

## HABITAT AND POPULATION STRUCTURE OF *POLYPHAGA AEGYPTIACA* (BLATTARIA : POLYPHAGIDAE) IN ASIR, SAUDI ARABIA

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**Mots-clés :** désert, structure de population, oothèque.

**Abstract.** – *P. aegyptiaca* was observed in rock shelters in a desertic location, 1200 m above sea level in Asir, Saudi Arabia. Each cavity harboured a small population of 1 to 15 individuals. These groups generally included a few adults with larvae. Cockroaches burrowed in the sand on the ground of rock shelters. Oothecae were found in the sand and they were made up of 8 to 12 eggs. *P. aegyptiaca* differs by many traits of its bionomics from other Polyphaginae cockroaches which inhabit the sand beneath cushion shrubs.

**Résumé.** – **Habitat et structure des populations de *Polyphaga aegyptiaca* (Blattaria : Polyphagidae) dans l'Asir, en Arabie Séoudite.** – *P. aegyptiaca* a été observée dans les abris sous roche d'un désert Saoudien à 1200 m d'altitude dans l'Asir. Dans chaque cavité, se trouvait une petite population de 1 à 15 individus, comprenant en grande partie des larves mais aussi quelques adultes. Les blattes fouillaient dans le sable sur le sol des abris sous roche. Leurs oothèques contenaient de 8 à 12 oeufs et étaient déposées dans le sable. Ce mode de vie diffère par nombre de caractéristiques biologiques de celui des autres Polyphaginae qui habitent le sable sous les buissons en boule.

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The bionomics of desert cockroaches belonging to the subfamily Polyphaginae are well-known compared to those of other cockroaches. Several ecological studies have been carried out on small species living under cushion shrubs in the deserts of North America (Hawke & Farley, 1973 ; Edney *et al.*, 1974 ; Cohen & Cohen, 1981), North Africa (Ghabbour *et al.*, 1977, 1978, 1980) and the Middle East (Grandcolas, 1994a, 1995a). However, some larger species of *Homoeogamia* and *Polyphaga* inhabiting cavities, in the New World and in the Old World respectively, are still poorly known. Some only anecdotal accounts have been published and quoted by Chopard (1938), Roth & Willis (1960), and Princis (1962, 1963). These accounts did not assess the life habits of these species clearly.

*Polyphaga aegyptiaca* is one of the most widely distributed of these large species. It is found from North Africa to the Middle East and also in some parts of the Mediterranean region (Bey-Bienko, 1950 ; Chopard, 1929 ; Princis, 1962 ; Grandcolas, 1994b). This cockroach species belongs to a large monophyletic group in the subfamily Polyphaginae, which includes desert-living genera (*Anisogamia*, *Eupolyphaga*) as well as forest-living species (*Therea*, *Eucorydia*, *Ergaula*, *Cryptocercus*) (Grandcolas, 1994c).

The present study documents the life habits of *P. aegyptiaca* in Saudi populations of Asir deserts. This study of *P. aegyptiaca* life habits is part of a larger comparative project concerning the subfamily Polyphaginae (Grandcolas & Deleporte, 1992 ; Grandcolas, 1995b).

### Material and Methods

Study site and sampling methods have already been described in Grandcolas (1995a). The study site was a desert of medium altitude in Asir mountains near Taif (30 km E Taif, road Al Sud-dayrah, NWRC reserve, 21°14'46 N. and 40°42'05 E.). It comprised an area that has been protected from grazing by goats for three years. Diverse structures which could shelter *P. aegyptiaca* were sampled in June 1992, namely free sand, sand under shrubs, sand under rocks, and sand in rock shelters. Twenty cubic samples of loose sand (20 cm x 20 cm x 20 cm) were examined. The sand was also examined under 31 small plants (less than 10 cm in diameter) and under 124 shrubs (diameter larger than 10 cm, maximum diameter observed : 140 cm). Twenty-six rocks (ranging from 1 000 cm<sup>3</sup> to 32 000 cm<sup>3</sup>) were also checked. Eight rock shelters ranging from 5 m<sup>3</sup> to 20 m<sup>3</sup> were sampled and special attention was paid to the sand on the ground and at the foot of the walls. On average, these shelters were small to medium cavities, neither very deep nor obscure with walls less than two meters high. They were relatively far from each other (hundreds of meters or several kilometers). In addition to direct observations, pitfall traps with bananas and peanut oil were placed in the ground of rock shelters. All observed specimens and oothecae were captured and recorded. Brood size was estimated from the external deformation of the ootheca wall. Pronotal width of nymphs was measured to estimate their age. Maximum survival ratios were estimated in each population by comparing the population size and the mean brood size assuming very low emigration/immigration ratios. Ten hours of direct observations were made nightly in order to observe any possible cockroach activity.

