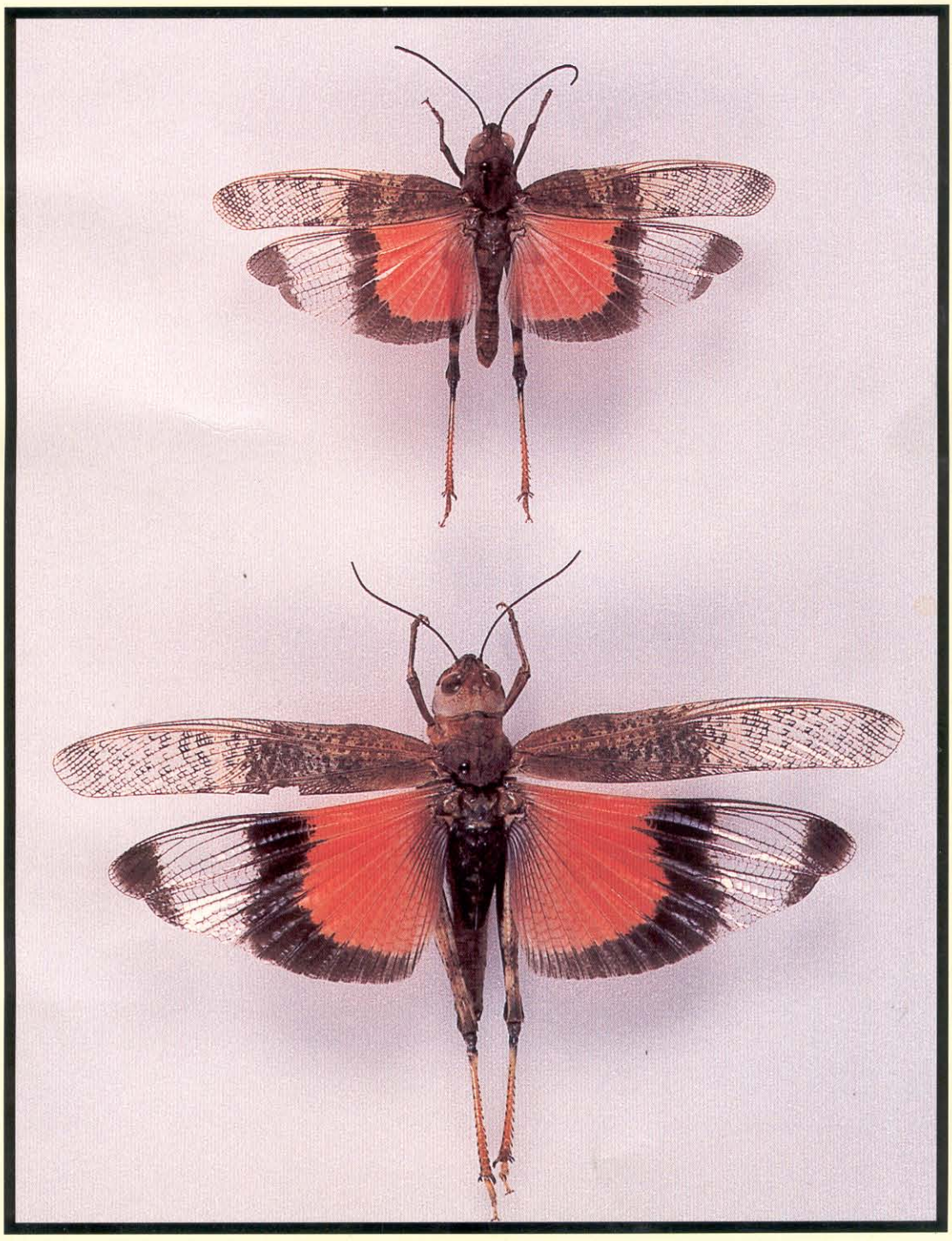
TRIBULUS

Journal of the Emirates Natural History Group

Vol. 10.2 Autumn/Winter 2000



NOTES FOR CONTRIBUTORS

TRIBULUS is the name of the Bulletin of the Emirates Natural History Group. The Group was founded in 1976, and over the next fourteen years, 42 issues of a duplicated Bulletin were published. The revised format of TRIBULUS, introduced in 1991, permits the inclusion of black and white and colour photographs, not previously possible.

TRIBULUS is published twice a year, in April and October. The aim of the publication is to create and maintain in standard form a collection of recordings, articles and analysis on topics of regional archaeology and natural history, with the emphasis on the United Arab Emirates and adjacent areas. Papers, short notes and other contributions are welcomed from anyone but should not have been published elsewhere. Guidelines are set out below. The information carried is as accurate as the Editorial Board and Advisory Panel can determine, but opinions expressed are those of the authors alone.

Correspondence and enquires should be sent to:

The Editor,
TRIBULUS,
Emirates Natural History Group,
P.O. Box 45553,
Abu Dhabi - U.A.E.

The plant motif above is of the genus Tribulus, of which there are six species in the UAE. They all have pinnate leaves, yellow flowers with free petals and distinctive five-segmented fruits. They are found throughout the country, except in coastal *sabkha.*

The animal motif above is of a tiny golden bull, excavated from the early Second Millennium grave at Qattarah, Al Ain. The original is on display in Al Ain Museum, and measures above 5 cm by 4 cm.

Manuscripts should be typed, on one side only, and double-spaced, and should be accompanied by a disc for material in excess of 500 words in length. A short abstract should precede the article, with the address(es) of the author(s) at the end.

Photographs may be submitted and should be either glossy black-and-white or colour prints or colour slides, which should be clearly captioned. Line drawings and maps should be in black ink on strong white or translucent paper.

References should give the author's name, with the year of publication in brackets, and with the list of articles, showing title and publisher, in date order.

Scientific names should follow customary nomenclature in Latin, while the English and, if appropriate, available Arabic names should also be supplied.

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TRIBULUS

Vol. 10.2 Autumn/Winter 2000

Contents

Cover illustrations:

Front: Red-winged male and female grasshoppers ***Scintharista notabilis blanchat'diana*** , one of the most colourful species in the UAE. *(See P.5)*
.....***Picture by Michael P.T. Gillett***

Back: **Arabian toad** *Bufo arabicus* in the Wadi Hayl, Fujairah, in Spring
.....***Picture by Simon Aspinall***

The Editorial Board of TRIBULUS and the Committee of the Emirates Natural History Group acknowledge, with thanks, the support of the Group's Corporate members, a full list of whom can be found on Page 4, without whom publication in this format would be impossible. We also acknowledge the support and encouragement of our Patron, H.E. Sheikh Nahayan bin Mubarak Al Nahayan, the U.A.E. Minister of Higher Education and Scientific Research.

TRIBULUS is published for circulation to members of the ENHG and is sold through associated groups as well as to subscribers in the UAE and overseas. It is also sold through the Ornithological Society of the Middle East. Annual subscription inside the UAE: Dh 50. Overseas details on request.

The text of this issue is also available on the website of the UAE Ministry of Information and Culture: **www.uaeinteract.com**

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EDITORIAL

With this issue of Tribulus, the journal completes twenty issues, and ten years of publication. Over that period, the journal has tried to continue the approach initially adopted by its predecessor, the thrice-yearly Bulletin of the Emirates Natural History Group, whose 42 issues appeared from 1977 to 1990, of publishing data relevant to the natural history, history and archaeology of the United Arab Emirates and adjacent areas.

it is with some pleasure that the Editorial Board notes that the scientific level of contributions has continued to improve over the last ten years, a process that has been facilitated of late by the introduction of an Editorial Advisory Board, comprised of leading experts in a number of fields. We are grateful for their interest and support as well as that of our contributors and of the support from the Corporate Members of the ENHG, whose financial contributions have made publication in this format possible.

Tribulus, like all publications, has its shortcomings. Despite these, however, it remains the only journal of its type in English dealing specifically with the UAE. Its content (a broad overview of which can be obtained from the *Index* to Volumes 6-10 that appears in this issue), has helped to make the journal of increasing value as a source of reference, for amateurs and professionals alike.

Although it is a journal produced with the support of a Non-Governmental Organisation, the ENHG, Tribulus has an important national role to play because thus far the relevant Government agencies have not launched their own journal or other forum where original papers of scientific interest can be published, whether by their staff or by others. Indeed, currently, the results of research by the staff of such bodies rarely reaches the local scientific community, even when it is published in journals abroad. Tribulus, however, does, provide a way through which professionals and interested amateurs can publish locally, regardless of affiliation, and, thereby, contribute to studies of the UAE's natural history and archaeology in such a way that the results of their research are easily available inside the country.

In this issue, two lengthy papers, by Michael Gillett, on dragonflies, and by Gary Feulner, on the mollusc *Terebralia palustris,* make contributions of this kind. Over the years, Tribulus has published the first proper UAE checklists of mammals, reptiles, amphibians, moths, freshwater fish and dragonflies, and, on a more detailed level, of endangered species of mammals and birds, as well as notes of newly recorded species. We are delighted to do so, and we are quite happy, thereby, to continue to provide a forum for the publication of the UAE's essential environmental baseline data.

In the sphere of archaeology, journals do exist overseas which pay substantial attention to the publication of results of work in the UAE. Such information, however, does not circulate widely in the Emirates, and Tribulus has been pleased to provide a forum through which shorter notes can be published so as to bring them to the attention of the local audience. We are pleased that a number of the top archaeologists working in the country have chosen to contribute to the journal.

At the close of our first decade, one should look to the future. Certainly one objective of the Editorial Board will be to examine ways in which the journal can be more widely circulated, both at home and overseas. Posting of the journal on the uaeinteract.com website of the Ministry of Information and Culture, one of the most popular UAE websites with around 750,000 'hits' a month, should help towards achieving this objective, By improving circulation, we can better fulfil our task of disseminating information.

