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Morphological observations on a gynandromorph of *Anacridium aegyptium* (Linnaeus, 1764) (Orthoptera Acridiidae)

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ABSTRACT This paper describes and illustrates a gynandromorph of *Anacridium aegyptium* (Linnaeus, 1764) (Orthoptera Acridiidae). Its morphological features are compared with normal male and female features in this species. Biometric data are also provided. This is the first case of gynandromorphism reported in *A. aegyptium.* The specimen was collected in the field near Imperia (northern Italy).

KEY WORDS Biometry; Caelifera; Catantopinae; gynandromorphism; Italy.

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INTRODUCTION

Gynandromorphism is a teratologic condition consisting in the simultaneous presence of both male and female phenotypic characters, with a clear demarcation between the one and the other, in the same individual of an animal species with separate sexes. To whatever degree, it is always a rather uncommon phenomenon. In the class of insects, gynandromorphism is fairly widespread and has been observed in both heterometabolous and holometabolous orders (Massa, 2010). The different frequency at which it has been reported for different taxa also derives from the presence (or lack thereof) of more or less marked sexual dimorphism, as occurs e. g. in some Coleoptera and Lepidoptera.

Among Orthoptera, gynandromorphs are observed more frequently in Ensifera, which exhibit more evident dimorphism principally due to the long ovipositor typical of the females in most families of this suborder. For Caelifera, reports are much less numerous (Nickle, 1983).

This article describes and illustrates in detail a gynandromorph of *Anacridium aegyptium* (Linnaeus, 1764) (Caelifera Acridiidae Catantopinae) (Fig. 1). Previously, the specimen had only been the subject of a very short analysis (Nicoli Aldini, 1996). *Anacridium aegyptium* is a common species with wide south-western Palearctic distribution (Harz, 1975). It is widespread in the Eurasia and Mediterranean region and frequent in all Italian regions (Massa et al., 2012). It winters in adult state. Sexual dimorphism is very slightly pronounced in this species. Almost exclusively, it has to do with size (dimegethism) - with females being larger than males - and a few other morphological features, such as the shape and development of the arolium in the pretarsi. As is observed in other *Anacridium* Uvarov, 1923, pretarsi are sexually dimorphic in *A. aegyptium*. Male arolium is rather narrow and 1.5 times as long as each pretarsal claw. Female arolium is a little wider than in male, but is as long as the claws, or exceeds them only slightly in length. Stridulatory structures are not present in this species; a clicking noise is produced with the mandibles (Harz, 1975).

MATERIAL AND METHODS

The gynandromorph was collected in the field near Imperia (Liguria, northern Italy) on February 18, 1993. Since it was already dead (though still relatively fresh) by the time it reached laboratory observation, ethological data are not available, nor was it dissected. Photographs of the abdominal details were taken at a time the gynandromorph was already dead, but still fresh. Biometric measurements - antennal length, body length (from the front to the posterior end of the abdomen), length of pronotum (dorsally along the midline), tegmina, and metathoracic femora, tibiae and tarsi (Table 1) - were made at a later time, on the dry specimen, using a manual gauge and under a stereomicroscope. The specimen is stored, dry, in the author's collection.

In order to obtain comparative biometric data, measurements were also made, with the same method, on 20 males and 20 females of the same species, collected in Italy (all coming from northwestern and central provinces and regions: Liguria, Piedmont, Lombardy, Emilia Romagna, Tuscany), kept dry in the entomological collections of the Department of Sustainable Crop Production - DI.PRO.VE.S., Università Cattolica, Piacenza (Table 2). In order to facilitate the measurements by giving some temporary flexibility to the insects' joints, each specimen spent a short time in a moist chamber.

ABBREVIATIONS. See figures 6–15. T = tergite; Ep = epiproct; RPp = right paraproct; LPp = left paraproct; RC = right cercus; LC = left cercus; RDV = right dorsal valve; LDV = left dorsal valve; RVV = right ventral valve; LVV = left ventral valve; LBvS = lateral basivalvular sclerite; MSgP = male subgenital plate; FSgP = female subgenital plate; S = sternite; lh = left half; rh = right half.

