ON THE DISTRIBUTION AND BIOLOGY OF THE GENUS *ANTHRACOCENTRUS* QUENTIN & VILLIERS, 1983 IN THE PERSIAN GULF REGION (Coleoptera, Cerambycidae, Prioninae)

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Abstract. New data on the biology and distribution of *Anthracocentrus rugiceps* (Gahan, 1894) and *Anthracocentrus arabicus* (Thomson, 1877) in the Persian Gulf region is presented. A key to separate the two species is given. *Anthracocentrus rugiceps* ssp. *hardei* (Heyrovský, 1959) is synonymised with the nominotypical species, *Anthracocentrus rugiceps* (Gahan, 1894).

Résumé. Dans cet article, nous apportons des précisions sur la biologie et la répartition d'*Anthracocentrus rugiceps* (Gahan, 1894) et d'*Anthracocentrus arabicus* (Thomson, 1877) dans la région du Golfe Persique. Une clé pour séparer les deux espèces est également donnée. La sous-espèce *Anthracocentrus rugiceps* ssp. *hardei* (Heyrovský, 1959) est maintenant mise en synonymie avec *Anthracocentrus rugiceps* (Gahan, 1894).

Key words : Coleoptera, Cerambycidae, Prioninae, Acanthophorini, *Anthracocentrus*, *A. arabicus*, *A. modicus*, *A. rugiceps*, *A. rugiceps* ssp. *hardei*, new synonymy, biology, geographic distribution, the Gulf Region, the Persian Gulf, the Arabian Gulf, United Arab Emirates, Bahrain, Oman, Iran.

Introduction

The Persian Gulf lies between the Arabian Peninsula and southwest Asia. It is connected by the Straits of Hormuz to the Arabian Sea, the northwest part of the Indian Ocean. The Gulf is a relatively shallow body of water, with a maximum depth of 90 metres, while the average depth is 50 metres, and due to hydrological conditions does not develop high waves. It is bordered by Iran, Iraq, Kuwait, Saudi Arabia, Bahrain, Qatar, the United Arab Emirates and Oman. In western countries it is referred to as the Persian Gulf, while in most Arabian countries it is called the Arabian Gulf. In this report, the region will henceforth be referred to as the Gulf.

The genus *Anthracocentrus* Quentin & Villiers, 1983 comprises six species (QUENTIN & VILLIERS, 1983 ; LACKERBECK, 1998) distributed mainly in the African continent and via the Middle East and Arabian Peninsula, extending their range to Iran, Pakistan and India. In the Gulf Region, two species of this genus are recognised : *Anthracocentrus arabicus* (Thomson, 1877) and *Anthracocentrus rugiceps* (Gahan, 1894). Neither the biology nor the distribution of either species is well known.

However, recently both species have been captured on opposite sides of the southern Gulf region ; *A. arabicus* in the United Arab Emirates and *A. rugiceps* in Iran. The circumstances relating to these captures together with observations on their biology are presented here together with keys to separate the two species.

Plate I (Photos : M. REJZEK) **:**
Figure 1 : S IRAN, prov. Hormozgan, Hasan Langi. A typical habitat of *Anthracocentrus rugiceps* (Gahan, 1894) ; Figure 2 : S IRAN, prov. Hormozgan, Hasan Langi. A typical habitat of *Anthracocentrus rugiceps* (Gahan, 1894) with a dead *Acacia* tree, the suspected host ; Figure 3 : S IRAN, prov. Hormozgan, Hasan Langi. Living female of *Anthracocentrus rugiceps* (Gahan, 1894) walking on the ground ; Figure 4 : S IRAN, prov. Hormozgan, Hasan Langi. Living male of *Anthracocentrus rugiceps* (Gahan, 1894) on a dead *Acacia* tree.