Beyond that, the Editorial Board will endeavour to continue to ensure that Tribulus remains a journal suitable for the publication of reports on scientific research in the Emirates, yet one which, at the same time, is of interest to, and comprehensible by, an interested but not necessarily specialist, public.

We would be delighted if the various Government agencies decide to enter the sphere of the local publication of research, whether by contributing to Tribulus or through their own in-house journals. We hope that they will do so. The broad scope of topics covered in Tribulus is such that we have no fear of competition, and welcome further publications. Today, Tribulus is the best journal of its kind because it is the only one, but members of the local research community, whatever their affiliations, deserve a wider choice.

Over the years ahead, we shall endeavour to continue to produce a journal of broad interest and steadily improving quality that will remain the leader in the field.

This 10th anniversary issue is longer than usual, because of the need to accommodate two important, but lengthy, papers. Michael Gillett's checklist of the grasshoppers of the Emirates and adjacent areas of Northern Oman is the first list of its kind to be published, and will provide, we hope, a useful guide for those interested in this under-studied group.

Gary Feulner's extensive review of the status of *Terebralia palustris* in the UAE and on Oman's Batinah Coast details new information about the species that has a major relevance towards understanding not only the ecology of the species but also of the environment in archaeological terms. As a result of his research, a re-evaluation of archaeological concepts about the coastal environment will be required.

Briefer notes cover a range of topics, including whales, reptiles, new damselfly breeding records and reviews and miscellany, along with the *Index* for the last five volumes. As always, the Editors welcome both comments and contributions.

Corporate Members of the ENHG

Production of ***Tribulus,*** and many of the other activities of the Emirates Natural History Group, including the grant programme of the Group's Conservation Fund, would not be possible without the generous support of the Group's Corporate members, many of whom have provided consistent assistance over many years. The Editorial Board and the Group Committee acknowledge, with thanks, the invaluable support of the following companies and bodies:

ABN Amro Bank, Abu Dhabi Company for Onshore Oil Operations, (ADCO), Al Fahim Group, Al Nasser Holdings, Al Sayegh Richards Butler, Banque Nationale de Paris, Bin Hamoodah, The British Council, British Petroleum, HSBC, Mobil Abu Dhabi, Mohammed Bin Masood & Sons, National Bank of Abu Dhabi, Ready Mix Abu Dhabi Ltd, Union National Bank.

Grasshopper biodiversity in the UAE - an annotated and illustrated list of short horned grasshopper species (Orthoptera - Acridoidea)

Dr. Michael P. T. Gillett

A checklist of the short- horned grasshoppers belonging to the families Pryrgomorphidae and Acrididae known from the UAE is presented together with brief notes on their occurrence. Illustrations are provided for many species, including preserved specimens arranged to show wing shape and colour as an aid to field identification.

Introduction

The order **Orthoptera** contains a large number of insects that show incomplete metamorphosis and have characteristically large hind legs adapted for leaping and jumping. Orthopterans are essentially winged insects, but some species have evolved into wingless forms. Males, and sometimes females, of many species stridulate or chirp and some species are actually easier to tell apart by their characteristic songs than by their morphology. The order contains two suborders, **Ensifera** and **Caelifera. Ensifera** encompasses several different groups of orphopterans with characteristic long thread-like antennae. It includes house and field crickets **(Gryllidae),** mole crickets **(Gryllotalpidae),** cave crickets **(Rhaphidophoridae)** and bush crickets or long horned grasshoppers **(Tettigoniidae)** among others. The suborder **Caelifera** includes orthopterans with short antennae. While this suborder contains several other groups, including ground hoppers **(Tetrigoidea),** the main group consists of true or short horned grasshoppers **(Acridoidea).** This superfamily includes such well known insects as the Migratory Locust, the Desert Locust and other pests of agriculture.

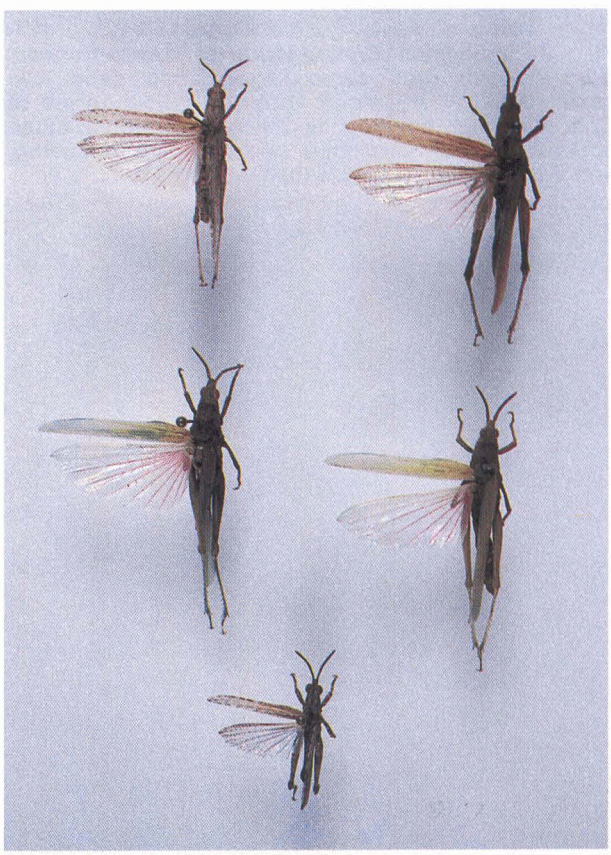
In arid regions wherever there is at least some vegetation, short horned grasshoppers are one of the most characteristic groups of insects. In the UAE, there are at least 45 different species belonging to the families **Prygomorphidae** and **Acrididae.** Some are of very large size and others are vividly coloured on the hindwings, making them easily noticed by even the most casual observer. A few species found in the UAE, such as *Sphingonotus rubescens,* are also readily apparent because they demonstrate a behaviour known as crepitation, in which they leap into the air with a very loud clatter of their wings. This article provides a checklist of the UAE species together with illustrations of their habitus and brief details on occurrence and habits.

SYSTEMATIC LIST

Family PYRGOMORPHIDAE
Tribe PYRGOMORPHINI

Pyrgomorpha conica - bispinosa - cognata spp. group

Two species of these small and variably coloured, common grasshoppers are known from the UAE: the commonest form is the Paneremian *Pyrgomorpha conica tereticornis* (Brullem, 1840) whilst the Palaeotropical *Pyrgomorpha cognata minima* Uvarov, *1943* is much less frequent. A third species



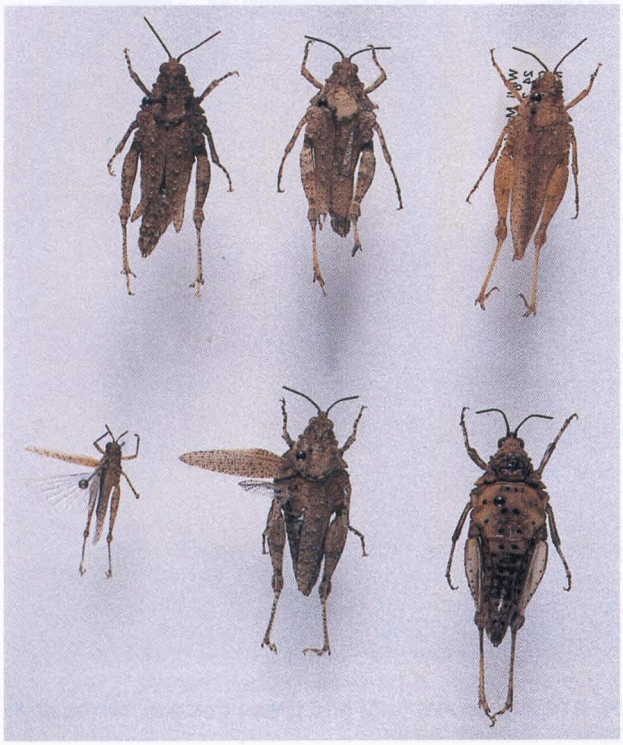
Pl. 1 (left): ***Pyrgomorpha conica tereticornis* on vegetation. Pl. 2** (right): **Brown** (top) **and green** (middle) **forms of *P. conica tereticornis* with *P. cognata minima*** (bottom)

Pyrgomorpha bispinosa incognita Hsiung & Kevan, 1975, known from elsewhere in Arabia, may also occur. All three are very variable, but superficially are very similar and difficult to separate (Hsiung & Kevan, 1975). The insects occur in most habitats that support vegetation (Plate 1) and are amongst the most frequent grasshoppers found. The specimens shown in Plate 2 show the typical appearance of these insects.

Tribe CROTOGONINI

Chrotogonus homalodemus homalodemus (Blanchard, 1836)
The squat shape of this species makes it easy to recognise as do the rows of black spots on the underside of the insect. It occurs in a wide range of different biotopes (Plate 3), including gardens where it has been noted as a minor pest. It is common in the UAE and throughout Oman and is present throughout the southern part of the Eremian zone from the Atlantic to Baluchistan. Those shown in Figure 4 are from the Al Ain region and show the typical range of colour variation.

Pl. 3 (above): ***Chrotogonus homalodemus homalodemus*** **well camouflaged amid sand and small rocks. Pl. 4** (below): **Different colour forms of *C. h. homalodemus*** (top row), **with underside of same species, spread specimen showing tiny hindwing, and *Tenuitarsus angustus*** (bottom row)



Tenuitarsus angustus (Blanchard, 1836)
Similar to, but smaller and more slender than the preceding species, and restricted to sandy biotopes, including bare dunes. The underside is white and lacks the black spots characteristic of C. homalodemus, but the upper surface is very finely speckled with white, yellow and rust coloured spots which very closely match the appearance of the sand on which the insect is found. It has been recorded from Sharjah and the Al Ain region, but is uncommon. The specimen in Plate 4 is from Al Ain camel race track. Elsewhere in Arabia, it occurs in northern Oman and Dhofar and its range extends to Baluchistan, southern Iran and the Horn of Africa.

