

Parthenogenesis and reproduction in *Charinus ioanniticus* (Kritscher, 1959) (Chelicerata, Amblypygi, Charinidae)

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Summary

Charinus ioanniticus from the Greek island of Rhodes can reproduce parthenogenetically. Young animals hatched in captivity started their first reproduction at an age of about 1.5 years when they had reached body sizes of about a half to two-thirds of the size of fully grown specimens. Egg numbers of these small specimens ranged from one to six (up to 13 in fully grown specimens). All reproduction occurred between late winter and early summer. The observations are discussed with respect to the concept of insular parthenogenesis of Cuellar (1977).

Introduction

Parthenogenesis is rare in whip spiders (Amblypygi). It has been observed in *Charinus acosta* (Quintero, 1983) (De Armas, 2000, 2005) and perhaps in *Charinus ioanniticus* (Kritscher, 1959) (Weygoldt, 2005) from the Greek island of Rhodes.

Although males of *Charinus ioanniticus* have been reported from Turkey (Kovacic & Vlasta, 1996; Weygoldt, 2005), the population from Rhodes seems to be all female (Weygoldt, 2005). Parthenogenetic reproduction was concluded from observations of some females collected in September 2003, which moulted in captivity and subsequently laid eggs that developed into viable protonymphs. Usually, whip spiders lose all stored spermatozoa when the ectodermal seminal receptacles or genital atria are shed during moulting (Weygoldt, 2000). However, in these observations, the possibility of an unknown method of sperm storage, perhaps similar to that of the theraphosid spider *Sickius longibulbi* Soares & Camargo (Bertani & Da Silva, 2002) (however improbable), could not be excluded. Therefore I attempted to raise some of the protonymphs (the first free-living instar: Weygoldt, 2000) hatched in captivity to sexual maturity in order to see whether the females are able to produce viable offspring without ever having met a male.

The aim of this contribution is to provide conclusive evidence as to whether females of *C. ioanniticus* from Rhodes are indeed able to reproduce

parthenogenetically. I also add some data that suggest that reproduction in *C. ioanniticus* is seasonal.

Material and methods

Of the 23 females collected in 2003, only one specimen was still alive in June 2006. It is the female designated ♀1 in Table 1 in Weygoldt (2005).

The immatures which hatched in July and August 2004 were separated from their mothers and sisters and kept in small individual containers as described by Weygoldt (2005). They were first fed on *Drosophila*, but after some of the animals had died and others did not grow, I offered small cricket nymphs (*Grylloides* sp.). They then grew much faster. Each specimen was checked twice per week.

Results

The only surviving adult (♀1) laid its first clutch in captivity on 20 April 2004. The brood sac was later dropped and eaten by the female. She later moulted on 26 August 2004 and laid her second clutch on 4 April 2005. Twelve praenymphs (or larvae, the first post-embryonic instar, still whitish and nearly immobile, clinging to the female's opisthosoma) hatched from this brood sac. The female moulted again on 8 August 2005 and laid her third clutch on 6 March 2006. She then measured 9.2 mm in total length and 3.4 mm in carapace length. The embryos developed normally, but the female dropped her clutch about two weeks before hatching. Thereafter she no longer accepted food, became weak and was finally preserved.

Five of fifteen animals that had hatched in summer 2004, although still much smaller than fully grown ones, had reached sexual maturity in the winter of 2005/2006. The others were only half the size of the five mature ones and did not show any sign of maturity. The five mature females developed large yellow eggs that were visible through the partly transparent opisthosomal pleura. Later in spring they laid eggs; the data and egg numbers for four of them are shown in Table 1. The fifth female laid eggs unnoticed and obviously immediately dropped and ate them.

It is evident from Table 1 that the egg numbers are low. The smallest specimen (juv. 2) laid only a single egg, which was dropped about two weeks after oviposition. The eggs of the other three females (between 4 and 6 in number) developed normally. Juv. 3 was accidentally killed, but the embryos had well-developed appendage

Female	Juv. 1	Juv. 2	Juv. 3	Juv. 4
Size of female	2.4:6.8	1.7:5.4	2.0:5.7	2.0:5.6
Oviposition (egg numbers)	13 Feb. 06 (6)	10 April 06 (1)	14 April 06 (4)	17 April 06 (4)
Praenymphs hatched	15 May 06 (6)	—	+16 June 06	28 June 06 (3)

Table 1: Sizes (median prosoma length and total length, in mm), oviposition dates, egg and praenymph numbers, and hatching dates of praenymphs of four of the females reared to maturity in the laboratory. The anaesthetised females were measured after the protonymphs had left their mothers.

rudiments and lateral organs (Weygoldt, 1975). Older and larger females can produce up to 13 eggs.

Discussion

Although the number of observations is low, the results clearly show that females of *C. ioanniticus* from Rhodes are able to reproduce parthenogenetically. They also show that young animals can become sexually mature at an age of about 1.5 years, when they have reached between a half to two-thirds of the size of a fully grown specimen.

The data further suggest that *C. ioanniticus* from Rhodes has its breeding season in spring. None of my animals ever laid eggs after June (see also Table 1 in Weygoldt, 2005). This is in contrast to many tropical species, which are able to reproduce, at least in captivity, irrespective of the season.

Although rare, parthenogenesis occurs in various arachnid groups. It has been observed in mites, several scorpions (e.g. Lourenço & Cuellar, 1994, 1995, 1999; Lourenço *et al.*, 2006), a few Palpigradi, pseudo-scorpions, spiders (e.g. Lake, 1986; Camacho, 1994; Edwards *et al.*, 2003) and, among amblypygids, in *C. acosta* (Quintero, 1983), a small species from Cuba (De Armas, 2000, 2005). This species also has a breeding season and a similar relationship between body size and egg numbers (3 to 9).

Many parthenogenetic populations occur in habitats that are different from those of their related bisexuals (Cuellar, 1977). Vandel (1928), studying crustaceans, coined the term “geographic parthenogenesis” for this pattern. Cuellar (1977, 1994) proposed the concept of insular parthenogenesis for the origin of parthenogenetic lizards. He suggested that parthenogenetic populations can only evolve in areas devoid of the generating bisexual population because fertilisation would disrupt an all-female lineage, and competition would impede its successful establishment.

Lourenço & Cuellar (1995) and Lourenço (2000) found that the distribution of parthenogenetic scorpions conforms to this concept. They discussed the possibility that the geographical expansion of the parthenogenetic population of the Brazilian scorpion *Tityus serrulatus* Lutz & Mello was related to human colonisation. Perhaps there is a similar pattern in *C. ioanniticus*. There is a bisexual population in Turkey, where the specimens were found in natural habitats (Weygoldt, 2005). On the island of Rhodes, however, the animals live in artificial cave-like conditions under the old cities of Rhodes and Lindos. The same may be true for the populations in

Israel and Egypt, where the animals have been found in ruins, houses, and the sewage system. However, the number of specimens collected in these areas so far is too low to allow the assumption of all-female populations.

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