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LARVAE OF THE GENUS *ANAX* IN AFRICA (ANISOPTERA: AESHNIDAE)

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10 spp. of the genus have been recorded from Africa and its offshore islands. The larvae of 7 of these are compared in this paper and *A. chloromelas* Ris and *A. congoliath* Fraser are believed to be described for the first time. A simplified key is provided to assist in the identification of the known African species together with the closely related *Hemianax ephippiger* (Burm.).

INTRODUCTION

The fieldwork providing the data for this paper took place in the South West Province of Cameroon in West Africa on two separate study visits: the first in July 1996 and the second in March and April 1997. A total of five weeks was spent in the country concentrating upon the montane rainforests around Mount Kupe. VICK (1996) provides a description of the landscape and climate of the area. In addition to the intensive fieldwork carried out during these periods, Otto Mesumbe, a resident of Nyasoso on the foothills of Mount Kupe, has been carrying out fieldwork on a regular basis as part of the Cameroon Dragonfly Project.

A number of species of *Anax* occur outside the study area and in order to provide comparative data I have examined material (exuviae) in other collections, including the Natural History Museum in London and that of G.S. Vick.

STATUS AND DISTRIBUTION

The genus *Anax* includes some of the largest and most widely distributed of dragonflies. With a total of only 28 species (BRIDGES, 1994) the genus is distributed over all continents with the exception of Antarctica and the more southerly parts of South America. Continental Africa contains 8 species and if the offshore islands are included the list extends to 10 (BELYSHEV & HARITONOV, 1978).

The currently understood status and distribution of the African representatives of the genus is discussed here.

- *A. BANGWEULUENSIS* Kimmins, 1955. — A very local species restricted to Zambia and Botswana. As an adult it is similar in appearance to *A. speratus*. The larva is unknown.
- *A. CHLOROMELAS* Ris, 1911. — Generally considered to be a rare species restricted to Central and West Africa and once from Uganda (PINHEY, 1961). In 1996 we collected larvae of this species (subsequently proved by successful emergence of the adult insect) from a shallow temporary marsh at sea level near Debundsha in Cameroon. In March 1997 we revisited the marsh which proved to be completely dry and transformed by the cultivation of maize and other crops. Clearly it is only in the wet season that the marsh exists and by inference *A. chloromelas* must be univoltine here. Interestingly, adults of this species have now been found on Mount Kupe at an altitude of approximately 1,800 m and in deep forest during the dry season.
- *A. CONGOLIATH* Fraser, 1953. — One of the largest dragonflies on the African continent, this species was described from the Belgian Congo and has been recorded from Zambia and Gabon in addition to Cameroon (VICK, 1996). Unlike other species of the genus, it appears to be restricted to lowland sluggish muddy streams at the edge of rain forest. Larvae were collected from a small stream near the villages of Ndisi and Ngusi in the lowlands near the foothills of Mount Kupe, the first was taken amongst submerged tree roots by the author in July 1996 and was a very early instar. At the time of collection this small larvae was of the most vivid bright green colouration which soon darkened on immersion in alcohol. Collections at the same site later in the year have produced one late-instar and one last instar exuviae. During the study visit of July 1997, despite rigorous searching, no additional larvae were taken.
- *A. GUTTATUS* Burmeister, 1839. — A widely distributed species in the area of the Pacific and Indian Ocean, reach-

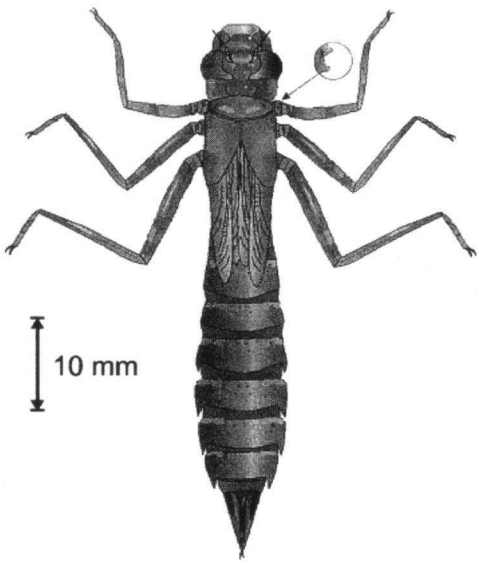

Fig. 1. *Anax congoliath*, dorsal view.

ing as far as the Seychelles and islands off the coast of East Africa. The larva of this species is described by ASAHINA (1974).