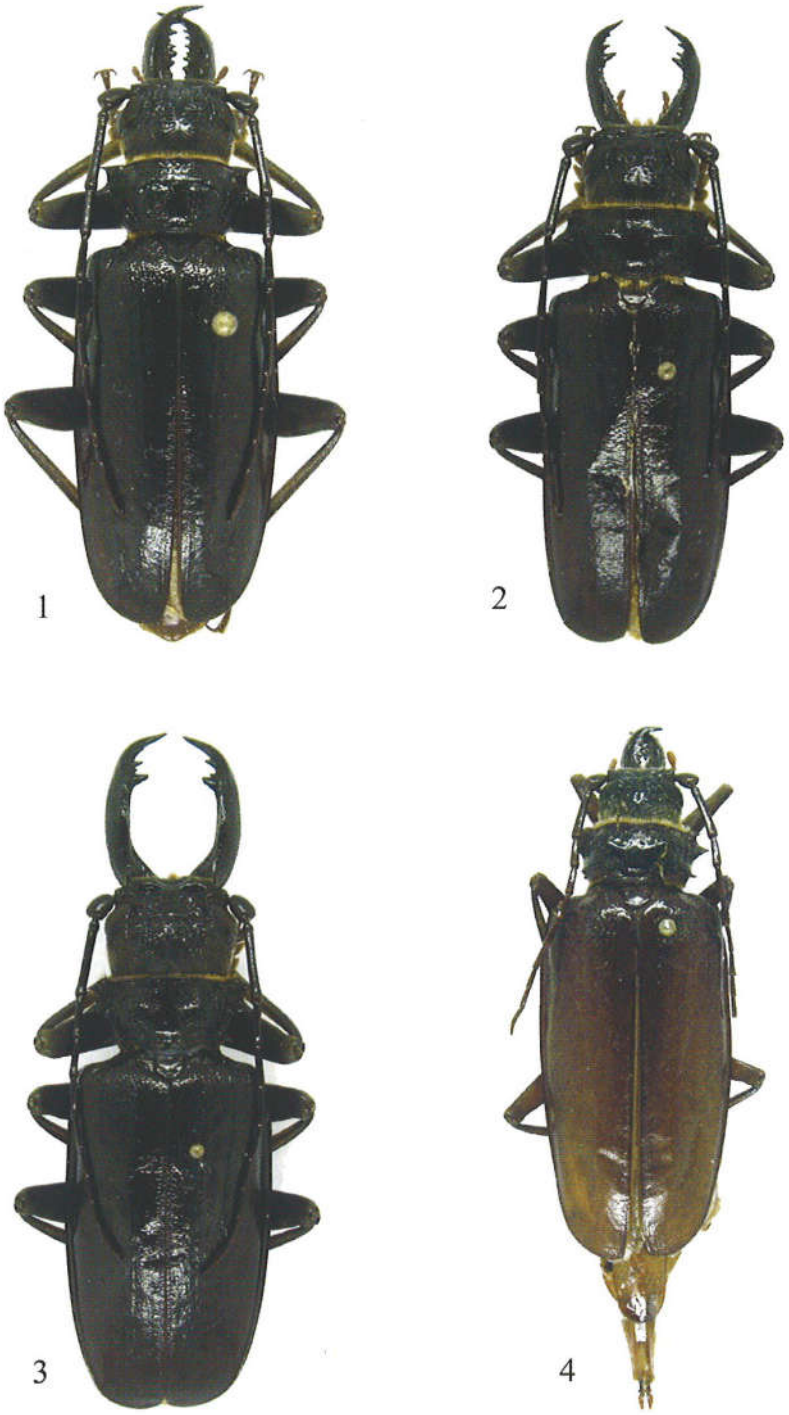

Plate II (Photos : M. REJZEK) **:**
Figure 5 : Small male of *Anthracocentrus rugiceps* (Gahan, 1894). Body size (incl. mandibles) : 47 mm ; Figure 6 : Medium male of *Anthracocentrus rugiceps* (Gahan, 1894). Body size (incl. mandibles) : 57 mm ; Figure 7 : Large male of *Anthracocentrus rugiceps* (Gahan, 1894). Body size (incl. mandibles) : 84 mm ; Figure 8 : Paratype female of *Anthracocentrus rugiceps* (Gahan, 1894) ssp. *hardei* Heyrovský, (1959). Body size (incl. mandibles) : 49 mm from mandibular to elytral apex (extended ovipositor not included). Staatliches Museum für Naturkunde, Stuttgart, Germany.

Results

Based on literature data and on our own observation *A. arabicus* and *A. rugiceps* can be distinguished using features summarised in the key below. It is worth mentioning that both species are markedly variable (see Plate II, Figures 5 to 8 and Plate IV, Figures 12 to 15) and for the purpose of constructing the key, many features have been studied and their variability assessed. Only features that remained relatively stable in all the studied specimens have been selected. Sexual dimorphism in both species is very pronounced and for this reason we decided to construct two separate keys, one for males and another for females.

Key to *Anthracocentrus* species of the Gulf Region (males only)

1 Head on vertex strongly rugose to wrinkled, interocular space bounded on each side by prominent supra-orbital ridges continued back a short distance beyond the eyes, labrum strongly triangular, clypeus bearing short erect setae at the middle becoming longer and recumbent towards the sides, pronotum strongly transverse, on average prosternal process more pointed at apex, lateral lobes of aedeagus usually long and narrow, oval in cross-section ..... ***A. rugiceps***

\- Head on vertex smooth and glabrous, supra-orbital ridges feebly raised and not continued back beyond the hind margin of the eyes, labrum rounded, clypeus bearing erect setae only, usually very short, pronotum less strongly transverse, on average prosternal process more rounded at apex, lateral lobes of aedeagus usually short and stout, flattened in cross-section ..... ***A. arabicus***

Key to *Anthracocentrus* species of the Gulf Region (females only)

1 Clypeus bearing short erect setae at the middle becoming longer and recumbent towards the sides, on average the pubescence of the clypeus is much richer, labrum usually triangular, pronotum strongly transverse, on average prosternal process more pointed at apex ..... ***A. rugiceps***

\- Clypeus bearing very short erect setae, towards the sides some longer setae may be present but then they are always erect, on average the pubescence of the clypeus is much sparser, labrum usually rounded, pronotum less strongly transverse, on average prosternal process more rounded at apex ..... ***A. arabicus***

Anthracocentrus rugiceps (Gahan, 1894)

Acanthophorus rugiceps Gahan, 1894, *Annals and Magazine of Natural History,* 6 (14) : 223. Type loc. : Bombay ?

= *Acanthophorus rugiceps* ssp. *hardei* Heyrovský, 1959, *Stuttgarter Beiträge zur Naturkunde*, 25 : 2. Type loc. : Südost-Iran, Makran, Chabahar ; Iranshar. **(syn. n.).**

Material examined :

- male **type** of *Acanthophorus rugiceps* ssp. *rugiceps* : body size 76 mm including mandibles, 60 mm without mandibles, labelled "*Acanthophorus rugiceps*, male, type, Gahan" square white paper, black ink, hand written, further "Syn-type" blue oval label with white centre, printed, further "Type" red oval label with white centre, printed, further "4b b" white oval label, hand written, no locality data, the specimen is well preserved, only right antenna 3 segments missing, left antenna 8 and a half segments missing, the type is preserved in the NHM London,

- type material of *Acanthophorus rugiceps* ssp. *hardei* Heyrovský, 1959 : 1 **paratype** male, body size 67 mm including mandibles, 57 mm without mandibles, labelled "*Acanthophorus rugiceps* Gah. ssp. *hardei* m. Paratyp male Det. Dr. L. Heyrovský" rectangular white paper, black ink, hand written and printed, further "COTYPUS" rectangular red paper, printed, further "IRAN Belutschistan Jranshar 800 m 18.V.1954 Richter u. Schäuffele leg." rectangular pale green paper, printed and hand-written, the specimen is well preserved, only 3 segments of left antenna and right metatarsus are missing, the type is preserved in the Staatliches Museum für Naturkunde, Stuttgart, Germany ; 1 **paratype** female, body size 49 mm from mandibular to elytral apex (extended ovipositor not included), 43 mm without mandibles, labelled "*Acanthophorus rugiceps* Gh. ssp. *hardei* m. paratyp female Det. Dr. L. Heyrovský" square white paper, black ink, hand written and printed, further "COTYPUS" rectangular red paper, printed, further "IRAN Belutschistan Jranshar 800 m 11.-21.V.1954 Richter u. Schäuffele leg." rectangular pale green paper, printed, the specimen is well preserved, only 1 segment of right antenna is missing, the type is also preserved in the Staatliches Museum für Naturkunde, Stuttgart, Germany,
- **Iran** : 7 males (body size 45-84 mm including mandibles), S IRAN, prov. Hormozgan, Hasan Langi E Bandar-e Abbas, 27°23'N 56°50'E, 155 m, 17-19.VII.2004, lgt. & det. (2004) M. Rejzek ; 1 very damaged female (without elytra and abdomen, one leg and some antenna articles missing), same data, lgt. & det. (2004) M. Rejzek.