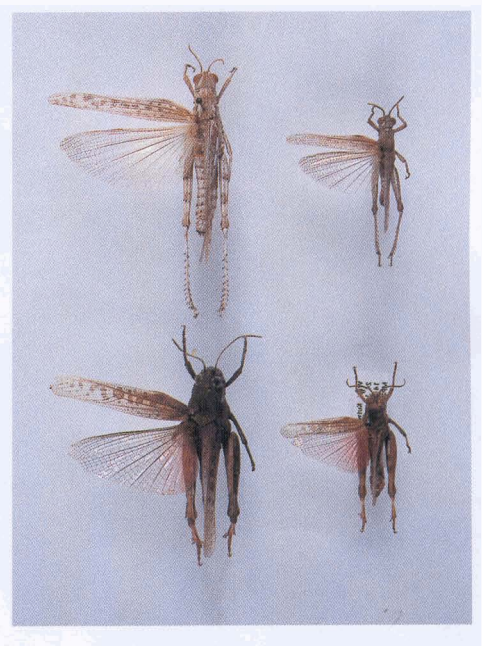
Family ACRIDIDAE
Subfamily DERICORYTHINAE

Dericorys cyrtosterna Uvarov, 1933
This species is known only from SE Arabia and Iranian Baluchistan. It is relatively uncommon in sandy areas around Al Ain. There are old records from Ra's al-Khaimah and the Liwa in the UAE and from northern and central Oman. In this and the next species the pronotum is strongly humped in front, making identification relatively easy. The specimens in Plate 5 are from Al Ain and Al Lisaili.

Dericorys albidula Audinet Serville, 1838
In this species, the pronotal hump is more pronounced than in D. cyrtosterna. It is found from N. Africa across central Arabia to SW Asia, but is apparently rare in the UAE and Oman. There are old records for 'Sharya', Manama and Ra's al-Khaimah.

Subfamily CALLIPTAMINAE

Acorypha glaucopsis (Walker, 1870)
This robust species occurs on rocky slopes with sparse vegetation, and is relatively common in such locations in the UAE and Oman. It is found in the southern half of the Eremian zone from the Atlantic to western and southern India. Although found in the Al Ain area (Plate 5), *A. glaucopsis* has not yet been found on Jebel Hafit, where conditions appear to be ideal. The species is depicted on one of a set of four stamps featuring UAE invertebrates issued in 1999 by the General Postal Authority.



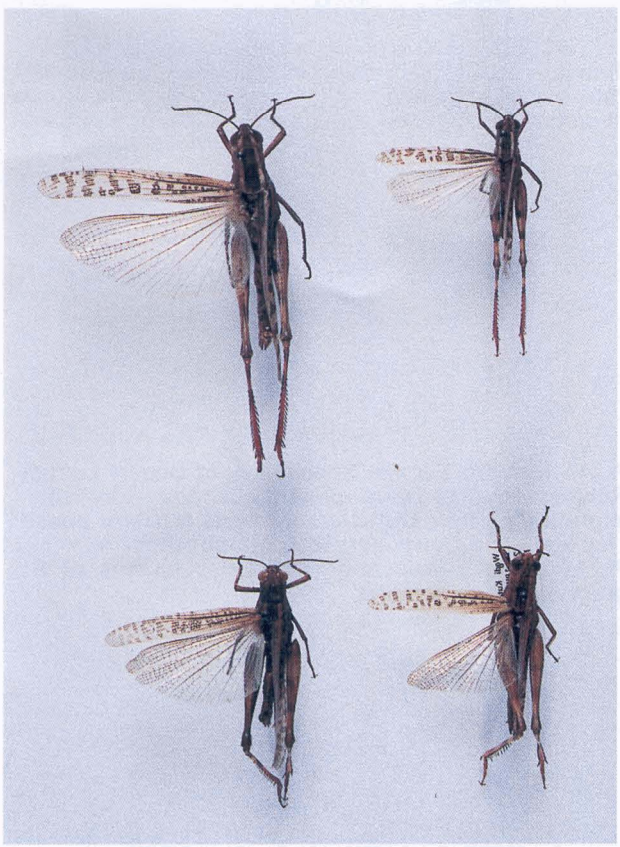
Pl. 5: Male and female specimens of *Dericorys cyrtostema* (top) **and *Acorypha glaucopsis*** (bottom)

Subfamily EYPREPOCNEMIDINAE

Heteracris adspersus (Redtenbacher, 1889)
A widespread southern Palaearctic grasshopper, this species seems to be more local and rare in the UAE than the following two congeneric species. There are records, however, for Ra's al-Khaimah and the East Coast as well as for northern Oman and Dhofar.

Heteracris annulosus annulosus (Walker, 1870)
A widespread species of the southern Eremian zone, including most of Arabia. It prefers bushes and undergrowth at the edges of fields and wadis. It also occurs on offshore islands such as Marawah, where it frequents mangrove stands. It is common in the UAE around Al Ain, Ra's al-Khaimah and the East Coast and probably elsewhere also. The species is shown in Plate 6.

Heteracris littoralis similis (Brunner von Wattenwyl, 1861)
Similar to H. annulosus, this species is larger and somewhat more slender. It is an insect of the eastern Eremic zone and is not known west of Arabia. There are records from northern Oman, Ra's al-Khaimah, Sharjah and Al Ain and it has recently been found on Marawah island, Abu Dhabi. The insect prefers sandy regions with moderate vegetation, such as grassy steppes and coastal sand dunes. The examples shown in Plate 6 are from Al Ain.

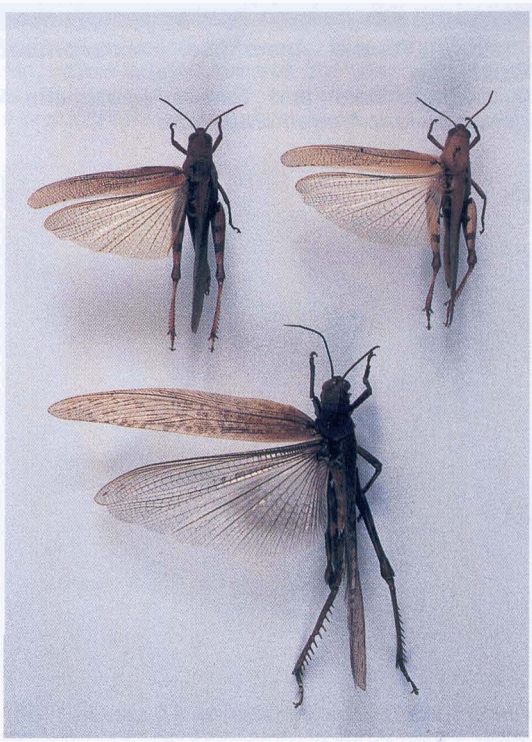


Pl. 6: Male and female specimens of *Heteractis annulosus annulosus* (top) **and *Heteracris littoralis similis*** (bottom)

Subfamily CATANTOPINAE

Diabolocatanops axillaris (Thunberg, 1815)
This large grasshopper is a common species and a minor nuisance in gardens and plantations. It occurs right across Africa along the edges of the Sahara Desert, into Arabia and southern Iran. It may be the dominant grasshopper in mountain wadis (e.g. around Masafi and Al Ain) where it prefers thickets of oleander ***Nerium*** sp. and tall grass (Plate ***7).*** It is also common in gardens in Al Ain, where the bright green nymphs seem to cause more damage to plants than do the adults. Females are usually a little larger than males (Plate ***8).***

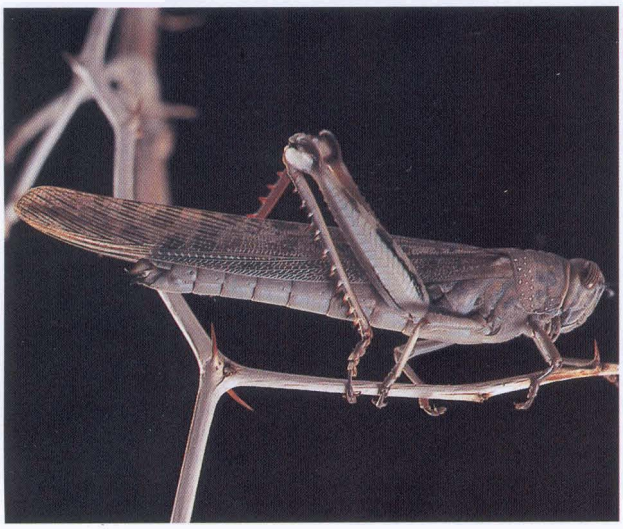
Pl. 7 (above): **The large grasshopper *Diabolocatanops axillaris* on *Nerium mascatense* in a mountain wadi.**
Pl. 8 (below): **Male and female D. *axillaris*** (top) **and a female *Anacridium aegyptium,*** (bottom)



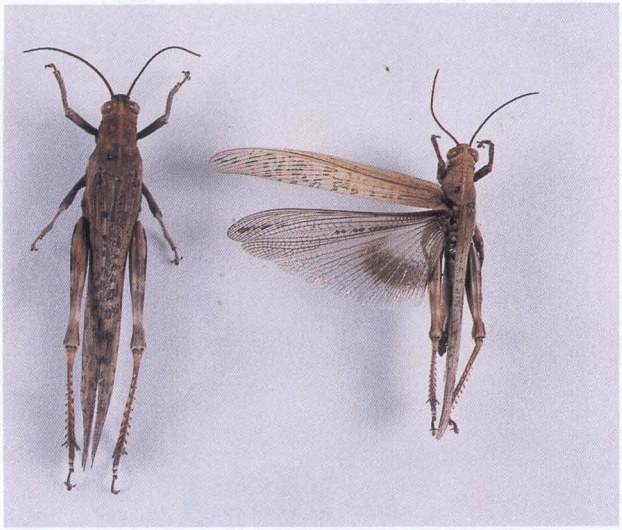
Subfamily CYRTACANTHACRIDINAE

Anacridium aegyptium (Linnaeus, 1764)
The Egyptian Tree Locust is an insect of the eastern Mediterranean region, but has been recorded from Bahrain and Kuwait, although not from Oman. It is common in northern Arabia and causes damage in plantations and gardens. Unlike most other locusts it does not swarm. Only stragglers are likely to occur in the UAE, like that shown in Figure 8 from Al Ain. The species differs from the much more common ***A.*** melanorhodon arabafrum, in that the black band on the hindwing is much fainter.