- *A. IMPERATOR* Leach, 1815. — PINHEY (1951) describes this species as the commonest aeshnid in Southern Africa. In the Palearctic regions (north of the Sahara), *A. imperator* is common; however in the Ethiopian portions it is replaced by its subspecies *A. i. mauricianus* Rambur, 1842 although Pinhey (1961) casts doubt upon the status of the race. We collected last instar exuviae of *A. imperator* at Crater Lake, Debundsha in March 1997.
- *A. PARTHENOPE* Selys, 1839. — BELYSHEV & HARITONOV (1978) describe *A. parthenope* as occurring in the Ethiopian region. PINHEY (1961) states that the species extends only into British Somaliland and that no Ethiopian examples have been found. PINHEY (1962) contradicts this stating that the species has been recorded from "tropical Africa". For this reason this species has been included here.
- *A. SPERATUS* Hagen, 1867. — This species is found commonly in many parts of Africa from sea level up to 1,600 m and from a wide range of habitats (PINHEY, 1961) although it can best be considered as a species of the savanna. We have found no examples of this species in either of our study visits to South West Cameroon.
- *A. TRISTIS* Hagen, 1867. — A widespread species, found throughout the Ethiopian region, often seen flying over temporary pools. We recorded females ovipositing in the temporary marsh at Debundsha in the company of *A. chloromelas*. However, no larvae of this species have been found on either of our visits nor during the intervening periods. The material examined for this paper is from Nigeria (R. Gambles leg.) and examples from the British Museum (Natural History) London.
- *A. TUMORIFER* McLachlan, 1885. — An endemic species restricted to Madagascar, the larva of which is unknown.

DESCRIPTIONS OF *ANAX* LARVAE OF THE AFRICAN FAUNA

Table I provides measurements of all the species known from Africa. Overall measurements are of last instar exuviae. Ratios stated apply to later instars.

Measurements have been made using a graticule eyepiece within a binocular microscope at × 10 magnification.

In addition to the statistical data, systematic and other features are discussed in the morphological sections below.

OVERALL SIZE AND PATTERNING

A. congoliath and *A. tristis* are similar in size and clearly much larger than any other species. Generally *A. i. mauricianus* and *A. parthenope* are slightly smaller