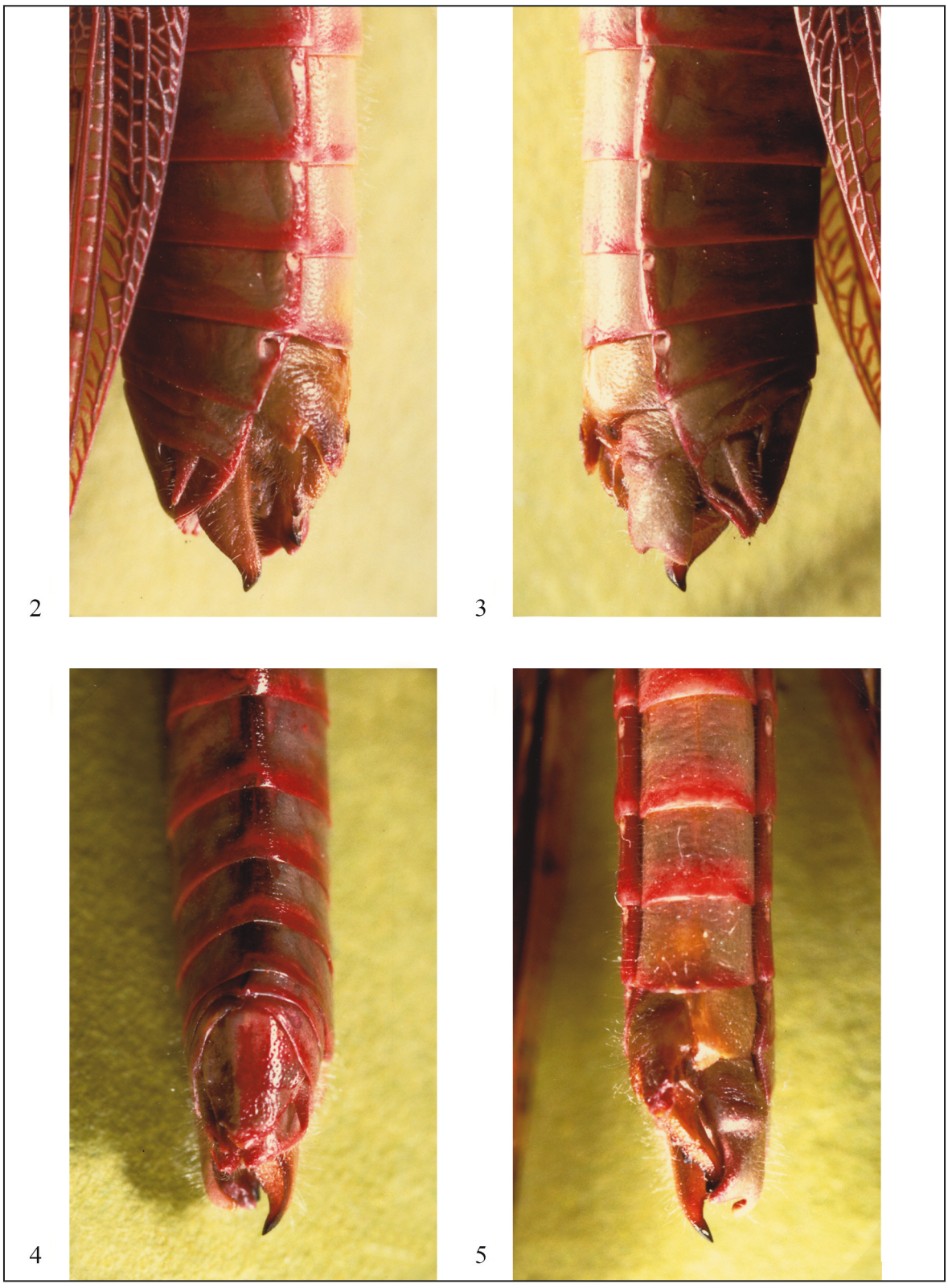
RESULTS

The size of the gynandromorph (body length approx. 48–49 mm, tegmina approx. 49.5 mm, no significant difference between the right and left tegmen) (Table 1) is intermediate, considering the mean male and female dimensions for this species. Harz (1975) reports that the mean length of the tegmen in male *A. aegyptium* is 46.5 mm, and 57 mm in female (also see biometric data in Table 2). The head features a very slight difference in length

