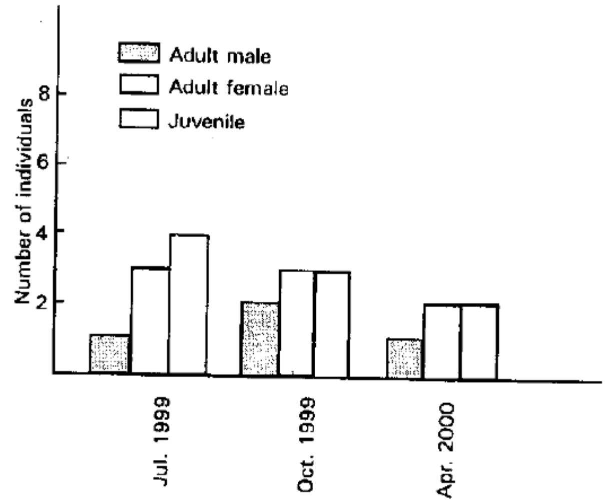

Fig. 3: Average numbers of adult males, adult females and Juveniles *Agarna agama spinosa* sharing the same crevice during the three observation periods. Figures above columns denote the individual number ranges

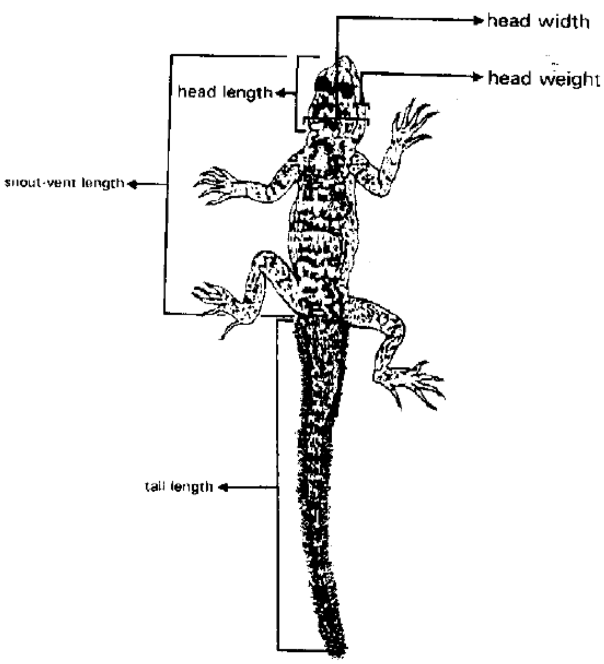

Fig. 2: Morphometric measurements of the agamid lizard, Agama agama spinosa

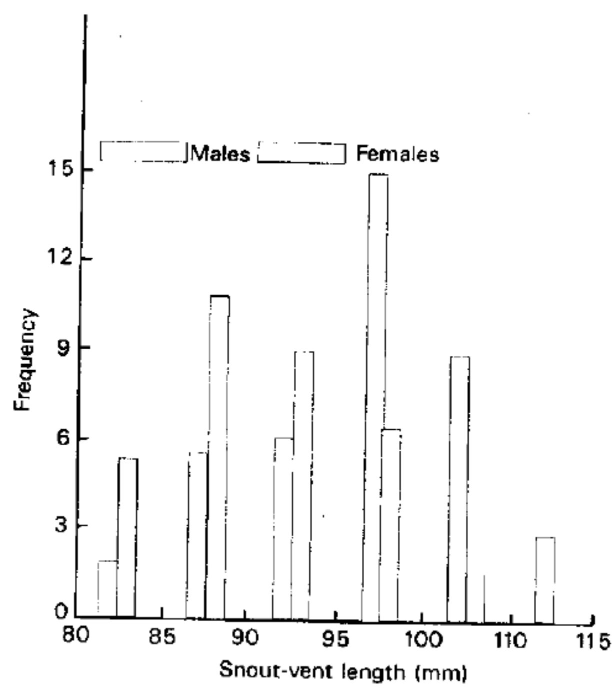

Fig. 4: The frequency distributions for male and female Agama agama spinosa of different body sizes

found that the diameter of occupied perches provided the most effective measure of the boundaries and relative density within the habitat space occupied by each species. The present study also reveal that the lizards *Agama agama spinosa* with their spinose bodies restricting movement in narrow horizontal crevices. Horizontal crevices are probably the most suitable for group living in that less energy would be expended for maneuvering inside crevices (Darevsky, 1967). In fact, most horizontal crevices, especially those formed by rocks lying on top of other rocks, there is usually a horizontal base immediately outside the crevice on which lizards can perch for basking and feeding purposes. On the other hand, most other rock- dwelling lizards will normally perch on top of rocks to increase their field of vision and to gain maximum benefit from solar radiation (Mouton and van Wyk, 1997). In comparison to other lizards, *Agama agama spinosa* is probably a slow- moving lizard and during our surveys, however, not a single individual was observed farther than few centimeters from its crevice. Therefore, it would probably be disadvantages to them to regularly venture too far away from crevices.

The sexual dimorphism in body and head sizes recorded for *Agama agama spinosa* ties in with the general pattern recorded for many lizard species *(Agama agama*, Harris (1964), *Anolis acutus,* Ruibal and Philibosian (1974), *Sceloporus jarrovi*, Ruby (1978), *Anolis valencienni*, Hicks and Trivers (1983), *Agama stellio,* Hussein (1994), *Cordylus niger,* Cordes *et al*. (1995).

The sexual selection is usually regarded as the main causal factor of sexual differences in body size, head size and body colouration in lizards, but many studies have shown that dimorphism in these characters can also result from natural selection (Anderson and Vitt, 1990; Ruby and Baird, 1993) or if not having a genetic basis, also from a wide array of local environmental processes (Shine, 1990). Advantages of male-biased sexual size dimorphism in lizards include: (1) an advantage for large males with large heads in male-male aggressive encounters, with resulting greater access to females and (2) an advantage for large males in mate choice by females which may prefer larger males (Carothers, 1984; Cooper and Vitt, 1987).

The results of regression analysis of head and tail dimensions against snout-vent length reported here indicate that the proportional increase in these dimensions with increasing snout-vent length is higher in adult males and juveniles than those in adult females. The most possible explanation for this phenomenon is that females allocate relatively more energy to reproduction after reaching sexual maturity than to characters less directly tied to reproductive success (Cooper and Vitt, 1989; Said and Hussein, 1992). Therefore, the observed dimorphism in body and head size in *Agama agama spinosa* may not necessarily be the result of sexual selection, but could also be the result of differential energy allocation by females.

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