Table 1
Summary measurements of African *Anax* larvae, in mm

Feature	*imperator*	*i. mauricianus*	*parthenope*	*congoliath*	*tristis*	*chloromelas*	*speratus*	*guttatus*
Number examined of last instar exuviae	20	3	15	1	7	1	4	1
Other instars				2		2		
Overall								
Length (average)	51.3	47.8	48.4	66.0	63.0	54.0	53.6	55.0
max - min	54.0 - 48.0	50.0 - 44.5	52.0 - 45.0		68.0 - 60.0		56.0 - 51.5	
Appendages								
Length of paraprocts	6.2	5.1	5.8	9.0	7.0	5.5	6.0	6.0
Epiproct (end ratio depth / width)	0.48	0.44	0.49	0.90	0.34	0.31	0.60	0.30
Ratio cerci / paraprocts	0.52	0.48	0.51	0.30	0.53	0.51	0.52	0.50
Gonaphyses female only ratio length / seg. length	0.79	0.75	0.67	0.84		0.78		
Epiproct base: male only (ratio length / width)	0.65	0.67	0.45		0.60		0.85	0.60
Abdomen								
Length S1-10	27.5	26.5	27.6	37.0	36.0	27.0	26.3	28.5
Legs								
Tarsi length front	3.1	3.1	3.4	4.0	4.0	3.0	3.0	3.0
middle	3.6	3.2	3.7	4.2	4.2	3.0	3.5	3.5
rear	4.4	3.9	4.2	5.0	5.2	4.1	4.3	5.0
Tibiae length front	6.2	5.8	6.1	8.5	8.0	6.5	6.2	6.0
middle	6.6	6.2	6.5	9.0	8.0	7.5	6.2	6.0
rear	8.5	7.3	8.1	11.0	10.5	8.1	8.2	7.8
Femora length front	5.4	5.2	5.4	7.2	6.0	5.0	6.0	5.5
middle	7.4	7.2	8.0	10.0	9.5	7.0	8.0	7.0
rear	9.9	8.9	9.7	13.0	12.5	8.2	9.0	10.0
Labium								
Length (average)	10.7	10.0	10.1	14.0	15.5	11.0	11.0	12.0
max - min	11.7 - 9.7	10.4 - 9.6	10.6 - 9.5		16 - 15.0			
Premental ratio length / width	1.71	1.85	1.67	2.26	2.00	1.72	1.93	2.11
max - min	1.79 - 1.62	1.86 - 1.85	1.78 - 1.58	2.35 - 2.14	2.00	1.89 - 1.59		
Head								
Width	8.6	8.6	8.4	9.8	10.7	9.2	8.8	9.0
Length	7.0	6.8	7.1	9.2	9.3	7.9	7.3	7.8
Ratio	1.22	1.26	1.20	1.17	1.15	1.16	1.21	1.15

(less than 50 mm long) than the remainder, but the considerable variation in size between species renders this an unreliable feature.

As with most aeshnids, overall markings are extremely variable within each species. Figure 3 shows three abdominal patterns commonly found in the genus. The following descriptions of the species refer to the examples shown in this figure.

A. congoliath — Figure 1 shows this species in full dorsal view. It is generally unmarked. The last instar exuviae is almost black with discontinuous lighter patches

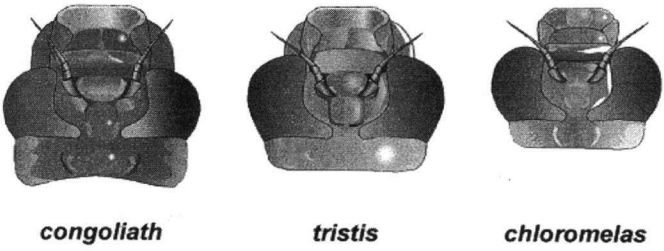

Fig. 2. Heads, dorsal view.

on the sides of the abdomen. The central line is very indistinct. None of the larvae collected shows any evidence of stripes on the abdomen.

A. tristis and *A. guttatus* — The abdominal stripes in both these species are more or less distinct (Fig. 3, pattern 2) straight and extend to the end of abdomen up to segment 10.

A. speratus — Abdominal stripes indistinct to non-extent (Fig. 3, pattern 3). The mid-dorsal light-coloured line (present in other species) is replaced by light-coloured patches, surrounded by dark spots on segments 5 to 8.

A. chloromelas, A. parthenope, A. i. imperator and *A. i. mauricianus* — These species are very difficult to separate on patterning since they are very variable. *A. chloromelas* is clearly striped (Fig. 3, pattern 1). However, such a feature also occurs commonly in both *A. imperator* and *A. parthenope*. *A. imperator* is the most variable as it is often found quite unmarked and without stripes. Early-instar material of *A. parthenope* collected in North Africa (Tunisia) has very spectacular marbled markings but again this marking is occasionally found in *A. imperator*. As with all *Anax* species the base colouring ranges from light or sandy to very dark brown.