Anacridium melanorhodon arabafrum Dirsh, 1953
The most common locust in Al Ain and elsewhere in the UAE, this Ethiopian species occurs almost anywhere that has trees (Plate 9). It does not swarm, but can be a serious pest of date palms and other trees. The specimens in Plate 10 were collected in Al Ain.

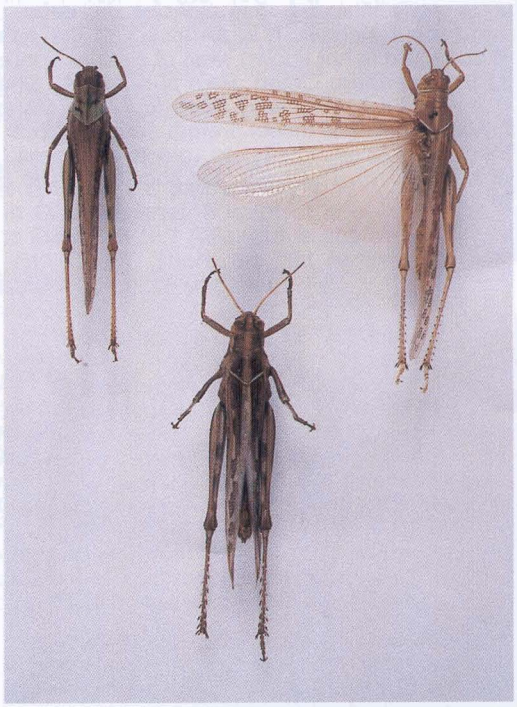


Pl. 9 (above)**: Female *Anacridium malanorhodon arabafrum***
Pl. *10* (below): **Male and female specimens of *Anacridium malanorhodon arabafrum***

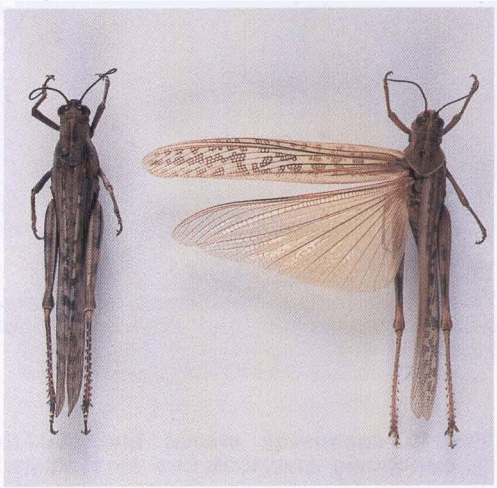


Cyrtacanthacris tatarica tatarica (Linnaeus, 1758)
This large Palaeotropical grasshopper has only been previously recorded in Oman from the Dhofar province, not from northern Oman. The example shown in Plate 11 is from a garden in Al Ain, UAE, where it does not appear common. It may just be a straggler in the region.

Schistocerca gregaria (Forskål, 1775)
The locust of most economic importance in Arabia, the Desert Locust is a feared pest throughout the Eremic Zone. Inner Oman is an important breeding area for this locust which can form vast swarms which migrate, bringing destruction in their wake. Its survival depends upon its high mobility, allowing it to migrate with, and to take advantage of, favourable weather systems bringing rain to the desert. Successive falls of rain allow scattered locusts to produce several generations very quickly without serious losses and to build up gregarious bands and swarms. In these conditions, both the colour and some aspects of the morphology of these insects, as well as their behaviour, change dramatically. Major outbreaks have arisen from central Oman in 1948-9 and 1967 and some minor ones in the last few years. In the UAE, Desert Locusts numbers are usually low, but in 1997 larger numbers were present, at least in Al Ain. The specimens in Plate 12 represent the brown phase '*solitaria*.' An individual tending towards the yellow phase 'gregaria' is shown in Plate 11.



Pl. 11 (above): **Female specimens of Desert Locust *Schistocerca gregaria* phase *gregaria*** (top left), **Migratory Locust *Locusta migratoria* (solitary phase** - top right) **and *Cyrtacanthacris tatarica*** (bottom).
Pl. *12* (below): **Male and female specimens of *S. gregaria* phase *solitaria***



Subfamily ACRIDINAE

Duroniella parallela Uvarov, 1952

Three species of this taxonomically difficult genus have been recorded from Arabia and most of the material from eastern Arabia is probably referable to *parallela*, including records from the East Coast of the UAE and from Ra's al-Khaimah. Specimens from further south (Nizwa, Behla and Sur) are reported by Popov to show a trend in morphology towards the species *Durionella* acuta, known from western Arabia. D. *parallela* has a preference for grassy places, particularly in brackish habitats, and this clearly correlates with its coastal distribution in the UAE.

Duroniella laeviceps Uvarov, 1938

This species has a distribution along the Iranian coast of the Arabian Gulf, but a single old (1944) record exists for Ra's al-Khaimah. The insect has similar habits to D. *parallela.*

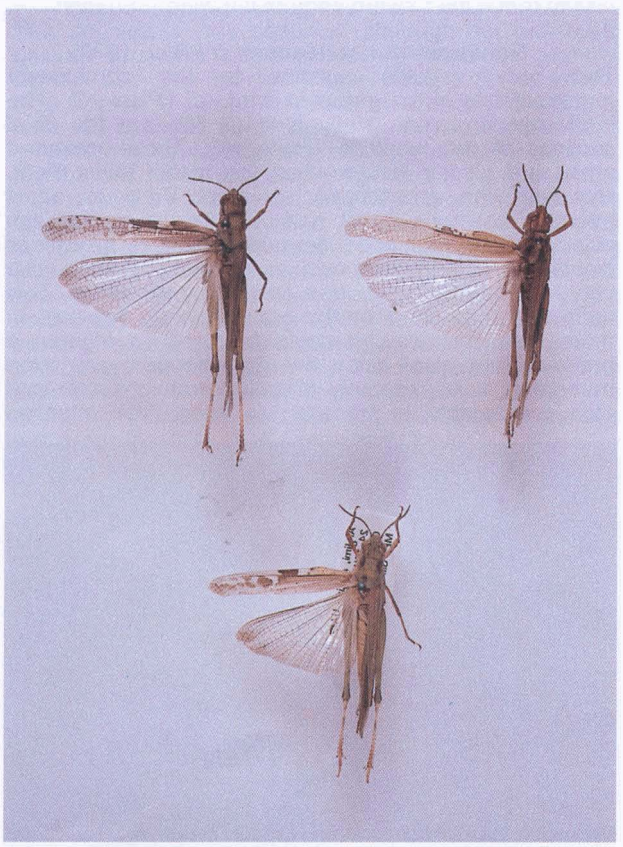
Subfamily OEDIPODINAE

Ailopus thalassinus thalassinus (Fabricius, 1781)

This is a common species in parks, gardens and fields in the UAE. It favours grasses of medium height, but is also found on lawns and may be a minor nuisance. The insect has both green and brown forms (Figure *13*), the latter occurring most frequently during dry periods. It is generally distributed throughout suitable habitats in the UAE and abroad, its vast range covers southern Europe, nearly all of Africa, Asia Minor, SW and C Asia and the Indian Sub-continent.

Ailopus simulatrix simulatrix (Walker, 1870)

This species is similar to the previous (Figure 13) and also has a wide range from the Atlantic coast of NW Africa to E Africa, Arabia and through India to Burma. It appears to be relatively uncommon or perhaps under-recorded in eastern Arabia. There are records from Al Khaburah in Oman and from the Al Ain area.



Pl. 13: Male and female specimens of *Ailopus thalassinus thalassinus* (top) **and a female *Ailopus simulatrix simulatrix*** (bottom)

Hilethra aelopoides (Uvarov, 1922)

This generally uncommon species is found under oasis conditions where it is restricted to dense undergrowth. There are UAE records from Sharjah, Al Ain, and Ra's al Khaimah as well as from many places in northern Oman, Abroad, its range extends from SW Asia across the Sahel to W Africa.

Oedaleus senegalensis (Krauss, 1877)

This is economically one of the most important grasshoppers in Africa where it is a serious pest of cereal crops in the Sahel. It also occurs in C and W Asia and appears to be common at times in Ra's al-Khaimah Emirate where agricultural damage has been recorded. Elsewhere in the region, it seems to be absent or rare, but it re-occurs in Dhofar, southern Oman.

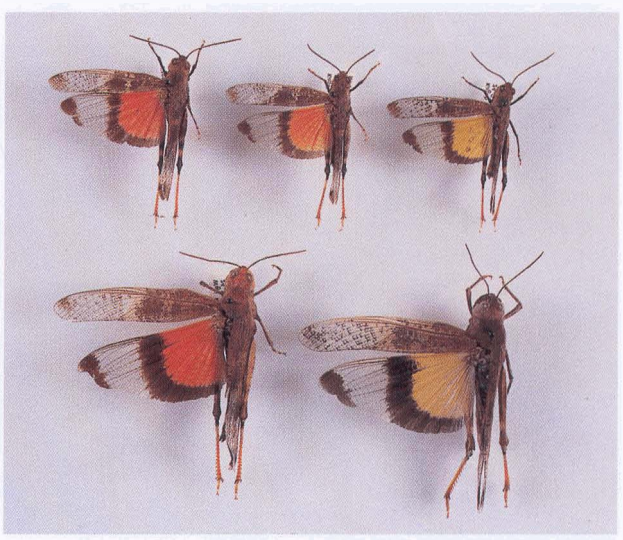
Locusta migratoria (Linnaeus, 1758)

Not previously recorded from the UAE/Oman, this well known species, the Migratory Locust, is often common in W. Arabia. The specimen shown in *Plate 11* is a female example of the solitary form and was found in a garden in the Al Muwaiji district of Al Ain, UAE.