### RESULTS

No individuals or oothecae of *P. aegyptiaca* were found either under rocks, in loose sand or in sand under cushion shrubs. Eight rock shelters were visited (fig. 1), of which five harboured a population of *P. aegyptiaca* (fig. 2-4). Most individuals were found burrowing in the sand of the darker parts of the rock shelters near the foot of the walls. They alternately burrowed and showed a freezing posture. Nymphs were often found close together although none were seen to interact directly. There was no guano in these rock shelters but only a few old faeces of small mammals. Individuals of *P. aegyptiaca* were not particularly close to these faeces and, they did not eat them in the laboratory. After several observation and trapping sessions, no more cockroaches or oothecae were found in these rock shelters and it was concluded that the populations had been captured completely. On average, they were 7.6 individuals (ranging from 1 to 15 individuals in a population) including some larvae and several adults (fig. 5). Age structures differed between populations, for both males and females (Kruskal-Wallis tests, males :  $H = 2.06$ , d.f. = 4,  $P > 0.10$  and females :  $H = 9.75$ , d.f. = 4,  $P > 0.10$ ). Some populations comprised mostly first instar nymphs and others included older nymphs and some last instar nymphs. Sex ratios were biased either toward males or toward females (ranging from 3 to 0.57). On the whole, for all populations, female nymphs were not younger than male nymphs (Wilcoxon two-samples test,  $P > 0.10$ ). Four out of five rock shelters with cockroach populations also harboured oothecae (mean 2.5); the fifth one without any oothecae only harboured a female nymph. The oothecae were deposited in the sand at the foot of the walls of the rock shelters. All sampled oothecae had already hatched and showed no holes of hymenopteran parasitoids. Parasitism by Diptera was impossible to assess on old oothecae since these parasites do not damage the ootheca during their emergence.

Mean brood size was 9.6 eggs ( $N = 10$ , ranging from 8 to 12). Comparisons between population sizes and estimates of brood size indicate that the larger populations necessarily originated from at least two oothecae. Nymphal survival may be estimated at

approximately 49 % (ranging from 10.4 % to 83.3 %), based on one or two minimal ootheca hatching(s) per population. No cockroaches were seen active except one adult female walking on the ground at the entrance of rock shelter n°2 at 21 H 00. A male attracted by the camp light was captured far from any rock shelter.

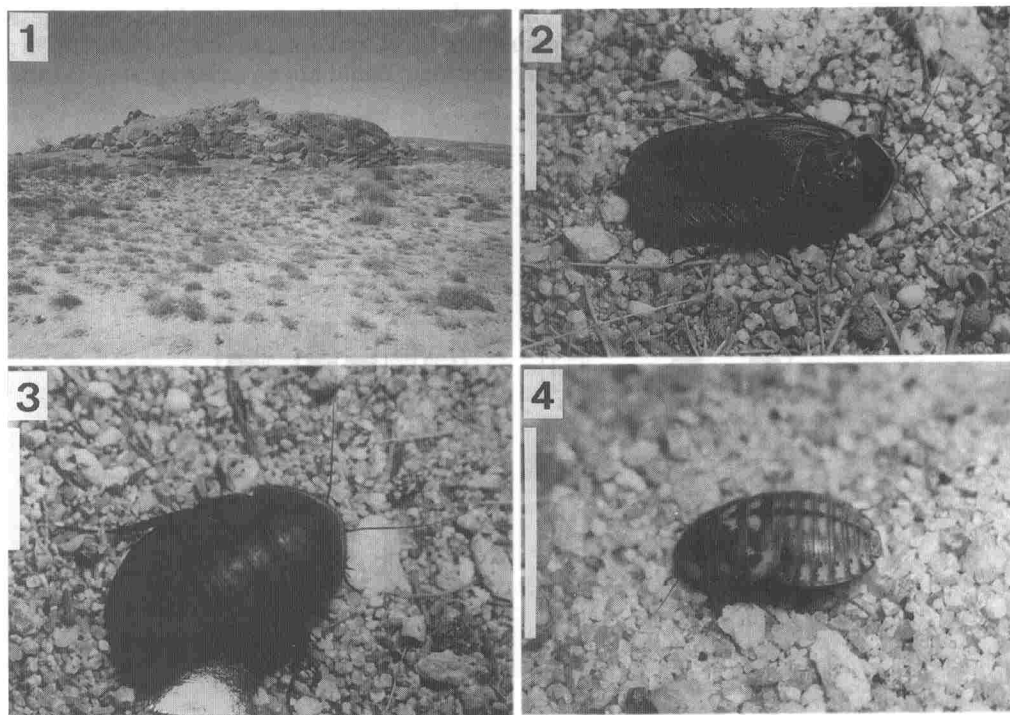


Fig. 1-4. 1, small inselberg harbouring rock shelters. – 2, adult male of *Polyphaga aegyptiaca*. – 3, adult female. – 4, nymph. Scale bars = 1 cm.

## DISCUSSION

*Polyphaga aegyptiaca* inhabited rock shelters on the study site. These observations are consistent with previous reports which mentioned this species either in burrows or in caves (quoted by Roth & Willis, 1960). A few old observations concerning *P. indica* and *P. saussurei* are partly consistent with these for *P. aegyptiaca*: some individuals were found in cavities while others were found burrowing in loose sand on ground. According to these ancient observations, it is impossible to assess whether the individuals observed in loose sand actually lived there or whether they were dispersing from cavities which could be their main habitat. Krivokhatsky (1994) assessed recently that *P. pellucida* inhabited rodent burrows in the Karakum desert but he did not mention any parallel examination of the fauna of caves or rock shelters.