A. rugiceps is a widely distributed species with a range extending from India via Pakistan and south-eastern Iran (VILLIERS, 1967), as far west as southern Iran. Further west it is replaced by *A. arabicus*. The male type of *A. rugiceps* lacks locality data, but in GAHAN (1894 and 1906) the type locality is given as "Bombay (?)".

The separation of *A. rugiceps* ssp. *hardei* (Heyrovský, 1959) from the nominotypical species is based on the much larger body size, on the elytral puncturation that, according to the author, should be evenly coarse in the basal quarter, and on the lack of a closely punctured spot situated close to the base of each elytron.
With regards to the body size, HEYROVSKÝ (1959) gave 87 mm for the largest male specimen of the new subspecies *hardei* and compared it to 60 mm for the type male specimen of the nominotypical *A. rugiceps*. The body size of 60 mm for *A. rugiceps* was published in GAHAN (1906). However, in the original description, GAHAN (1894) clearly states 60 mm as the body size plus 16 mm for mandibles. From this we believe that Heyrovský actually never saw the type specimen of *A. rugiceps* and it is evident that Heyrovský's male holotype of *hardei* was measured to include the mandibles. In our material collected in southern Iran, specimens ranging from 45 to 84 mm (including mandibles) were found. This clearly indicates the high extent of variability in the body size and the limited diagnostic value of this feature.
As for the sculpture of the basal quarter of the elytra, in the *hardei* paratype male the elytral punctuation is evenly coarse, rather sparse and the elytra generally appear somewhat shiny. The elytral base in the type male of the nominotypical species are definitely more coarsely punctured. However, this feature is highly variable and in specimens originating from southern Iran, elytral sculpture ranges from being smooth, shining and sparsely punctured to being shining and rugosely punctured. It is therefore apparent that this feature is also of very limited or no diagnostic value.
The last argument given by Heyrovský, the lack of a closely punctured spot situated close to the base of each elytron, holds to some extent on examination of his male paratype. In the type specimen of *A. rugiceps* this spot is much more apparent. On the other hand in Heyrovský's female paratype, this spot is very well developed. Unfortunately this fact has not been mentioned in Heyrovský's description.

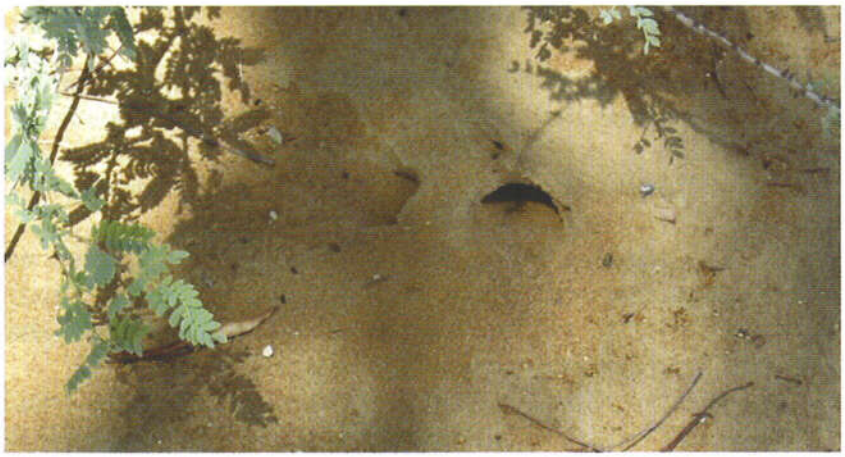

Plate III (Photos : C. GILLETT) **:**
Figure 9 : UAE, Wadi Towayya. A typical habitat of *Anthracocentrus arabicus* (Thomson, 1877) showing live *Prosopis cineraria* trees, the suspected host ; Figure 10 : UAE, Wadi Towayya. Suspected emergence holes of *Anthracocentrus arabicus* (Thomson, 1877) ; Figure 11 : UAE, Wadi Towayya. Living male of *Anthracocentrus arabicus* (Thomson, 1877).

In our specimens originating from southern Iran, this spot clearly shows a high degree of variability, from being very well developed to nearly completely missing. In *A. arabicus* and in the African species *A. capensis*, this pattern is analogous. The closely punctured basal spot is developed to a variable extent in males. In females, it is usually much more apparent. For these reasons we believe that this feature cannot be used to separate a subspecies.
To conclude we believe that the population originating from Iran easily falls within the variability of the nominotypical species and consequently we synonymise here ssp. *hardei* with the nominotypical *A. rugiceps*.

According to the literature (HEYROVSKÝ, 1959 ; VILLIERS, 1967) and the recent collection data from southern Iran, adults of *A. rugiceps* can be found from late March until August with a maximum abundance in May. The host plant, larvae and life history of this species are unknown. Here we wish to report our own observations of this spectacular species.

In Iran *A. rugiceps* inhabits the Saharo-Sindian (or Nubo-Sindian according to some authors) region also referred to as the South Iran Nubo-Sindian desert and semi-desert. This region is restricted to the lowlands surrounding the Gulf and its vegetation comprises plants such as *Acacia*, *Prosopis*, *Ziziphus*, *Calotropis* and *Phoenix dactylifera*. In 2004, several specimens of this impressive beetle were collected in Hasan Langi situated to the east of Bandar-e Abbas in southern Iran.