Scintharista notabilis blanchardiana (Saussure,

This interesting and colourful species is an Arabian endemic species and is occasionally common in the Hajar Mountains, including Jebel Hafit. It prefers rocky slopes with scant vegetation and is a good example of the use of flash colouration. At rest, the insect blends in perfectly with the rocky ground on which it rests. On being disturbed, the bright red or yellow and black hindwings are readily apparent to predators, but as soon as they are folded and cowered, the grasshopper seems to disappear into the background.

Uvarov (1941) believed that hindwing colouration in females was always yellow and in males always red. Popov (1981) pointed out that females can occur with red as well as yellow hindwings. In material from around Al Ain, yellow-winged females are rarer than red-winged ones, but yellow- and even orange-winged males can also occur (*Plate 14* and *cover picture*).



Pl. 14: Yellow-, orange- and red-winged males of *Scintharista notabilis blanchardiana* (top) **and yellow- and red-winged females** (bottom)

Mioscirtus wagneri (Kittary, 1849)
This African, Arabian and SW Asian species is not common in the UAE/northern Oman region. There are, however, records from Ra's al-Khaimah and the East Coast of the UAE and the Batinah coast and Muscat in Oman. It favours halophilic vegetation in salt marshes and sabkhas. The base of the hindwing of the male is always yellow, that of the female may be either red or yellow.

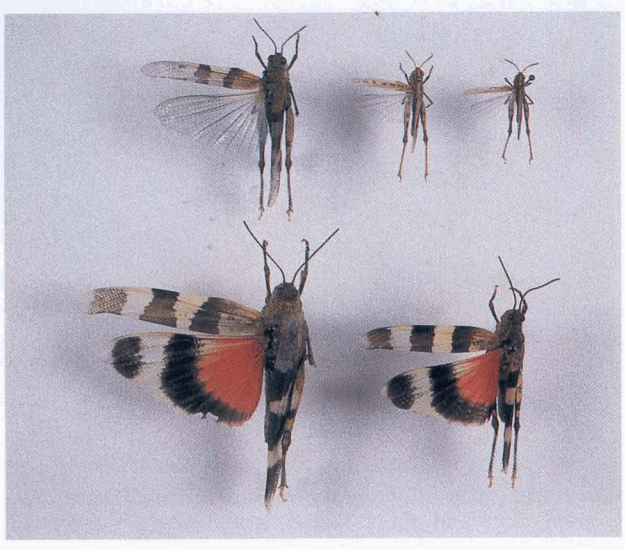
Hyalorrhipis canescens (Saussure, 1888)
This grasshopper is found in N. Africa and the Sahara Desert as well as in Arabia. It occurs in sandy areas including dunes. In this region, records are from Sharjah and Buraimi (Oman), but it does not appear to be a common species.

Hyalorrhipis arabica Uvarov, 1936
This rare Arabian endemic grasshopper was described from the Hejaz, but there is also a record in the UAE from Sharjah. It is one of the smallest grasshoppers occurring in the region.

Leptopternis gracilis (Eversmann, 1848)
A single specimen of this desert species is in the Oman Natural History Museum. It was collected in Al Ain in 1993 by the author and identified by the late G.B. Popov. Two other specimens are shown in Figure *15,* but the species is uncommon, although known elsewhere in Arabia as an occasional inhabitant of desert areas.

Sphingonotus femoralis Uvarov, 1933
All species of the large genus *Sphingonotus* and related genera (Lepfopternis and *Pseudosphingonotus*) are geophilous and found on bare ground with scattered vegatation. This species occurs in Arabia and extends to the Horn of Africa and S. Iran. It is reasonably common on the gravel plains between the Hajar Mountains and the sandy desert areas. There are records from Masafi (UAE) and Buraimi (Oman) and the specimens shown (Plate 15) are from the Al Ain region, UAE.

Sphingonotus octofasciatus (Audinet Serville, 1838)
Like *Scintharista notabilis blanchardiana*, this beautiful species of *Sphingonotus* is a classic example of the use of flash colouration as an adjunct to camouflage. At rest with the wings closed, the sombre colours of the insect blend in with the rocky ground and gravel on which this insect is usually found (*Plate 16).* On disturbance, the very striking red and black hindwings are disclosed (Plate *15).* Usually this species is quite rare, but in 1997, it occurred in good numbers in the Al Ain area. It has also been recorded from Masafi and Ra's al- Khaimah in the UAE and Muscat in Oman. Elsewhere its range covers N Africa, including Egypt, and SW Asia.



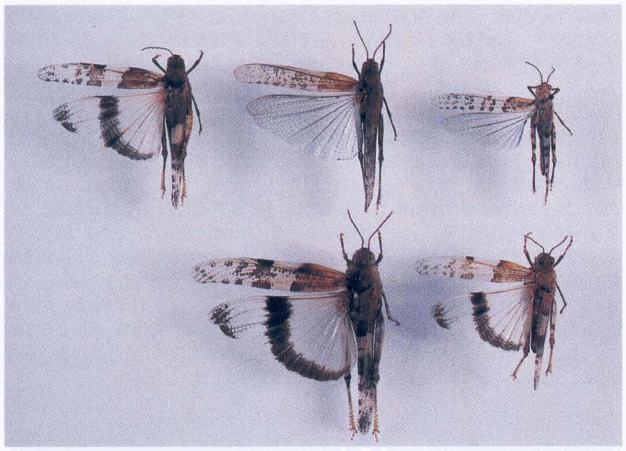
P1.15: Male and female *Leptotérnis gracilis* and a female *Sphingonotus femoralis* (top, left to right) **and male and female *S. octofasciatus*** (bottom)

Pl. 16: *Sphingonotus octofasciatus,* well camouflaged on a gravel surface

Sphingonotus predtetshensky Mitshenko, 1936
An Eastern Eremic species known from Iran, this species is very rare and only recorded a few times from central and eastern Arabia. The only such records for the UAE are both from Ra's al-Khaimah (1949, 1957). In this species, the hindwings are colourless except for a more or less faint black band in the middle and which fails to reach the forward edge of the wing.

Sphingonotus rubescens (Walker, 1870)
This very variable species is the commonest representative of the genus in the UAE *(Plate 17).* The hindwings are very faintly blue as too are the tibial sections of the hindlegs (*Plate 18*). These coloured areas are clearly visible when the insect takes flight. However, the grasshopper is most likely to attact attention as much by its noisy display as by its flash colours. When frightened into taking flight, *S.* rubescens displays a behaviour known as crepitation, whereby a very loud crackling sound is emitted by the wings. This behaviour may enhance the grasshopper's defences in more than one way. It could be used to frighten a predator, but also, since the grasshoppers are often numerous, it is extremely difficult for an observer and also presumably a predator, to keep their attention

Pl. 17: *Sphingonotus rubescens*

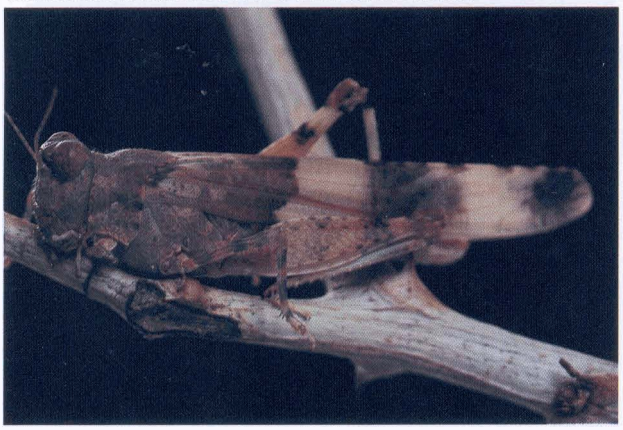


Pl. 18: Male and female specimens of *Sphingonotus rubescens* and male *Pseudosphingonotus paradoxus* (top, left to right) **and male and female *Pseudosphingonotus savignyi*** (bottom)

focussed on a single individual insect because of the constant distractions caused by the successive crepitations from neighbouring insects. The range of this species includes the whole of the Mediterranean region, the Sahara and SW Asia.

Sphingonotus lavandulus Popov, 1980
This beautiful insect was first described from material collected at Ra's al-Khaimah and Buraimi (Oman). Unfortunately, those are the only records known and the species is presumably quite rare. The central area of the hindwing is a clear lavender-blue without any black markings.

Pseudosphingonotus savignyi (Sassure, 1884)
This species is very common, although not previously officially recorded from the UAE. In years with plentiful rainfall, both this species (*Plate 19*) and S. *rubescens* may appear in great numbers in towns and villages, attracted by bright street lamps, Such occurrences have given rise to newspaper stories of grasshopper swarms, but there is no evidence of gregarious behaviour of the type shown by the Desert and Migratory Locusts. This species has clear hyaline hindwings with a thick complete curved black band in the middle of the wing (*Plate 18*). The next species, *P. paradoxus*, is identical in rance and differs from R only in the structure of the stri ulatory file on the tegmen or forewing. That of P. *savignyi* is situated on the intercalary vein, whereas in P. *paradoxus* the file is on the medio-radial vein. Both species occur in the Al Ain region, but only P. *savignyi* is common. Published records for this species include numerous localities in N. Oman and Dhofar.