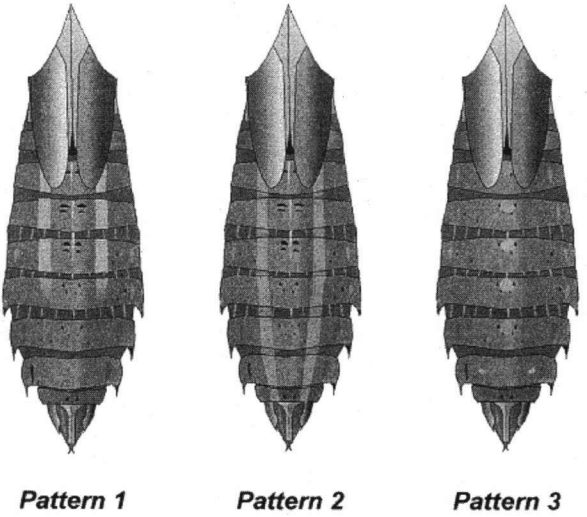

Fig. 3. Typical abdomen patterns.

HEAD

Figure 2 illustrates the heads of three species. *A. congoliath* is quite distinct with its very much smaller eyes and deep occipital region. *A. tristis* has

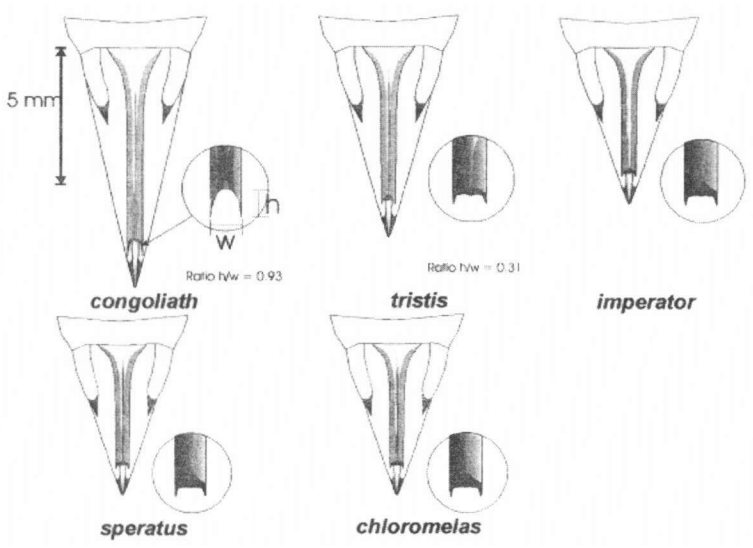

Fig. 4. Anal appendages, dorsal view.

the shape typical of the genus whilst *A. chloromelas* has slightly more conspicuously projecting eyes.

LABIUM

Figures 6 and 7 illustrate a number of labium details which serve to separate the species in the following headings. Terminology is based upon CORBET (1953).

SIZE AND SHAPE OF THE PREMENTUM. — The general aspect of *A. congoliath* is shown in Figure 6. It is conspicuously thin and waisted and extends back as far as the third coxa. In all other species, the premental joint with the postmentum extends slightly beyond the rear of the second coxal joint.

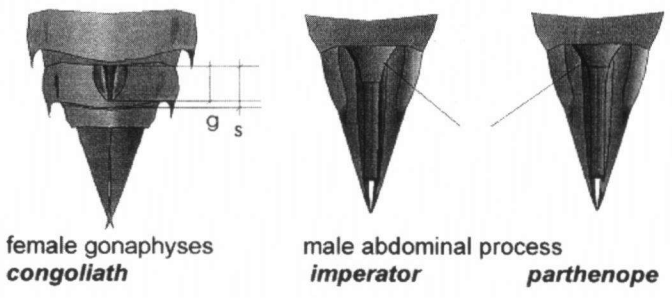

Fig. 5. Anal processes.

DISTAL MARGIN OF THE MEDIAN LOBE. — Figure 7 shows the various species together with their labial palps.

A. congoliath and *A. speratus* possess two dis-

tinct rounded lobes heavily setose. In the remaining species, the margin rises to the median cleft where it splits abruptly, forming one overall lobe (more or less setose). At Debundsha we collected a number of small *Anax* larvae with a conspicuous dark projection at the point of divergence of the median cleft (Fig. 7, *A. chloromelas*). *A. imperator* and *A. parthenope* occasionally have very small rounded projections but never as large as those seen on these small larvae which I have taken to be *A. chloromelas*. Somewhat frustratingly the exuviae F-1 and F-0 from the bred specimen of *A. chloromelas* do not possess these projections.