The habitat of the beetle (Plate I, Figures 1 and 2) is an alluvial plain stretching to the right hand bank of a seasonal river. The high salinity of the soil was reflected by the presence of a variety of halophilic shrubs and herbaceous plants. Trees were represented by scattered *Phoenix dactylifera* and *Prosopis spicigera* but the habitat was dominated by various species of *Acacia*. Large dead standing *Acacia* trees could occasionally be found. Such trees were usually heavily infested by a variety of xylophagous insects such as *Gnatholea soraya* Villiers, 1974 (Coleoptera : Cerambycidae) and it is very likely that these trees also serve as the host for *A. rugiceps*.

In the second half of July, most adults found at Hasan Langi were already dead. The species is strictly nocturnal and during the day, when July temperatures frequently reach over 40°C, living males were found hiding under loose bark of the host trees or in convenient crevices formed by lateral branches and the main trunk. The males showed a tendency to hide high in the tree canopy. Females on the other hand were never found directly on the dead trees. It is believed that due to the significantly larger body size the females are prevented from climbing the trees and prefer therefore to remain on the ground most of the time. It is likely that they spend the daytime hiding in low vegetation or other convenient concealed places.

On the ground or in low vegetation growing under the dead *Acacia* trees, the bodies of dead adults in various stages of disintegration were frequently found. The soft tissues of the dead insects had been consumed by insectivorous animals, mainly by ants. The vast majority of the dead insects were found in close proximity to the dead trees and were males. Only a single female specimen in a high degree of disintegration was found. On the other hand, focused searches of the ground directly surrounding the tree trunks did not reveal any live specimens during the day.

At night the males start to emerge from their hiding places, and shortly after sunset, one male was observed descending from the canopy down the main tree trunk (Plate I, Figure 4). Later at night more males and one female were found walking randomly on the ground, in no apparent proximity to any of the dead *Acacia* trees. No adults were attracted to a strong source of artificial light. None of the trees inspected in this locality show any apparent damage caused by the larvae of *A. rugiceps*. It is therefore likely that larvae of this insect feed underground on roots of the dead or dying host plants. However, no larval tunnels, exit holes or females ovipositing into the soil were observed to confirm this.

One very large female found walking on the ground exhibited a very unusual defence behaviour. The insect, sensing the presence of danger, raised its large body on the strong legs and opened the strong mandibles, then kept walking unceasingly towards the moving source of the disturbance (Plate I, Figure 3).

Anthracocentrus arabicus (Thomson, 1877)

Acanthophorus arabicus Thomson, 1877, *Rev. Mag. Zool.*, 3 (5) : 266. Type loc. : Arabia, Djeddah.

= *Acanthophorus vicarius* Lameere, 1912, *Mém. Soc. ent. Belg.*, 21 : 173. Type loc. : Egypt.

= *Nothophysis rugosiceps* Pic, 1925, *Bull. Soc. Royale Ent. Egypte* : 404. Type loc. : Haute Egypte, Abou Simbel temple. Remark : in the original description of *Nothophysis rugosiceps*, the author stated that the single specimen collected was a female, however, the figure published in this paper was in fact of a male.

Material examined :

- female **type** of *Acanthophorus arabicus* : body size 69 mm including mandibles, 64 mm without mandibles, labelled "*Arabicus* Th. Type T. C. 18, Djedda, Arabia" rectangular white paper with orange border line, black ink, hand written, further "Th. type" rectangular white paper with black border line, printed, further "Type" red rectangular paper, printed, further "Museum Paris, Coll. Thomson 1952" blue rectangular paper, printed, the specimen is well preserved, only the last tarsomers of the hind legs are missing, the type is held in the MNHN of Paris,

- **United Arab Emirates** : 93 males (body size 28–86 mm including mandibles) and 22 females (body size 50–95 mm including mandibles) females, Wadi Towayya, Al Ain (Abu Dhabi), 23.IX.2004 to 8.XI.2004, lgt. C. & M. Gillett, det. M. Rejzek, 2004, including 7 males (body size 28-74 mm including mandibles) and 2 females (body size 61-85 mm including mandibles) in coll. M. Rejzek ; 1 male, same locality, 12.XII.2003, lgt. B. Howarth, det. M. Gillett, 2004 ; 2 very defective males (in the first specimen head and most of tarsi missing, in the second one head, abdomen and most of legs missing), Fili / Al Madam, 5.V.1984, lgt. J.N.B. Brown, det. A. Drumont, 2004 in coll. NHM London ; 2 females, Sweihan, Abu Dhabi X.1993 or 1994, det. B. Tigar ; about 80 dead specimens, Wadi Towayya, XII.1996, XII.2003 and IX. to XI.2004, lgt. M. Gillett ; 1 female (body size 72 mm including mandibles), 30.IX.1993, NARC (note by authors : National Avian Research Centre, NARC, is located on the outskirts of Sweihan, just over 100 km from Abu Dhabi), det. J. Boorman, in coll. NHM London ; digital images of 1 male from Sharjah 01.X.2004 were also determined as *A. arabicus*, det. M. Gillett,

- **Oman** : 5 dead specimens, Al Khal, lgt. & det. M. Gillett ; digital images of 1 male from Jebel Huwarrah 07.X.2004 were also determined as *A. arabicus*, det. M. Gillett,

- **Bahrain** : 1 female (body size 78 mm including mandibles), Sharjah, 19.X.1970, in dry sandy well, lgt. M. D. Gallagher, det. M. I. Russell, 1972, in coll. NHM London. 1 male (body size 66 mm including mandibles), Sharjah, III-1973, dead adult, leg. M.D. Gallagher, B.M. 1973-236, det. A. Drumont, 2005, in coll. MHM London.

According to QUENTIN & VILLIERS (1983), *A. arabicus* is distributed in Saudi Arabia, Egypt, Sudan, Djibouti, Ethiopia and part of the Sahara (southern Algeria, Northern Chad). The species has been recorded from Yemen (FAIRMAIRE, 1888 ; LAMEERE, 1910 ; HOLZSCHUH, 1993) and from Somalia (HOLZSCHUH, 1993). It has also been recorded from Israel (BYTINSKI-SALZ, 1956 ; HALPERIN & HOLZSCHUH, 1993) and more recently from Jordan (SAMA *et al.*, 2002).
Based on literature, *A. arabicus* is reported to be associated with *Ficus* in Africa (VILLIERS, 1946), *Acacia* spp., *Tamarix articulata* and *T. aphylla* in the Sahara (MATEU, 1972 *in* SAMA *et al.*, 2002) and with *Acacia* spp. in Israel (probably feeding on the main roots) (HALPERIN & HOLZSCHUH, 1993). Adults of *A. arabicus* can be found from July to October and are frequently attracted to light (SAMA *et al.*, 2002).