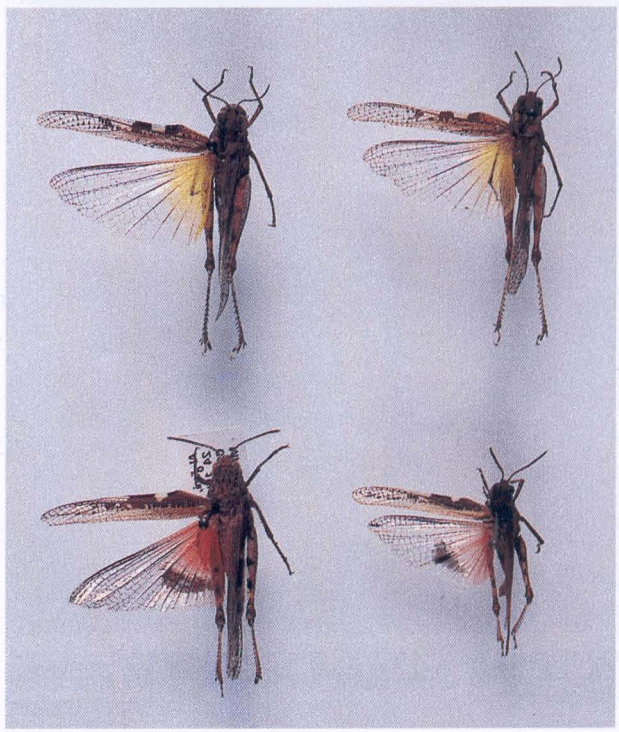
Pl. 19: *Pseudosphingonotus savignyi* is often attracted to lights at night.

Pseudosphingonotus paradoxus (Bei-Bienko, 1948)
As already mentioned, this species is virtually identical to *P. savignyi* (Plate *18*). It is known to occur in the UAE, at Sharjah and Ra's al-Khaimah, and in Oman, along the Batinah coastal strip, as well as at Al Ain. Abroad, the insect has a rather disjunct distribution in Iran and W Africa.

Psuedosphingonotus dentatus (Sassure, 1884)
This rare species is similar to S. *predtetshensky* in that the hindwings are hyaline and have only a faint and incomplete black band. There are UAE records from Ra's al-Khaimah, Khatt and Abu Musa Island. It also occurs in Oman at Muscat and Khasab.

Acrotylus longipes (Charpentier, 1834)
This is a common grasshopper across the Eremian zone. In the UAE and Oman, it is widespread in towns, farms, desert steppe (*Plate 20*) and in the mountains. There are many published records. All specimens from the region appear to have the base of the hindwing coloured yellow without any black markings (*Plate 21*). Further south in Dhofar, some specimens have salmon-pink hindwings which are similar to those of the related species *A. incarnatus* Krauss, 1907, an endemic insect from Socotra Island, Yemen.

Pl.20 (above)**: *Acrotylus longipes* is difficult to spot even on sandy ground.**
Pl. 21 (below)**: Male and female specimens of *Acrotylus longipes*** (top) **and *Acrotylus insubricus inficitus*** (bottom)

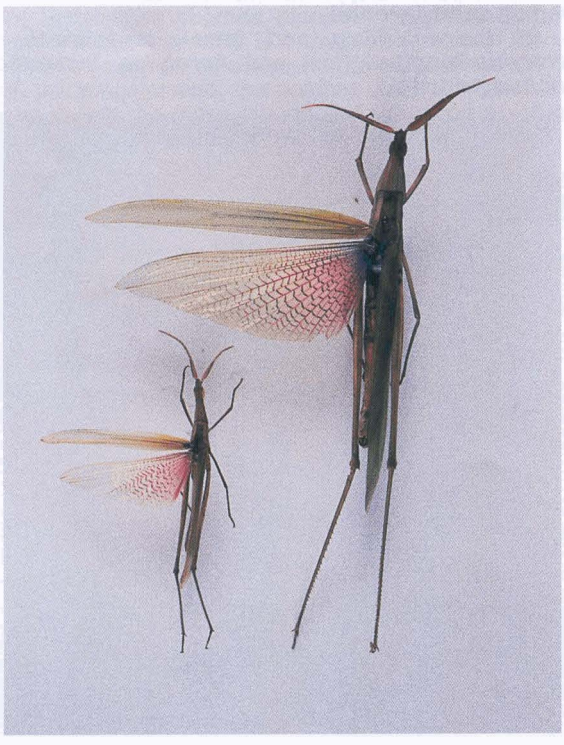


Acrotylus insubricus inficltus (Walker, 1870)
Less common than the previous species, *A. insubricus inficitus* is known in the UAE from the Al Ain region, Sharjah and the East Coast and from Muscat, Nizwa, Ruwi, Buraimi and other places in northern Oman. The hindwings are red at the base and there is a incomplete black band in the centre of the wing *(Plate* 21). In Dhofar, this subspecies is replaced by another, *innotatus* Uvarov, 1933, in which the black band is lacking, but the apex of the hindwing is instead darkened.

Subfamily TRUXALINAE

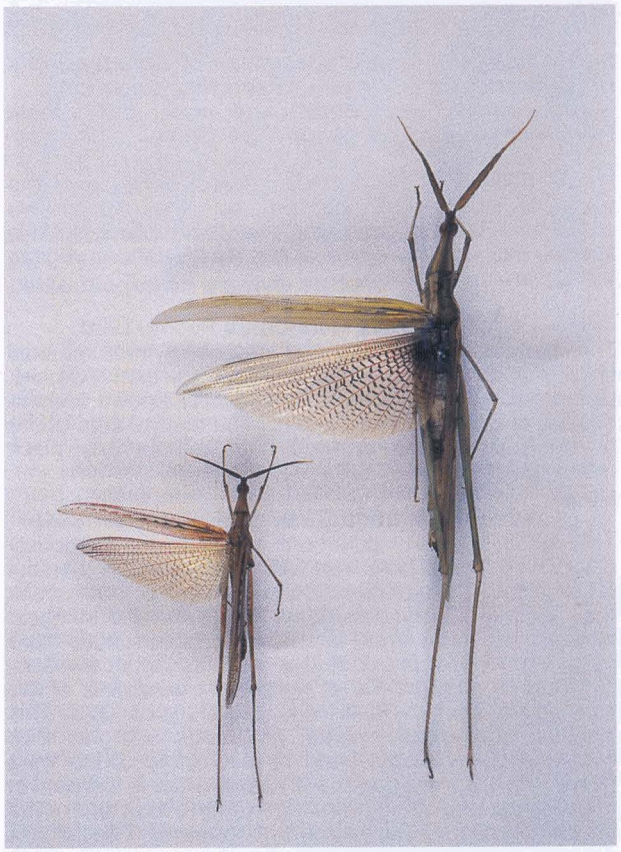
Truxalis fitzgeraldi Dirsh, 1950
The most elegant of all Arabian grasshoppers are found in the genus *Truxalis* and they are characterised by large size, long acutely tapered head with flattened antennae, the eyes situated near the apex of the head, brightly coloured hindwings and long slender legs, the hind femora of which is not flattened sideways as in other grasshoppers. There are at least six species in Arabia, of which four occur in the UAE. In all species, the female is very much larger than the male. *Truxalis fitzgeraldi* is typical of these insects. The basal area of the hindwings is purple-black in the female and bright red in the male *(Plate* 22). This grasshopper only occurs in the UAE, northern Oman, Baluchistan and the Punjab. It is replaced in Dhofar, the rest of Arabia and Africa by a closely related species, *T. grandis* Klug, 1830. Records for the UAE include Khatt and the mountains around Masafi. On occasions, the insect can be found in numbers on farms in the Al Ain region. It frequents patches of tall grass and is often attracted to electric lights at night.

Truxalis eximia eximia Eichwald, 1830
Similar to the preceding species, *T. eximia* appears to be less common. The female has the base of the hindwings deep blue-black or purple-black, but those of the males are pale yellowish green *(Plate* 23). Records for the UAE include Kharran (near Ra's al Khaimah) and Wadi Siji near Masafi. The specimen illustrated is from Khutwah in northern Oman. Abroad, the distribution extends from Turkey to India and northwards into C Asia.

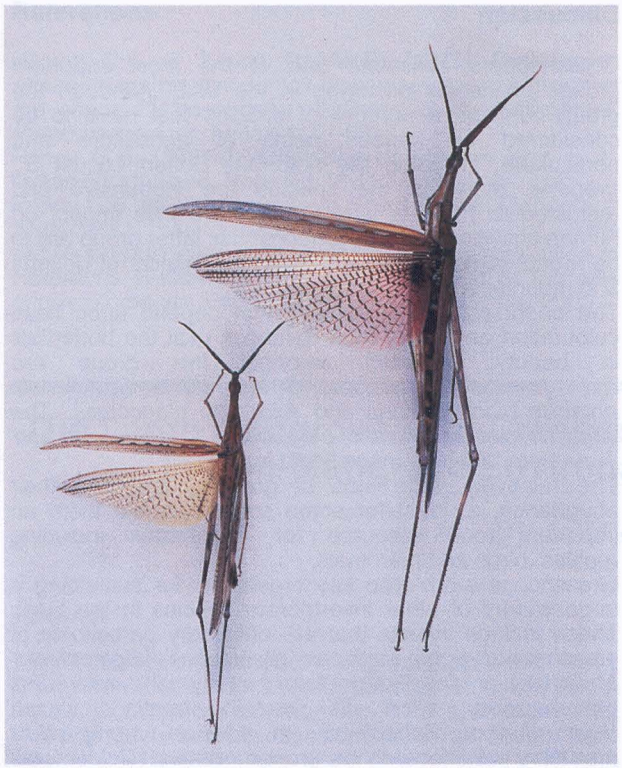


Pl. 22: Male and female specimens of *Truxalis fitzgeraldi*

Truxalis procera Klug, 1830
This species is typically found in desert steppeland and is often attracted to artificial lights. The overall colour is very variable from green *(Plate* 24) to brown, often shaded with grey or grey-blue *(Plate* 25). The base of the hindwings in the female is 'pink-black' and in the male yellow-green. It occurs right across the Eremian zone from Mauritania eastwards to Baluchistan. In Arabia it is most common in the UAE with records from Sharjah and Kharran. It is also known from Al Lisaili (Dubai), Al Ain and Jebel Hafit (*pers. obs.).* There are also some records for northern Oman.