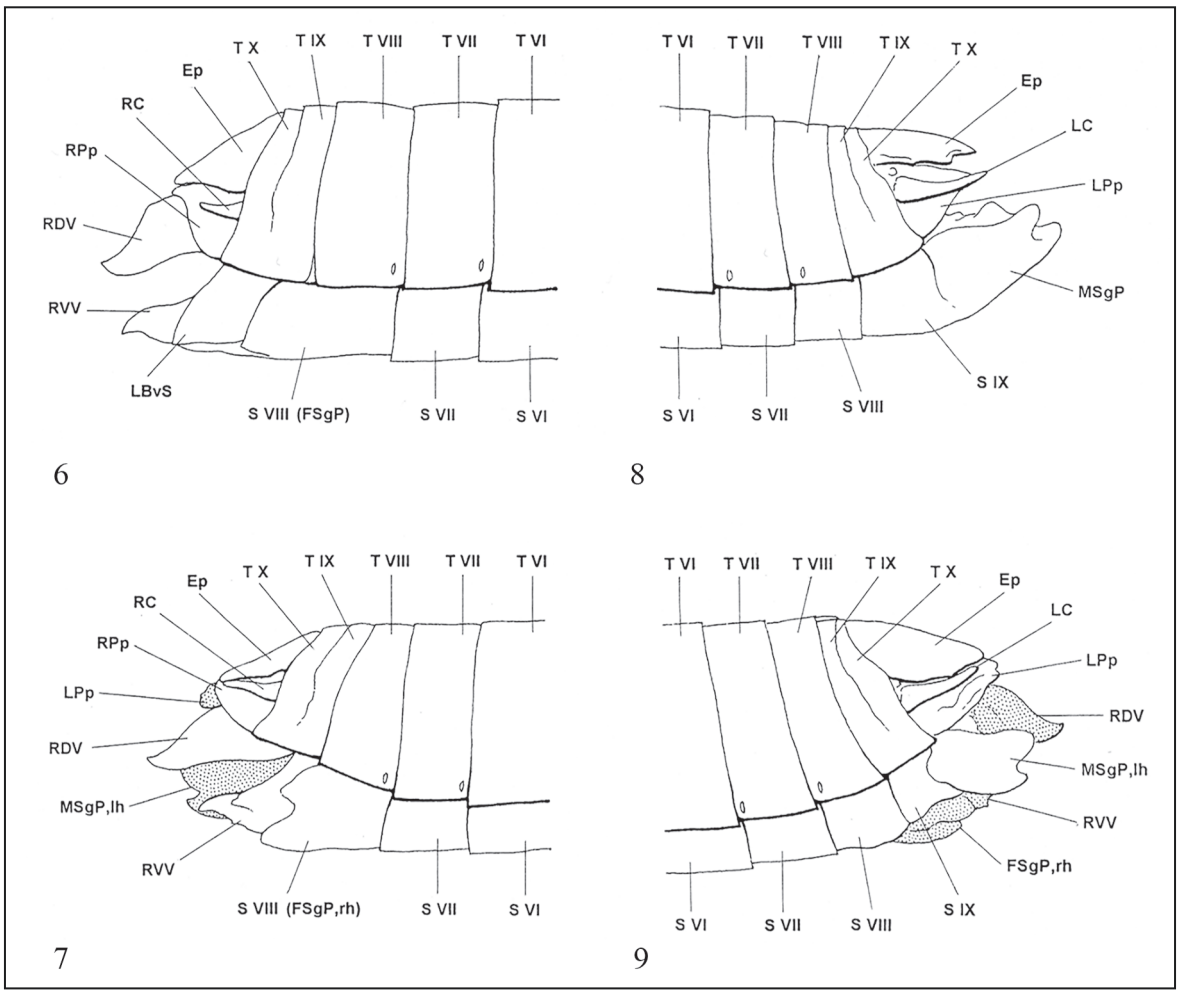
Figure 1. Gynandromorph of *Anacridium aegyptium*: dorsal view of the whole specimen (photo S. Gabbiani).

Length (mm)	Right side of the body	Left side of the body
Total body	49.04	48.23
Antenna	15.91	15.06
Pronotum (midline)	11.80	11.80
Tegmen	49.57	49.46
Metafemur	26.04	24.85
Metatibia	24.12	21.70
Metatarsus	8.08	7.99

Table 1. Gynandromorph of *Anacridium aegyptium*, all biometric data measured (in mm).



Figures 2–5. Gynandromorph of *Anacridium aegyptium*. Figure 2. Right lateral view of the last segments of the abdomen. Figure 3. Left lateral view of the last segments of the abdomen. Figure 4. Dorsal view of the last segments of the abdomen. Figure 5. Ventral view of the last segments of the abdomen (photos I. Rossi).