The occurrence of very large longhorn beetles corresponding to *Anthracocentrus arabicus* in the territory of the UAE seems to have been established in the 1980's not just from the collection by BROWN of the two dead and incomplete specimens that are now in the Natural History Museum London (see Material examined), but also from a live male specimen. This was figured as a 'ground' beetle by JONGBLOED (1991) and a photograph of the same specimen was later published and discussed in *Gazelle* – the Newsletter of the Dubai Natural History Group - (August/September 1999). In the early 1990's, the National Avian Research Council (NARC) was set up in Abu Dhabi and engaged in collecting insects in relation to the diet of the endangered Houbarra Bustard (*Chalmydotis undulata*). The NARC collection eventually included two correctly identified female specimens of *A. arabicus* collected in October 1993 or 1994 from the Sweihan region of Abu Dhabi (TIGAR, 1996), which are now in the Environmental Research and Wildlife Development Agency (ERWDA) collection in Abu Dhabi. A third unprepared and incomplete NARC specimen from the early 1990's and labelled Dubai (with no further data) has since been lost. Except for one small and very incomplete dead male specimen collected in Wadi Towayya on the northern outskirts of Al Ain in December 1996 by one of the authors (Mike GILLETT) and some hearsay reports of very large beetles in the neighbouring Masoudi and Mraijeb residential areas of Al Ain in October of the same year, the beetle remained little known in the UAE until December 2003.

On the 12th of December 2003, as part of an environmental National Clean-up Day, a party of school children and adults lead by Dr. Brigitte HOWARTH visited Wadi Towayya. During the operation, a number of dead male *A. arabicus* were found at the foot of *Prosopis cineraria* trees and a small live male was found hiding under loose bark near to ground level. This material was generously given by Dr. HOWARTH to Michael GILLETT for study. Subsequently, the site was revisited several times over the next few months and a total of 59 dead beetles were eventually recovered. These included 41 males (size range 4.2 – 8.5 cm) and 18 females (size range 7.0 – 10.5 cm). Virtually all of the dead specimens were collected from the foot of *Prosopis* trees. Except for the two largest female specimens which were extensively bleached and, therefore, probably one or more years old, all others seemed to be recently dead. Many were relatively complete and showed no signs of predation, but had in most cases been scavenged by ants or occasionally gnawed by rodents.

In 2004, a determined effort was made to study the occurrence of *A. arabicus* in Wadi Towayya. The Wadi runs along the northern edge of Al Ain from Al Foha (formerly Al Oha) in the east to the Airport Road and beyond. On the south side is a new dual-carriageway road and residential districts and to the north, sand dunes with little vegetation except for some sedges and saltbushes. Within the wadi bed and along the

sides are numerous scattered clumps of *Prosopsis cineraria* trees with no other plants except for occasional saltbushes, *Zygophyllum qatarense*. *P. cineraria* is treated as native to Arabia only in the UAE and Oman by JONGBLOED (2003). Known as '*ghaf*' in Arabic, it is commonly used in afforestation schemes in the UAE with small plantations in cities and along roadsides and very large ones in remote desert areas. It occurs naturally both in the mountains, where it often grows along the sites of underground streams, and in clumps forming open woodland in sandy desert areas.
One such area of trees in Wadi Towayya was chosen as the study area as it had yielded a good number of dead specimens of *A. arabicus* the previous year. It consists of one fallen and about 100 standing live trees (estimated to be less than 0.5% of the total number of *ghaf* trees in Wadi Towayya) alongside a 80 m stretch of sand-track on the north side of the wadi in an area that has been extensively used to dump rubbish from nearby construction sites (Plate III, Figure 9).

When first visited on 16 September 2004, no beetles were found, but a week later a single live male was found beneath a piece of board at the base of one of the trees. It was decided to move other boards, pieces of sacking and large rags from the dumped rubbish to the base of different trees within the study area. In all some six boards and ten pieces of sacking or rags were thus moved. The site was then revisited every morning except one for the next four weeks. The materials placed at the bases of the trees were carefully turned over, and the whole site examined for beetles.
Remarkably over the course of this period (23 September – 18 October, 2004), a total of 94 live specimens of *A. arabicus* were collected, as well as a smaller number of dead examples. The specimens were removed from the habitat to be measured and weighed in the laboratory. With this method, there was no possibility of measuring the same example twice. All but six of the live beetles were collected from beneath the materials placed at the tree bases, usually on the ground or occasionally clinging to the back of the sacking or rag. Of these six, three were moribund females with extended ovipositors and a fourth was a severely damaged male (see below) all collected on the ground together with all of the dead beetles. The other two specimens were males found beneath bark and in termite-damaged wood respectively about 0.5 m above the soil level. Examination of all trees in the study area revealed no traces of damage or emergence holes that could have been caused by *A. arabicus*, suggesting that the larvae of this species in Wadi Towayya feed on the roots of living *Prosopsis* trees. During the study period, characteristic burrows near to such trees (not seen at other times) were observed ; these very possibly represent the emergence holes of the adult insects (Plate III, Figure 10).

After collection, the length of each live specimen was measured (tip of the abdomen to the front of the mandibles) and in many cases they were also accurately weighed with a top-pan laboratory balance. Data from this collection are shown in graphs A, B, C and D, and give respectively the number of live males and females caught daily, the size range of live beetles of both sexes for each week of collection and the cumulative numbers of live and dead beetles.
These data indicate that following the first appearance of the adult beetles in late September, there was a steady, almost daily, emergence of fresh examples over the next four weeks (graph A). Furthermore, the number of recorded males is far greater than females and this preponderance occurred each week, although it may have been most marked in the first two weeks.