*P. aegyptiaca* could be considered troglobitic since it lives and lay oothecae in caves when they are available. Its tendency to inhabit burrows as well and to disperse easily outside cavities attests conversely that it could be trogliphilic. Its habits differ from those of the *Heterogamisca*, and *Hemelytrobatta* species and some *Arenivaga* species which burrow into the sand beneath cushion shrubs (Hawke & Farley, 1973 ; Ghabbour *et al.*, 1977, 1978, 1980 ; Grandcolas, 1995a). The bionomics of *P. aegyptiaca* and *Heterogamisca chopardi* can be compared since they have been studied in the same way in Saudi Arabia (this study and Grandcolas, 1994a, 1995a). Despite their different habitats – cavities and sand beneath shrubs respectively – , behaviours of these species are somewhat comparable: both burrow into the sand, display a freezing posture and lay

oothecae directly in loose sand. Their population structures are however very different. The populations of *P. aegyptiaca* in rock shelters are generally smaller than those of *H. chopardi* beneath cushion shrubs. The population structure of *P. aegyptiaca* is more variable than that of *H. chopardi* concerning the sex ratios and age structures. The fecundity of *P. aegyptiaca* also seems lower since fewer oothecae were found. Brood size is however larger in *P. aegyptiaca*. Parasitism level could not be compared between these species. *H. chopardi* experienced a high parasitism level by Diptera (Grandcolas, 1995a ; Greathead & Grandcolas, 1995) but dipteran parasitism could not be assessed after the old oothecae found in this study.

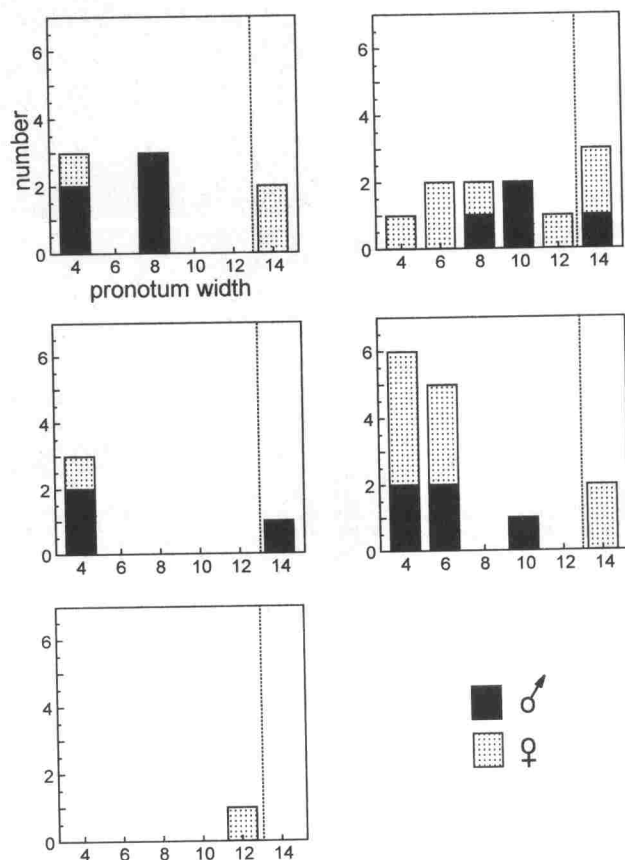


Fig. 5, population structure of *P. aegyptiaca* in five rock shelters according to the number of individuals of each sex for different ages (pronotum width in millimeters). Adults, with the largest pronotum width, are separated from nymphs by a dashed line.

Emigration/immigration ratios of *P. aegyptiaca* populations could be hypothesised as being very low in rock shelters; these rock shelters are far from each other and only a few adults were observed outside but never any nymphs. Thus it was possible to estimate maximum survival rates for *P. aegyptiaca* in each rock shelter. Survival is not high, especially as most nymphs are still far from being adults and could disappear, decreasing survival rate. Comparisons in this respect between *P. aegyptiaca* and *Heterogamisca chopardi* are impossible. Emigration/immigration occurred between the populations of *H. chopardi* beneath shrubs and precluded any survival estimation (Grandcolas, 1995a).

In conclusion, the habitat and the population structures of *P. aegyptiaca* appear to differ clearly from those of other desert-living Polyphaginae. They are more comparable to those of cavicolous species inhabiting treeholes in forest areas (Schal *et al.*, 1984 ;

Grandcolas, 1991). This report increases the known diversity of life habits existing in the subfamily Polyphaginae. The life habits of *P. aegyptiaca* will be compared to those of related forest-living genera which could also inhabit cavities (Grandcolas, in prep.). Using phylogeny (Grandcolas, 1994c, 1995b), this will undoubtedly help to improve our knowledge of the evolution of life habits in the subfamily Polyphaginae.

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