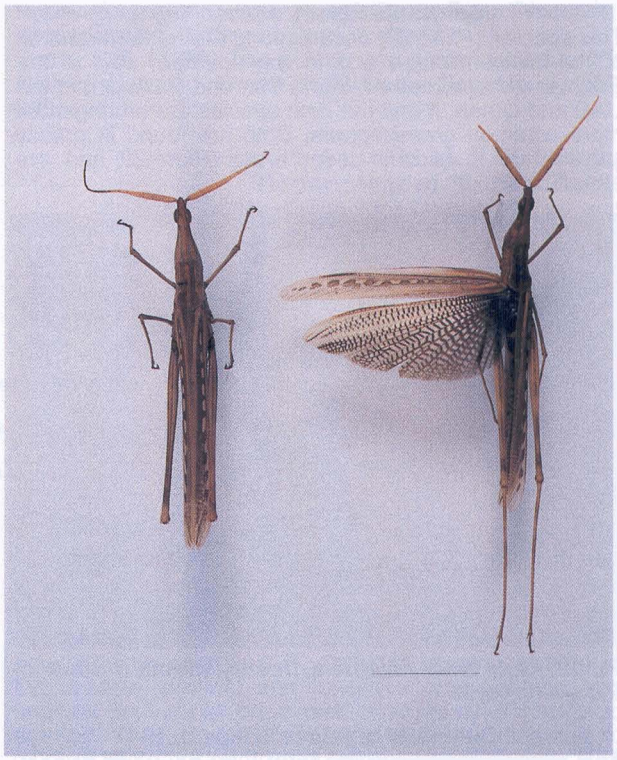
Pl. 23 (above): **Male and female specimens of *Truxalis eximia eximia***
Pl. *24* (below): **Female specimen of *Truxalis procera*, green form**



Pl. 25: Male and female specimens of *Truxalis procera*

Truxalis longicornis (Krauss, 1902)
This very large insect is a strikingly beautiful inhabitant of the mountains (Plate 26). The base of the female hind wing is black, that of the male red (Plate 27). It is known from most of Arabia and Somalia and there is an isolated population in the Aïr Mountains of Niger. In the UAE and northern Oman, it occurs around Al Ain and on most of the nearby mountains, including Jebel Hafit.

Pl. 26: A female *Truxalis longicornis*, one of the most beautiful grasshoppers in the UAE.



Pl. 27: Female specimens of *Truxalis longicornis*

Subfamily GOMPHOCERINAE

Ochrilidia geniculata (I. Bolivar, 1913)
This species (Plate 28) is better recorded in the UAE than *O.tibialis* and is probably more common. In the UAE, there are records from Sharjah, Dhaid, Ramlet Anej, Ra's al-Khaimah, 'Sharya' and Al Qitan. It also occurs at Al Ain and Al Lisaili. Abroad it is found in N Africa and its range extends eastwards to India.

Fig. 28: Female specimens of *Ochrilidia geniculata* (top) **and male and female specimens of *Ochrilidia tibialis*** (bottom)

Ochrilidia tibialis (Fieber, 1853)

This species (Plate 28) occurs along the northern shores of the Mediterranean and in the southern part of the Eremian zone across Arabia to Iran and Pakistan. In the UAE and Oman, it and the next species are amongst the more common grasshoppers. Both are found in grassy steppes and in wadis in desert areas (Plate 29) and are attracted at night to lights.

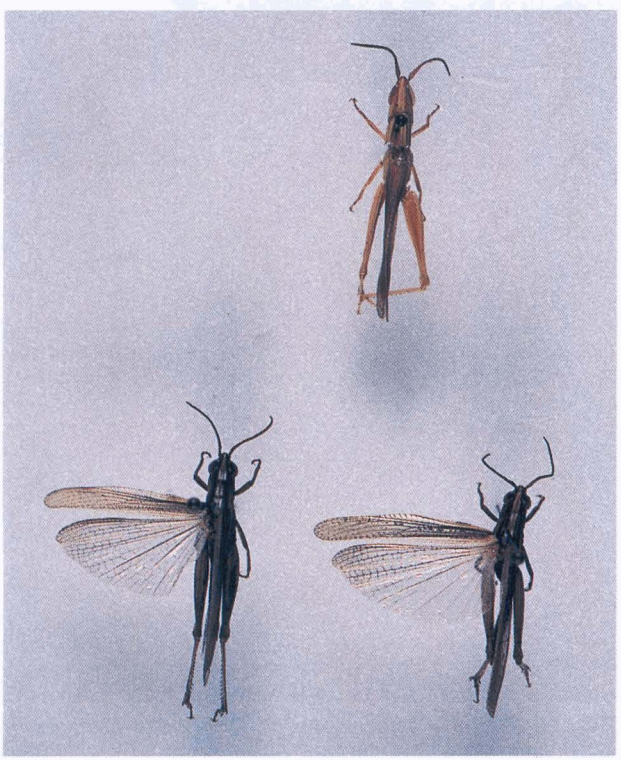
Pl. 29: *Ochrilidia tibialis,* a freshly moulted adult of the green form

Ochrilidia brevipes Chopard, 1947

This species is smaller and rarer than the other Arabian Ochrilidia. There is a record for Sayh in Oman and it also occurs in Al Ain (Plate 30).

Leva spp

At least two species of this genus are found in eastern Arabia. Both are small insects of dry grassland habitats. Like Ochrilidia, they are frequently attracted to light. The two recognised species are: L. *mundus* (Walker, 1871) and L. arabica (Uvarov, 1936). They are difficult insects to separate, even for an expert. The specimens shown in Plate 30 are from the Al Ain region.



Pl. 30: ***Ochrilidia brevipes*** (top) and ***Leva*** species, (bottom)

Discussion

Grasshoppers constitute one of the most important groups of insects occurring in the UAE. Although the group contains a number of species that have to be considered as serious pests of agriculture and horticulture, including the notorious Desert Locust S. gregaria, many of the species are inoffensive and restricted to habitats where they have little impact on human activities. Indeed, amongst this latter group are to be found some of the most beautiful insects of deserts and mountains.

The bright colours of species that depend upon flash colouration as part of their defences rival the butterflies in beauty. Included amongst this group are Sphingonotus octofasciatus, S. *lavandulus,* Scintharista notabilis blanchardiana and Acorypha *glaucopsis*. The large species of Truxalis, particularly *T.* longicornis and *T.* procera, are also magnificent insects.

The relatively large size of grasshoppers and their abundance, at least for some species, make them an important food resource for vertebrates including reptiles, birds and mammals.

Grasshoppers are also key organisms for sustaining a large variety of other invertebrate species in the UAE. These include insects that are obligatory parasitoids of grasshopper eggs such as oil beetles (*Coleoptera:* Meloidae) or specific predators of nymphs and adult grasshoppers such as certain hunting wasps (Hymenoptera: Sphecidae). In addition, many other predatory insects such as ground beetles (Coleoptera: Carabidae) and Mantids (Mantodea) avail themselves of grasshoppers if they are available, as do scorpions. Dead grasshoppers are eaten by yet other insects, including darkling beetles (Coleoptera: Tenebrionidae).

The records for the UAE grasshoppers given above are almost certainly incomplete. They are taken in part from the published studies of Popov (1981a, 1981b, 1985, 1988) and from material that I have collected incidentally whilst concentrating my fieldwork on other orders. Some of this original grasshopper material dating back to around 1993 was donated along with many other insects to the Natural History Museum. Muscat, Sultanate of Oman. This sample of Orthoptera was examined by Popov and found to include only one species of Acridoidea not already listed by him for eastern Arabia - a single specimen of *Leptopternis gracilis*.

Since 1995, a growing amount of grasshopper material from the UAE and neighbouring parts of Oman has been deposited in my own small collection and now totals well over two hundred specimens, all representing species which have previously been listed by Popov. Only Anacridium *aegyptium* and *Locusta migratoria* had not been officially recorded for this region of Arabia, although their presence was thought to be quite likely (Popov, 1981a).

Since no systematic collecting of grasshoppers has occurred in the UAE, it is entirely possible that additional and even undescribed species await discovery. Amongst the most likely to occur are the following species already known from Oman: Eyrepocnemis *alacris* impicta Uvarov, 1933; *Clomacris* omanica Uvarov, 1936; *Cyclopternacris* muscatensis Popov, 1985; *Tropidopola cylindrica* obfusa Uvarov, 1926; *Vosseleriana* arabica *gallagheri* Popov, 1985; *Cophotylus* eos Popov, 1985; *Dnopherula* omanica Popov, 1985; Truxalis *philbyi* Dirsh, 1951 and *Ochrilidia* persica Salfi, 1931. In addition, there may be others known from eastern Saudi Arabia and even Iran, but also not yet recorded from Oman and UAE.

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The Large Mangrove Mud Creeper *Terebralia palustris* (Linnaeus, *1767)* in Non-Mangrove Environments in Southeastern Arabia

by Gary R. Feulner

Abstract

The Potamidid gastropod *Terebralia palustris,* well known from coastal archaeological sites in southeastern Arabia, is also more common live in the area today than has previously been recognised. Although absent from the Arabian Gulf, populations are now reported from nine locations along the Gulf of Oman coast of the UAE and Northern Oman, including all six mangrove areas as well as three non-mangrove estuarine environments.
The occurrence of *T. palustris* in non-mangrove environments has not been mentioned in the literature, but is associated with distinctive and consistent ecological characteristics. Adult *T. palustris* in the mangrove environment has a mostly upper intertidal distribution and is said to feed primarily on fallen mangrove leaves. In contrast, in the non-mangrove environments observed, *T. palustris* is concentrated in the shallow subtidal and lowest intertidal zones and appears to subsist an a diet of algae and/or organic detritus. These traits are similar to those attributed to juvenile T. *palustris* in mangrove environments. The existence of non-mangrove populations requires a re-evaluation of the common characterisation of *T. palustris* as a "mangrove obligate" and its uncritical use in palaeo-environmental reconstructions.
The extreme salinity and temperature conditions of the Arabian Gulf may generally exclude *T. palustris* there, so that what calls for explanation is not its modern absence but its former abundance along the shores of the

Pl. 1 ***Terebralia palustris***

Northern Emirates. It is suggested that this might have been attributable to a period of locally reduced (i.e., normal) salinity, under the influence of a somewhat less arid climate coupled with the role of the nearby Hajar Mountains in inducing precipitation and channelling it to the coast.

introduction

Terebralia palustris is the largest member of the gastropod Family **Potamididae,** also known as mud creepers, horn whelks or horn shells. Potamidids have long, conical shells and are typically found on soft substrates in estuarine and intertidal areas, including mangrove forests. Where present, they are usually abundant. T. *palustris* has a distinctive, heavy shell *(Plate 1)* that reaches an adult length of c.70-110 mm in SE Arabia.