The marked variation in body length of live captured male beetles (32 – 86 mm) and, to a lesser extent, females (50 – 95 mm) is also shown in graph B, which also indicates that small and large individuals appear together throughout the study period. The cumulative totals of beetles recorded (graphs C and D) suggest that overall, the Wadi Towayya site may host several thousand examples of *A. arabicus* annually if all patches of *ghaf* trees harbour the species.
The small number of dead beetles recorded during September-October 2004 is due to the removal of all live specimens and contrasts with the previous year's findings of large numbers of dead specimens.
Not shown are the data for body weight, which ranged from 15.20 g for the largest female to 0.74 g for the smallest male specimen. Following the four weeks of intensive collecting described above, the study site was revisited a further 12 times during the subsequent five weeks, during which another 21 live (13 males and 8 females) and three dead (2 males and 1 female) beetles were collected. However, no fresh live beetles were found after 8 November, although one specimen with a missing leg captured on 18 October and subsequently released back at the site was continually re-found until the last visit made on 15 November.

In the light of the above collecting data dealing with large numbers of live and dead beetles from a single site, some observations on their behaviour and other aspects of their biology are in order.
Firstly, in this species both males and females when disturbed during daytime showed a remarkable threat display, which consisted of raising the front of the body, opening the mandibles wide and rapid pivoting movements to confront visually perceived threats (Plate III, Figure 11). This behaviour was also observed with a female of *A. rugiceps* collected in Iran (see above). At this stage, both sexes would very often bite hard onto any object, such as a twig or the rim of a plastic collecting tube, placed near to the mandibles.
Secondly, there is both direct and indirect evidence that males fight each other. Two captured medium sized male beetles were inadvertently put together in a glass dish at evening time and immediately raised themselves on their forelegs and began to attack each other. Intervention to put a stop to the proceedings resulted in breakage of the dish and Michael GILLETT sustaining a painful bite to the tip of a finger with bleeding from beneath the fingernail. One of the two beetles lost a foreleg in this encounter and was released back into the study site as noted above. Given the preponderance of males over females that the collecting data of both live and dead beetles shows, it is obvious that competition for mating must be intense and the possession of enlarged mandibles and noticeably stouter legs in males would seem to be adaptations for battling rivals. The collection of the severely damaged dying male mentioned above fits this picture. The male in question was large (75 mm) and had seemingly not been attacked by a predator, but in some fashion it had contrived to loose half of its right mandible, the entire left rear leg and the claws from the remaining five legs. The injuries may well have resulted from an encounter with a more powerful male on the trunk of a nearby tree, causing the damaged beetle's displacement to the ground below. No instances of mating of *A. arabicus* were ever observed in Wadi Towayya, but one pair of very large specimens captured on the bottom of a tree trunk under sacking, were in an apparent post-copulatory position with the male above the female and gripping her with the forelegs.

Thirdly, the capture of so many beetles and their confinement in collecting tubes has shown that the beetles are unlikely to feed as adults since no faecal pellets were ever observed in the tubes even after an interval of more than a day.
Fourthly, the data obtained and the other observations made suggest that these beetles in Wadi Towayya are surprisingly not subject to any obvious predation by birds since most dead specimens found were remarkably intact and above all retained their abdomens, the most nutrient-packed part of the insect. It seems likely from the data that males may live for at least a month and may on average emerge earlier in the season than females (graph A), whereas females may be shorter-lived and die soon after oviposition. A further observation of these beetles is that although they are strictly nocturnal, they have never been found at light in the Wadi Towayya area, either nearby bright street lights or mercury vapour light traps, even though the specimens mentioned from Sweihan were said to have been collected at lights.
Lastly, it has to be emphasised that in the UAE and nearby parts of Oman, *A. arabicus* seems to be quite closely associated with clumps of *ghaf* trees growing in sandy areas and not with other tree species or with *ghaf* trees in the mountains or in artificial plantations. In Al Ain, planted *Ficus* are very common as too are small plantations of *ghaf*, but despite many searches no evidence of *A. arabicus* has been found, neither does the beetle seem to occur in areas such as Ain al Faydah where *Tamarix aucheriana* is a dominant bush or small tree. On the other hand, away from Wadi Towayya, in other areas of natural *ghaf* woodland at Sweihan (Adu Dhabi), on the outskirts of Sharjah and Dubai cities and on plains in northern Oman (Jebel Huwarrah and Al Khal) the beetle is clearly present.

Anthracocentrus modicus (Gahan, 1894)

Acanthophorus modicus Gahan, 1894, *Annals and Magazine of Natural History*, 6 (14) : 222. Type loc. : Lahore in the Punjab.

Material examined :
male **type**, body size 49 mm including mandibles, 45 mm without mandibles, labelled "Acanthophorus modicus, male, type, Gahan" square white paper, black ink, hand written, further "Syn-type" blue oval label with white centre, printed, further "Type" red oval label with white centre, printed, further "Punjab" white oval label, hand written, the specimen is well preserved, only right antenna 1 segment missing, left antenna 2 segments missing, right protarsus composed of two basal segments only, the type is preserved in NHM London.

For the sake of completeness, the type material of *Anthracocentrus modicus* (Gahan, 1894) was also inspected. The species was described from Lahore in the Punjab in northern Pakistan.
The type of *Anthracocentrus modicus* differs from *A. rugiceps* in the head being almost impunctate in front and upwards along the middle, in the supra-orbital ridges being feebly raised and not continued back beyond the margin of the eyes, in the interocular space being rather less than half of the whole width of the head, in the labrum being rounded, and in the base of the elytra being sparsely punctured with no distinct closely punctured spot situated close to the base of each elytron.
Surprisingly, *Anthracocentrus modicus* is more similar to *A. arabicus*, from which it differs in having a proportionately smaller head (the interocular space rather less than half of the whole width of the head), in the prosternal process being pointed at the apex, and in the noticeably smaller mandibles.