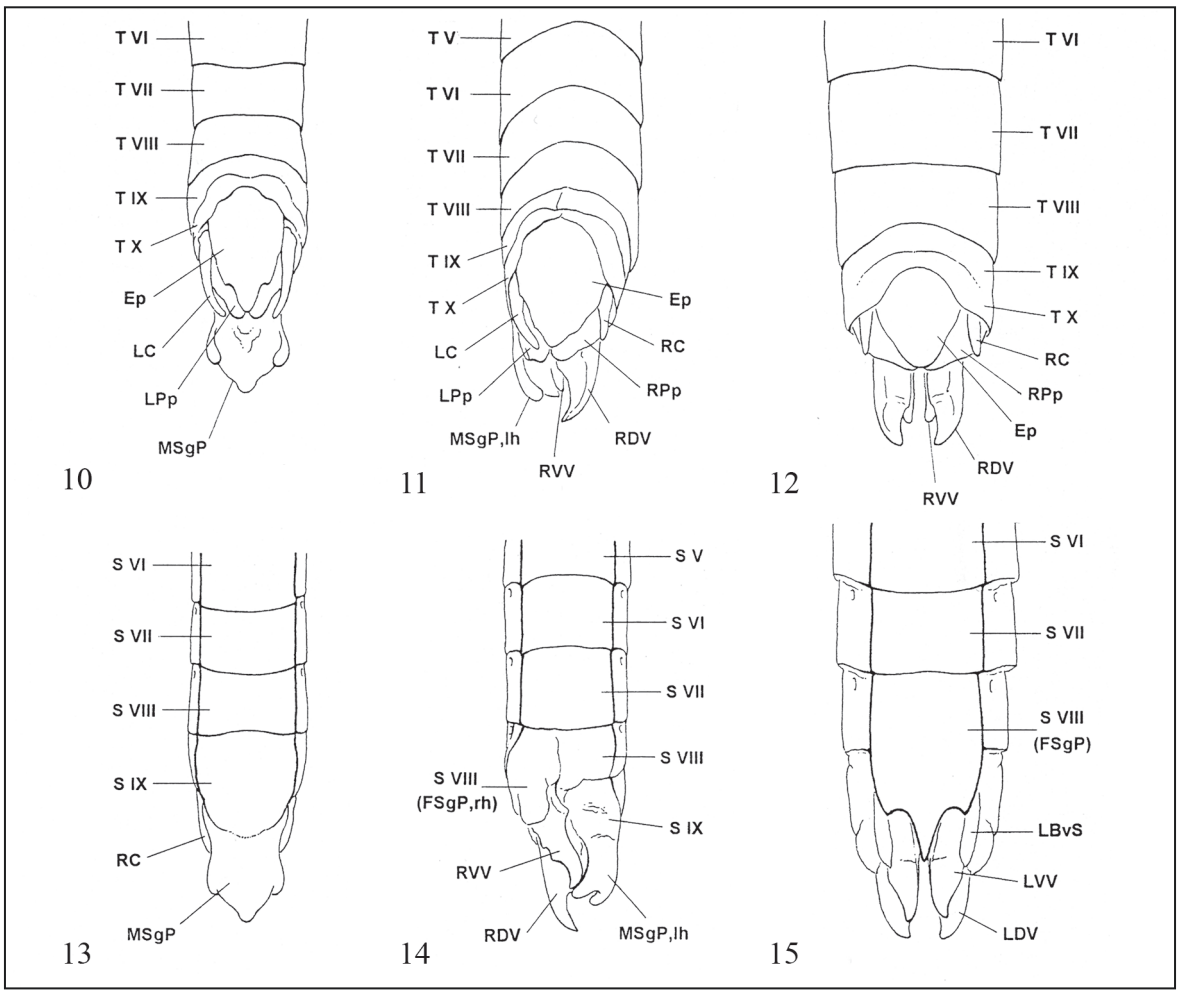


Figures 6–7. *Anacridium aegyptium*, lateral view of the last segments of the abdomen. Fig. 6: normal female, right side. Fig. 7: gynandromorph, right side. Fig. 8; normal male, left side. Fig. 9: Gynandromorph, left side. Abbreviations: see Material and Methods.

between the antennae: the right antenna is 0.85 mm longer than the left. In the thorax, pro- and mesothoracic legs on both sides are symmetric, while metathoracic legs are clearly asymmetric, the right leg being distinctly longer than the left, due to greater development in length of the femur and, especially, the tibia (Fig. 1; Table 1). Moreover, the maximum width of the right metafemur is approx. 0.2 mm greater than the left. The right metatibia is also slightly thicker than the left. With regard to the arolia, no clear difference was observed between the right and the left side of the body, in each pair of legs. All arolia in the gynandromorph seem to be similar to the male type on both sides.

