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Seven stone spiders on the gravel plains of the Namib Desert

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RIASSUNTO

Un nuovo ragno *Segestriidae*, *Ariadna* sp., è stato scoperto in alcune pianure ghiaiose del Namib Desert. Esso scava nel suolo una tana individuale, cilindrica e verticale, nonchè tappezzata internamente con la seta. Inoltre, esso dispone alcune pietre quarzose, aventi dimensioni, forma e colore simili, a costituire un anello attorno all'imboccatura circolare della tana.

Tra le tre dimensioni delle pietre (lunghezza, larghezza e spessore) e tra queste e il diametro della tana esistono interessanti relazioni di proporzionalità, che difficilmente possono essere spiegate sulla base di un prelievo casuale delle pietre da parte del ragno.

Alcune osservazioni sul comportamento di *Ariadna* sp. inducono a ritenere probabile una funzione predatoria dell'anello di pietre.

Parole chiave: Predazione, Deserto, Namib, *Ariadna* sp., Araneae.

SUMMARY

The presence of a segestriid spider, *Ariadna* has been recently noted on the gravel plains of the central Namib Desert. These spiders excavate individual, cylindrical burrows vertically into the ground, which they line with silk. A ring of small quartz pebbles is arranged around the circular entrance. Most commonly there are seven stones around the entrance, although the number may range from four to eleven. All the stones around a single, individual burrow entrance are similar in size, shape and colour.

Length, width and height of the stones around an individual burrow are in proportion, as is the relationship between stone size and the diameter of the burrow. These regularities suggest stones are not selected randomly.

Observations of *Ariadna* sp. behaviour suggest that the the stone rings may facilitate detection of prey by spiders in their burrows.

Key words: Predation, Desert, Namib, *Ariadna* sp., Araneae.

A segestriid spider, observed by us in some areas of the Namib gravel plains, appears to be a newly discovered species of the genus *Ariadna* (J.HENSCHEL & P.ALICATA, pers. comm.). Segestriidae, previously included amongst the Disderidae, appear to be represented in Namibia by several species of the same genus. According to PURCELL (1908) the only species described for the central Namib Desert is *A. pulchripes*, found near Walvis Bay.

Observations on the new *Ariadna* sp. were carried out in areas near Gobabeb, seat of the Desert Ecological Research Unit of Namibia (DERUN). During September 1991, juvenile and sub-adult spiders were found along the road to Mirabeb about 11 km east of Gobabeb (COSTA *et al.*, 1994). In September 1992, further studies were carried out 5 km north-east of Gobabeb.

The spiders live in individual, almost cylindrical burrows, vertically excavated into the ground. The burrow, which has an enlargement at the bottom, is thickly lined with silk. The peculiarity of these burrows is a stone ring (Fig. 1), made of small quartz pebbles, arranged around the circular hole edge. The number of stones in a ring can range from four to eleven, but usually there are seven, which are seemingly similar in shape, size and colour. Furthermore, oblong stones are radially placed according to their major axis.

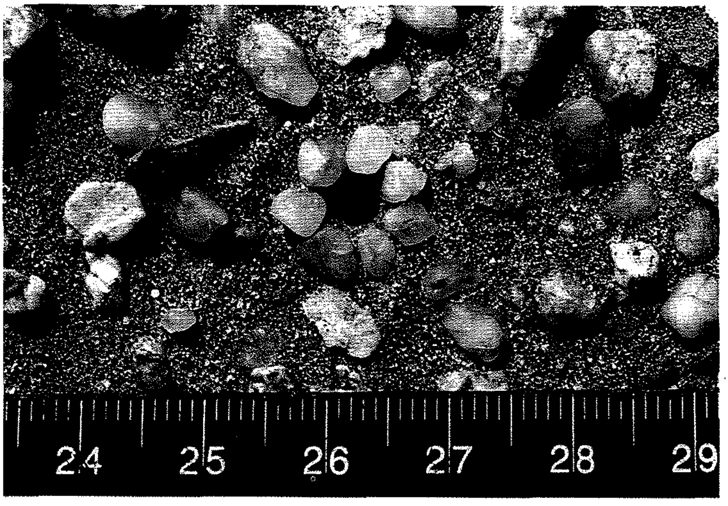


Fig. 1 - A typical stone ring of *Ariadna* sp.

During September 1991 we analyzed a sample of 30 burrows. We measured the hole diameter and three dimensions (length, width and height) of each stone in a ring. We also studied the hole features by making gypsum casts of some burrows. In addition, five specimens were caught, weighed and kept for further analysis.