Discussion

Detailed information about the occurrence and biology of beetles belonging to the genus *Anthracocentrus* in the Arabian Gulf region has not previously been available. The present study documents the presence of the two species *A. rugiceps* and *A. arabicus* on opposite sides of the lower Arabian Gulf in southern Iran and the UAE, respectively. Both the males and the females of these two species in the region are well differentiated and a key has been provided to separate them. Furthermore, from examination of the Types and of material collected in southern Iran, it has been found necessary to synonymise *A. rugiceps* ssp. *hardei* (Heyrovský, 1959) with the nominotypical *A. rugiceps*.

The present findings have not shown *A. rugiceps* and *A. arabicus* to occur sympatrically in the study area. However, in the lower Gulf region, the two are separated from each other essentially only by the shallow waters of the Gulf. The two species could at least in theory be sympatric in the northern Gulf region, but as there are no records of either species from eastern Saudi Arabia, Kuwait, southern Iraq or south-western Iran, this supposition seems improbable. In other congeners, a distinct separation of distribution areas is well documented (QUENTIN & VILLIERS, 1983). Thus *A. capensis* (White, 1853) occurs in south-western Africa (Republic of South Africa, Namibia, Angola), *A. beringei* (Kolbe, 1898) in eastern Africa (Kenya, Tanzania, southern parts of Ethiopia and Somalia), *A. nigerianus* Lackerbeck, 1998 in west Africa (Nigeria) and *A. arabicus* in the northern part of the African Continent (Egypt, Sudan, southern Algeria, Djibouti, northern Chad and the northern parts of Ethiopia and Somalia).

In geological terms the Gulf region has experienced dramatic changes during the last half million years. There have been several periods during which the Gulf has been dry-land traversed only by the Euphrates / Tigris river system, which would have emptied into the Gulf of Oman through the Strait of Hormuz (GLENNIE, 1996), well below the areas where the beetles are presently found. These past events have corresponded with the last five major periods of glaciation in the northern hemisphere, the last of which occurred only 18,000 years ago when sea levels were some 120 m below those of the present day. There is very little information on the climate and vegetation of the Gulf region during the cold periods. Very likely however the arid and warm habitats required by the species in question would have been suppressed substantially towards the south. Although there is no direct proof, it still seems quite probable that the distribution of *A. arabicus* and *A. rugiceps* could once have overlapped in the Gulf region at some point during the last half million years. With regard to the present day distribution of these beetles in the Gulf region, it would be extremely interesting to know whether one or other species occurs on the currently disputed UAE islands of Lesser and Greater Tumb and Abu Musa, that lie midway between the Iranian localities for *A. rugiceps* and mainland UAE, where *A. arabicus* seems to be widely distributed.

Little is known regarding the biology of *A. rugiceps* and *A. arabicus*, and to the best of our knowledge nothing has been published. DUFFY (1968) gives an account on the biology of *Acanthophorus serraticornis* (Olivier, 1795), another representative of the tribe Acanthophorini Thomson, 1864 : "The larva feeds in decaying roots of mature trees and often leaves the wood to travel through the surrounding soil to neighbouring roots. The pupal cell, which is smooth inside, is composed of earth particles and wood fibres (a similar cocoon is prepared by the palaearctic *Prionus coriarius* (Linnaeus)).

In this species the mature larva hibernates throughout the cold months, pupating about April. Adults emerge from April to September and are readily attracted to artificial light."
The biology of *A. arabicus* and *A. rugiceps* may at least to some extent resemble this species. Females of both *A. arabicus* and *A. rugiceps* are likely to oviposit into soil perhaps in the vicinity of convenient larval substrate, which may be moribund or recently dead trees. It is likely that larvae of both species are at least partially terricolous. The last larval instars are likely to build some sort of a cocoon. The adults will free themselves from the cocoons and surface by digging through the soil.
Clearly the two species share many characteristics in common, including their strictly nocturnal activity, marked size range in males and the preponderance of males over females, defensive behaviour and the suspected subterranean feeding habits of their larvae at the roots of host trees.
However, there are some important differences relating to the two species that should be emphasised. Firstly, although both species have relatively prolonged periods of adult activity, these are clearly different and occur on either side of the hottest months of the year, which correspond to July and August in the lower Gulf region. Thus, *A. rugiceps* is essentially a spring species appearing in late March and all but disappearing by mid-July. On the other hand, *A. arabicus* is an autumn species, active from mid-September to early December. Secondly, observations suggest that there is a crucial difference in host plant selection. In this context, the actual species of host tree may be less important than other factors. In southern Iran, *A. rugiceps* seems to be associated with dead or dying *Acacia* trees in areas with saline soil, but *A. arabicus* is clearly linked with healthy *Prosopsis* trees growing in sandy soil, including dunes.
A third and perhaps less important difference concerns the hiding places adopted by the adult beetles during daytime. Females of both species appear to hide at ground level under debris and similar behaviour is shown by males of *A. arabicus*, which are usually found on the ground and only occasionally hidden on the lower parts of the host tree. Males of *A. rugiceps*, however, seem to favour hiding places in the host tree that are well above ground level.

In summary, new information on the distribution and biology has been given for two spectacular and little known species of the genus *Anthracocentrus* in the Gulf region. However, there is clearly much more to learn about these species and their adaptations to such arid environments. Studies of larval behaviour, in particular, would be of great interest.