Gynandromorphic features are very evident in the abdomen, where the exterior of genital and postgenital segments features the typical side bipartition of primary sexual characteristics: female on the right side and male on the left. This is evident in viii sternite, which forms an abnormal right half of the female subgenital plate, in the ix tergite, x tergite, epiproct, paraprocts, and cerci. The left half of the ix sternite is prolonged in an abnormal left half of the male subgenital plate. On the right side, we can observe the two valves of the ovipositor. The dorsal valve is normal in conformation, while the ventral valve is slightly abnormal and deviated medially (Figs. 2–5, 7, 9, 11, 14).

For comparison, the external morphology of the abdomen's rear end in a normal male and female specimen of *A. aegyptium* (Figs. 6, 8, 10, 12, 13, 15) is illustrated.



Figures 10–15. *Anacridium aegyptium*, dorsal and ventral view, respectively, of the last segments of the abdomen. Figs. 10, 13: normal male. Figs. 11, 14: gynandromorph. Figs. 12, 15: normal female. Abbreviations: see Material and Methods.

Biometric data of the ginandromorph can be compared with original data of the normal male and female specimens of the same species, taken on Italian specimens (Table 2).

DISCUSSION

As in most cases observed for gynandromorph Orthoptera (Nickle, 1983), even in this gynandromorph the external female features of the abdomen are on the right-hand side of the body (which also shows a greater development of the metathoracic leg), while the male features are on the left-hand side. Significant asymmetries of other external somatic structures are not present. The conformation of the last abdominal segments is similar to the gynandromorph of *Schistocerca gregaria* (Forskål, 1775) (albino strain) described by Pener (1964). The specimen of *A. aegyptium* illustrated above can be considered a bilateral gynandromorph, in the current sense of the term.

For the genus *Anacridium*, the only gynandromorph previously reported is a specimen of *A. moestum* (Serville, 1838) from a laboratory colony, which exhibits dorsoventral gynandromorphism (Potter, 1940). This is the first gynandromorph recorded for *A. aegyptium*. Notably, the specimen is field-collected.

According to the review by Nickle (1983) (which completed and updated previous reviews by Chopard (1938), Baccetti (1954) and Uvarov (1966) literature

Sex	Total length			Length of antenna			Dorsal length of pronotum			Length of tegmen			Length of metafemur		
	Mean ± st.dev.	Min	Max	Mean ± st.dev.	Min	Max	Mean ± st.dev.	Min	Max	Mean ± st.dev.	Min	Max	Mean ± st.dev.	Min	Max
Males (n = 20)	44.92 ± 2.31	39.36	48.43	14.44 ± 0.64	12.96	15.28	10.09 ± 0.62	8.78	10.98	47.78 ± 2.09	43.72	51.24	21.70 ± 1.10	19.30	23.86
Females (n = 20)	56.86 ± 4.55	47.70	67.80	16.82 ± 1.03	14.92	18.70	13.06 ± 0.99	10.51	14.40	60.08 ± 3.61	52.44	66.58	28.19 ± 1.82	24.03	31.76
Gynandromorph, right side (F)	49.04	-	-	15.91	-	-	11.80	-	-	49.57	-	-	26.04	-	-
Gynandromorph, left side (M)	48.23	-	-	15.06	-	-		-	-	49.46	-	-	24.85	-	-

Table 2. *Anacridium aegyptium*, biometric data (measured in mm) of normal males and females, compared with data of the gynandromorph (Min = minimum; Max = maximum; st.dev. = standard deviation).

has reported only just over 500 gynandromorphs among Orthoptera, mostly deriving from laboratory stocks or experiments. Fewer than 10% are clearly referable to bilateral gynandromorphism, which is the most extreme form of this phenomenon. Most reports describe ensiferan Orthoptera. As for Caelifera, in which, as mentioned above, this anomaly is morphologically less marked and more easily escapes observation, the instances recorded amount to a few dozen and refer, according to Nickle (1983), to 25 species. The reports are generally solely devoted to the external morphology of the anomalous specimens. The genetical, embryological, anatomical, physiological, developmental and ethological aspects of this phenomenon, which has implication for many realms in general entomology, often remain largely outside the possibility of study.

As far as the determinism of this interesting anomaly is concerned, besides Nickle (1983), see also Laugé (1985), and Massa (2010).

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