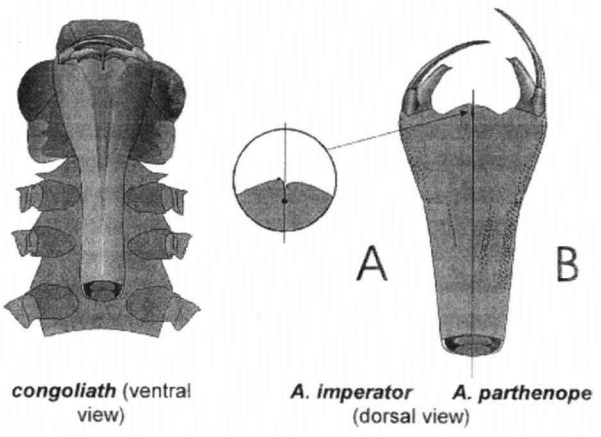

Fig. 6. Prementums.

LABIAL PALPS. — The palps of *A. congoliath, A. tristis* and *A. guttatus* are in the form of pointed and more or less decurved hooks; shallowly curved in *A. tristis* but strongly decurved in *A. congoliath*. In the remaining species the palps form distinct lobes which have small end hooks only. The undersides of the labial palps of all species are more or less crenated. This latter feature is not illustrated.

PREMENTUM, DORSAL VIEW. — The outer margins of the prementum have small

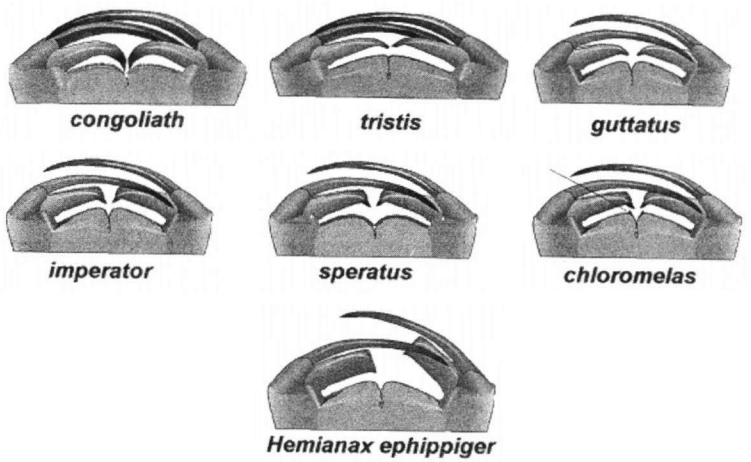

Fig. 7. Labial palps and premental margins.

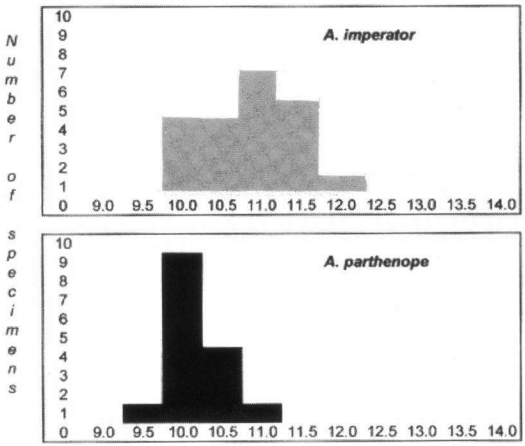

Fig. 8. *Anax imperator* and *A. parthenope*: histograms of mask length.

spines distally and spiniform setae are present on the dorsal surface of the prementum. These features are illustrated in Figure 6. KUMAR (1973) cites the spinous margins of the prementum as a diagnostic feature of *A. parthenope*. This may be true in the Indian region but is not so in Europe or Africa as *A. imperator* and *A. parthenope* both possess such spines and spiniform setae. Generally all three species, *A. imperator, A. chloromelas* and *A. parthenope* are very similar in appearance although *A. imperator* is more likely to have much reduced setae (Fig. 6A). As further guide, the junction at the median cleft (Fig. 6, enlarged detail) is more likely to be rounded in *A. parthenope* than in the other two species.