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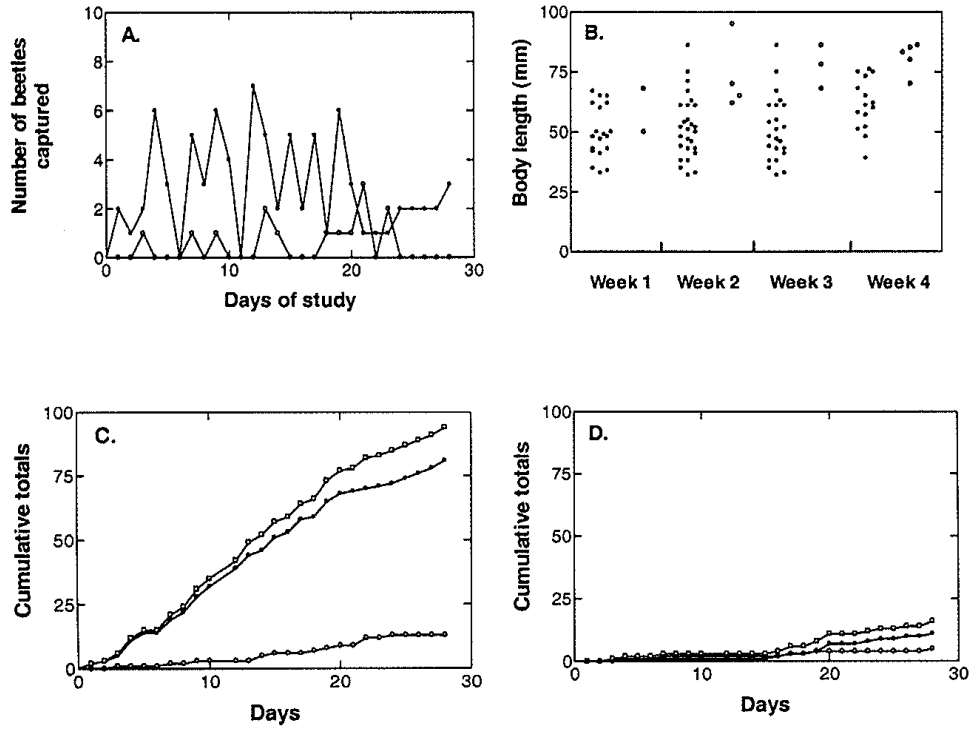

Caption to graphs :

Collecting data for *A. arabicus* in Wadi Towayya for the four-week period 23 September – 18 October, 2004 inclusive. The site was visited every day except for day 11 (3 October).
Graph. A. Daily numbers of males (●) and females (○) collected ;
Graph. B. Body length of individual males (●) and females (○) collected each week ;
Graph C. Cumulative live totals of all beetles (□), males (●) and females (○) collected during the period ;
Graph D. Cumulative dead totals of all beetles (□), males (●) and females (○) collected during the period.
(See text for further explanation.)

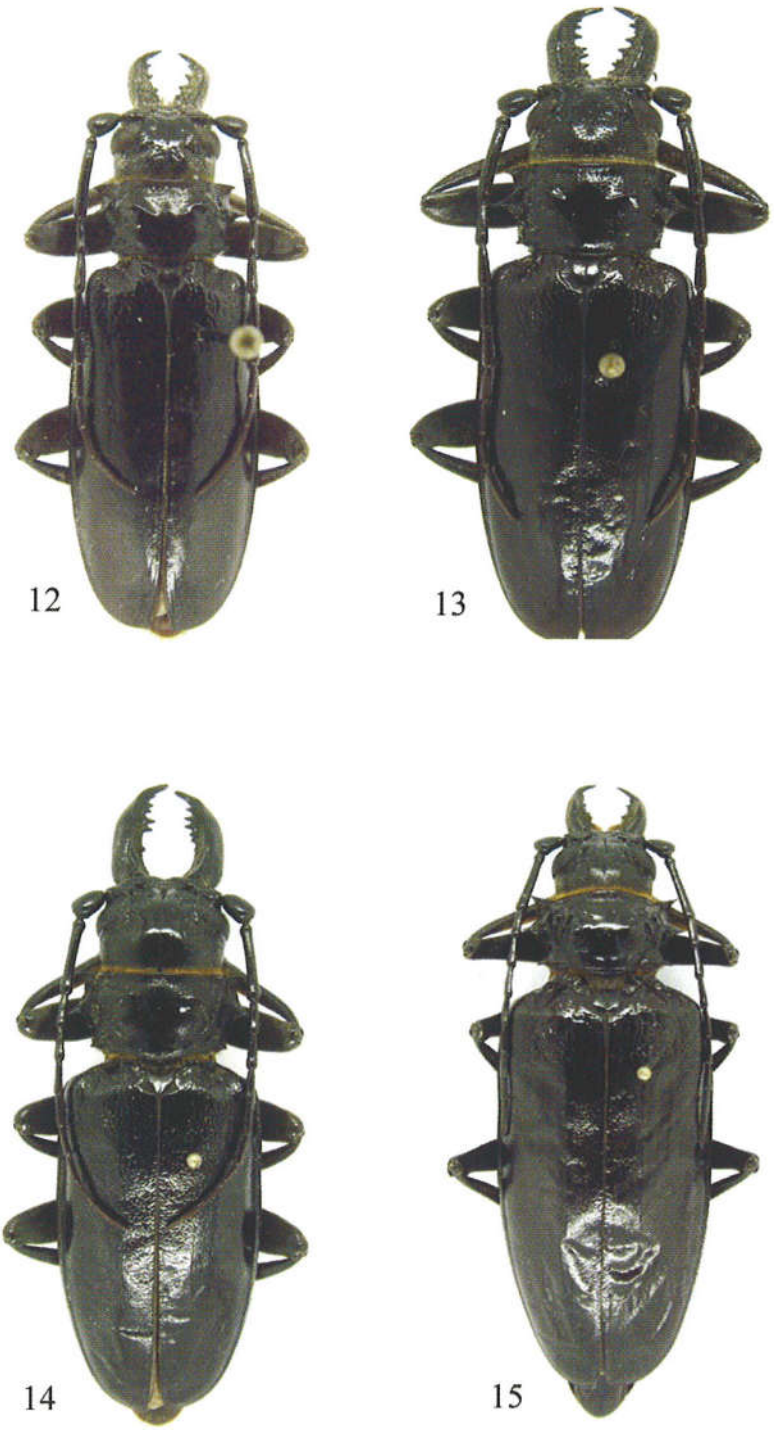

Plate IV (Photos : M. REJZEK) **:**
Figure 12 : Small male of *Anthracocentrus arabicus* (Thomson, 1877). Body size (incl. mandibles) : 28 mm ; Figure 13 : Medium male of *Anthracocentrus arabicus* (Thomson, 1877). Body size (incl. mandibles) : 46 mm ; Figure 14 : Large male of *Anthracocentrus arabicus* (Thomson, 1877). Body size (incl. mandibles) : 74 mm ; Figure 15 : Female of *Anthracocentrus arabicus* (Thomson, 1877). Body size (incl. mandibles) : 85 mm