During September 1992, we continued the research on the *Ariadna* sp., in collaboration with J. Henschel. We defined a 30 x 60 m area, within which we carried out most of the observations. Other measurements and experimental manipulations were conducted outside the main research area. Observations over a 24 hr period showed that the hole entrance was often open at night and closed by one additional stone during most of the day-time (Fig. 2).

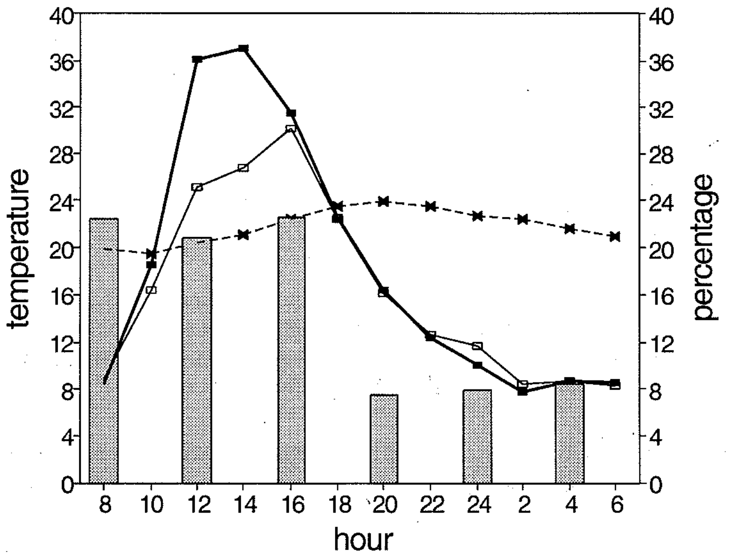


Fig. 2 - 24-hours observations in the study area (temperatures of ❑ air, ■ soil-surface, x -20 cm). Bars indicate the percentage of closed holes.

The size of this stone has to be a little larger than that of the hole diameter. Experimental manipulations showed that smaller stones falling into the burrow can be ejected, as can stones twice as large as those normally used by the spider. Burrows that remained open during the day-time showed no sign of spider activity at or near the entrance, suggesting that the spider stays at the bottom of the hole. On the contrary, at night the spider could be seen positioned just below the holes edge.

An analysis carried out on both the 1991 and 1992 samples, showed that a relationship exists between length and width, width and height and length and height as well as between hole diameter and animal weight (Tab. I).

		1991	**1992**
	m	1.36	1.32
Le/Wi	**s**	0.13	0.11
	r	0.94	0.98
	m	1.37	1.29
Wi/He	**s**	0.11	0.11
	r	0.95	0.98
	m	0.87	0.89
Wi/HD	**s**	0.15	0.12
	r	0.78	0.91
HD/AW	**r**	0.88	0.92

Tab. I - Comparison of stone dimensions and hole and spider measurements between 1991 and 1992 samples. **Le** = stone length; **Wi** = stone width; **He** = stone height; **HD** = hole diameter; **AW** = animal weight. Statistical parameters: **m** = arithmetic mean; **s** = standard deviation; **r** = coefficient of correlation.

Obviously, big burrows have large diameters, and the stones of the circle are also proportionately large. The same is true for small burrows that have small diameters and thus accordingly small stones. The number of stones surrounding small burrows is often higher than the number surrounding large burrows. Of the 148 burrows for which stones were measured during September 1992, an inverse relationship between the number of stones and the size of the entrance was found. Holes having from six to eight stones in the ring had almost identical hole diameters. Holes having nine stones and more had smaller diameters (Tab. II).