The main problem with identification is that *A. imperator* is so variable in many systematic characters leading to confusion with other species. An example of this is shown in Figure 8 where the uniformity of length of prementum in *A. parthenope* contrasts with the wide range in size shown by *A. imperator*.

SUPRACOXAL ARMATURE

Figure 1 highlights the position of this process above the first coxal joint. Figure 9 shows the profiles of two species. In *A. tristis* the front lobe is clearly smaller and much less distinct than the rear. In all other species the lobes are essentially equal although in *A. congoliath* it appears to be slightly deeper.

ABDOMEN

A.congoliath is unique in that it possesses lateral spines on segments 6-9. All other species possess lateral spines only on segments 7-9.

ANAL APPENDAGES

Figure 4 shows the dorsal view of the anal appendages of five species. *A. congoliath* is unique in the length of the paraprocts which are clearly longer than any other species. The end of the epiproct is also much more deeply lobed than any

other species. By contrast the epiproct of *A. tristis* has the shallowest lobe of all the African species.

Two other features are relevant with regard to the appendages. In males there is a process above the epiproct which is illustrated in Figure 5. In most species this process is almost as long as wide (ratio l/w > 0.5). Only in *A. parthenope* is this process wider than long (ratio l/w < 0.5).

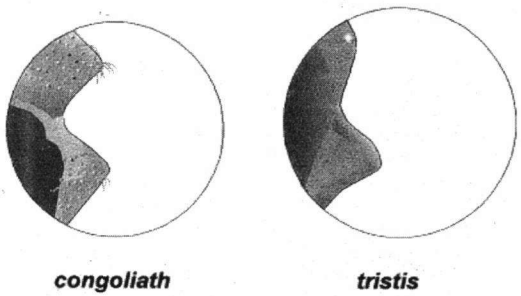

Fig. 9. Supra coxal armatures.

Figure 5 illustrates the female gonapophyses of *A. congoliath* situated ventrally beneath segment 9. The ratio (g/s) as shown in the illustration is given in Table I.

A KEY TO THE LARVAE OF THE KNOWN SPECIES OF THE GENERA *ANAX* AND *HEMIANAX* IN AFRICA

The aim of this key is to assist in identification of larvae in the field. Systematic characteristics in very small larvae can be highly variable and reliable determinations can only be made from the later instars (in excess of 35 mm long). *Hemianax ephippiger* has been included here as it is widely distributed in the African continent and has the overall appearance of an *Anax*. *H. ephippiger* has been described by DE MARMELS (1975). In addition, I have examined material of this species in the Natural History Museum (London). *H. ephippiger* is quite straightforward to identify in last instar as it does not exceed 45 mm in length.

1 Lateral spines present on segments 6-9 ..... ***A. congoliath***
— Lateral spines present on segments 7-9 2
2 Distal margin of prementum clearly two lobed between the median cleft (Fig. 7) ..... ***A. speratus***
— Distal margin of prementum with a single lobe separated by the median cleft (Fig. 7) 3
3 Distal margin of prementum at median cleft with two clear projecting points, one on each side of cleft (Fig. 7). This feature is not reliable in the late larval instars ..... ***A. chloromelas***
— Distal margin without projecting points or at most with very small rounded projections 4
4 Labial palps in the form of decurved pointed hooks 5
— Labial palps in the form of thickened lobes with end points 6
5 Labial palps shallowly decurved pointed hooks (Fig. 7) ..... ***A. tristis***
— Labial palps obviously decurved pointed hooks (Fig. 7) ..... ***A. guttatus***
6 End points on labial palps prominent and conspicuous 6
— End points on labial palps minute to non existent (Fig. 7) ..... ***Hemianax ephippiger***
7 Abdominal process above epiproct (males only) almost as long as wide (Fig. 5) ... ***A. imperator***
— Abdominal process above epiproct (males only) wider than long (Fig. 5) ..... ***A. parthenope***

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