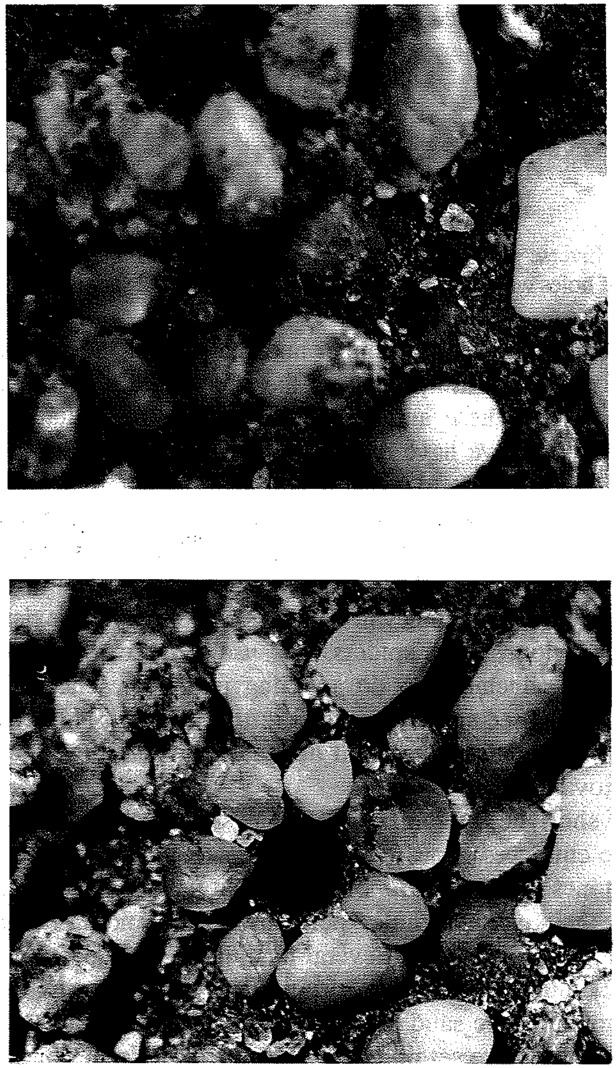
Stone number	Hole diameter (mm)	%
4	3.30	0.68
5	3.35	2.70
6	3.18	14.19
7	3.14	41.22
8	3.15	31.08
9	2.28	7.43
10	1.87	2.03
11	1.30	0.68

Tab. II - Inverse proportionality between stone number and hole diameter, and percentage of holes with different stone number in the 1992 sample.

These regularities in the number and features of the stones used by spiders and the relationship between the stone sizes and hole diameters could suggest that these animals choose the stones suitable for their burrows. However, we have observed random stone selection on occasion, making it difficult to explain the size characteristics of the ring stones. Although it appears obvious that spiders would need to employ a stone selection strategy because of the great number of stones available in their habitat, no active selection has yet been recorded.

We removed certain stones in an attempt to verify the existence of a replacing behaviour by the spiders. Because of their apparently nocturnal habits and reluctance to do anything in the presence of artificial lights, we did not see spiders engaged in this activity. Nevertheless, we ascertained that stone replacement does take place within the first few days of removal.

After a short heavy rainfall over the study area in March 1993, several hole entrances appeared virtually closed with silk and sand and their ring stones scattered (Fig. 3a). The next day these holes were open again with their entrance holes perfectly round and the stones symmetrically replaced (Fig. 3b). Several hypotheses have been put forward to explain the function of the stone ring. First, the stone ring could serve to prevent or minimize sand being blown by the wind into the hole. To test this hypothesis, we set up two sets of artificial spider burrows in an adjacent area to the main study site. We used glass vials with a diameter similar to that of the average spider burrow, with the open end positioned level with the ground surface. We constructed artificial rings, with stones of approximately the same dimensions and orientation as those of the average spider hole, around the openings of one set of vials.



a)

b)

Fig. 3 - A stone ring after a heavy rainfall (a).
The stone ring rebuilt the day after (b).

After several days of exposure (that included strong winds), the vials of both sets were checked for a possible difference in sand accumulation. No significant difference could however be found between the two sets.

As a second hypothesis we suggested that the stone rings could facilitate predation by the spiders. Spiders were seen positioned just below the hole entrance at night. The stone rings, connected to the hole by silk threads, could serve to transmit vibrations caused by the prey movements, alerting the spider to the presence of the prey.

One act of predation was witnessed. An ant walked on a ring, moving from one stone to another. When the ant reached the stone below which the spider was positioned, the spider swiftly dashed out and captured the prey, dragging it inside the hole.

Other hypotheses may include the suggestion that the ring could serve to strengthen the top of the burrow, since the stones appear to confer a certain stability to the upper part of the hole. Alternatively, they could prevent the entry of wind-blown debris. Another possible function may be that of regulating temperature and humidity in the burrow. Although the stones are not large, the temperature of the stone surface is always lower than that of the sand surface. This could also serve to reduce the risk of predation on the spider. A homogeneously white-coloured circular crown around the burrow entrance could make the hole appear similar to a black stone or shaded zone. The characteristic shading of light and dark zones on the gravel plains could make it difficult for predators to find spider burrows.

While serving to facilitate predation by the spiders appears to be the most probable function for the stones, we believe that several of the above explanations may be acting in concert.

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