T. palustris has attracted special attention in southeastern Arabia. Although its present day occurrence there is highly localised (and it appears to be absent from the Arabian Gulf), it was a dietary staple of earlier human populations in the area. It has been considered by many authors to be a "mangrove obligate" and thus an indicator of mangrove environments, also called mangals (Plaziat, 1984, 1995; Dalongeville *et al.,* 1991, Prieur, 1999). Its abundant presence in UAE archaeological contexts has been relied on to infer the former existence of extensive mangrove forests in the vicinity (Glover, 1991, 1999).

The discovery of three significant populations of T. *palustris* along the Gulf of Oman coast in environments devoid of mangrove vegetation enlarges the common understanding of the biology and ecology of this organism and may permit alternative environmental reconstructions of SE Arabian archaeological sites.

Distribution and biology of T. *palustris*

T. palustris is found in the tropics and subtropics of the Indo-Pacific region from the southeast coast of Africa to the western Pacific, including the Red Sea (Houbrick, 1991; Glover, 1999). It reproduces and disperses by means of a free-swimming veliger larval stage (Houbrick, 1991, citing Rao, 1938), but adults are typically associated with mangrove environments. Individuals take several years to mature. Adult size varies regionally, but growth is relatively rapid; a shell length of 20 mm or more can be reached within two years, and 40 mm or more within 3 years (Houbrick, 1991, citing Sewell, 1924, Rao, 1938 and Soemodihardjo & Kastoro, 1977).

In the mangrove environment, *T. palustris* is most often observed in the upper intertidal zone, where it may be emergent during most of the tidal cycle. It is typically concentrated, at least by day, under mangrove trees or shrubs or among dense pneumatophores (Plaziat, 1984; Crowe, 1997; Slim. *et al.,* 1997; Glover, 1999). Experiments in Darwin Harbour indicate that most displaced individuals actively return to available shade (Crowe & McMahon, 1997). T. *palustris* may also be found in tidal channels or in isolated deep, muddy pools, as within the mangal at Qurm, Oman (Smythe, 1983; *pers. obs.).*

Emergent individuals are typically immobile. Feeding and locomotion can nevertheless occur as long as the substrate remains damp, and may therefore be more prevalent at night (Plaziat, 1984; Slim *et al.,* 1997). Like other Potamidids, T. *palustris* is considered a detrital feeder, but various researchers have concluded that whereas immature T. *palustris* feed on algae and other microscopic organisms, adults (>50 mm) consume fallen mangrove leaves (Plaziat, 1984; Slim *et al.,* 1997). This dietary transition has been correlated with changes in the morphology of the radula (Plaziat, 1984 and Slim *et al.,* 1997, citing Annandale, 1924; Houbrick, 1991). It has been suggested that different dietary requirements could account for the somewhat different distribution of juveniles and adults, the former being reputedly more common in tidal channels and foreshore areas (Plaziat, 1984; Houbrick, 1991; Glover, 1999). Unusually for a Potamidid, T. *palustris* is said to have well developed gills (Plaziat, 1984, citing Risbec, 1943).

***T. palustris* in Arabia**

Glover (1999) maps the recorded occurrence of *T. palustris* in the Arabian Peninsula, but the result may say as much about the state of existing records for this part of the world as it does about the actual distribution of T. *palustris.* Her map shows a total of only five locations, all said to be associated with mangroves: three on the Gulf of Oman (one at Khor Kalba in the UAE and two near Muscat, apparently representing collectively Qurm, Yiti and nearby Bandar Khayran, and Qurayat, all named in the text) and two in Yemen (one on either side of the Bab El-Mandeb, the entrance to the Red Sea). Glover also mentions, but does not map, an Egyptian site in the northern Red Sea. On this basis, she concludes that the present day distribution of T. *palustris* in Arabia is restricted to these localities. As to the arid coast of easternmost Oman, she relies on the absence of records of *T. palustris* and personal observation that several larger lagoons near Ras Al-Hadd have little or no mangrove growth. Regionally, her map indicates sites along the Indus delta and the Rann of Kutch, on the border between SE Pakistan and NW India, but none along the intervening, arid Makran coast of Iran and Pakistan.

Other recent maps of mangrove areas in the circum-Arabian region (Sheppard *et al.,* 1992, Fig. 8.1; Plaziat, 1995, Fig. 1) indicate a relative wealth of potential sites for the occurrence of *T. palustris,* which Glover (1999) herself describes as "widely distributed throughout the Indo-Pacific wherever there is suitable mangrove."

In the Red Sea, mangroves are found as far north as the southern tip of the Sinai peninsula, and small pockets of mangrove are dotted along the southern coast of Arabia. In the Arabian Gulf and the Gulf of Oman, the most extensive mangals are apparently on the Iranian side, in the Straits of Hormuz and along the Makran coast. With the exception of SE Arabia, the areas in question remain difficult to investigate, for a combination of physical and political reasons. so that the absence of information cannot safely be interpreted as negative information. This logic is supported by the information newly reported in the present paper about mangroves and T. *palustris* along the relatively accessible and well-studied coast of Northern Oman.

***T. palustris* in *the* Arabian Gulf**

T. palustris was a major food resource for prehistoric inhabitants of the Northern Emirates, as evidenced by its abundant presence at coastal archaeological sites dating from at least the 5th millennium through the 2nd millennium BC, including 'Ubaid shell middens (Boucharlat *et al.,* 1991; Haerinck, 1991) and tombs and soil at sites from the Umm al-Nar and Wadi Suq periods in Ra's al-Khaimah (Glover, 1991, 1999). Its remains often show characteristic breakage and occasional charring but one shell was found to have been purposefully included in a rare well-preserved burial assemblage in a 3rd millennium BC Umm al-Nar tomb near Shimal (Velde, 1998).

At Tell Abraq on the border of Sharjah and Umm al-Qaiwain, *T. palustris* was common during the Umm al-Nar and Wadi Suq periods (late 3rd and early 2nd millennia BC) but rare in Iron Age contexts (1300-300 BC), although Potts cautions that this result largely reflects the nature of the materials available, since virtually no shell material of any kind was excavated from Iron Age levels at Tell Abraq (Potts, *pers.* comm.).

Prieur (1999) nevertheless concludes that T. *palustris* was a major food item for various Iron Age populations, as witnessed by the large shell accumulation along the littoral belt from Sharjah to Umm al-Qaiwain.

For the subsequent period, Prieur's compilation of seashell data from the inland site of Mileiha suggests that T. *palustris* declined in both its absolute and relative abundance throughout the record there, from 300 BC to 300 AD, although Mileiha is equidistant from both coasts and the provenance of shell material could not be determined (Prieur, 1999). Finally, T. *palustris* is only a minor constituent at the coastal site of early Christian era Ad-Door (c. 0-200 AD) (Glover, 1999) and is essentially absent at sites dating from the early Christian era to the present, *e.g.* Kush and Julfar in Ra's al-Khaimah (together c. 400 - 1700 AD) (Glover, 1999; Kennet, *pers.* camm.).

Ancient shells in excess of 70 mm can still be found in coastal sands in the Northern Emirates.They are also locally abundant in shallow subsurface accumulations in some khors where mangroves are found today, as at Khor Zawrah in Ajman. Elsewhere, shell fragments and whole smaller shells can be found weathering out of lithified beach sediments *(Plate* 2). However, modern investigators in the UAE, including the author, have been unsuccessful in finding *T. palustris* alive within the Arabian Gulf (Smythe, 1982; Dipper and Woodward, 1989; Hornby, *pers.* comm.).

Relatively fresh looking *T. palustris* shells, usually less than 70 mm in size, are occasionally found on beaches in the Northern Emirates, but until a living population is identified it seems prudent to suppose that such shells are re-deposited from sub-fossil occurrences such as described above. A trait believed to be indicative of re-deposition is a pinkish staining, presumed to result from iron oxides formed in the diagenetic environment.

Plate 2: Sub-fossil T. *palustris* weathering from recent sediments

Despite its former abundance in the Northern Emirates, *T. palustris* is essentially unknown elsewhere in the Arabian Gulf. The most westerly shell so far reported from Arabian Gulf beaches (i.e. in a non-archaeological context) is from Jebel Ali in Dubai emirate, near the border with Abu Dhabi (Fowler, *pers.* comm). With three exceptions, it is absent from beach sands, sedimentary deposits and archaeological contexts in Abu Dhabi emirate to the SW (Beech, *pers.* comm.; Hellyer, *pers.* comm., citing studies by geologist Graham Evans and archaeologist Geoffrey King), as well as to the North in Bahrain (Green, *pers.* comm.) and Qatar (Hellyer, *pers.* comm.). This is despite the current and historical presence of mangroves, albeit a reduced presence in the case of Bahrain and Qatar, which are at the limit of mangrove tolerance due to occasional frosts (Sheppard *et al.,* 1992). About a dozen shells have recently been collected in association with Late Islamic pottery (17118th-20th century) at Al-Aryam Island, W of Abu Dhabi Island, (Hellyer, 2000), while others were identified on archaeological sites at Jubayl in 1995 and Ras Sadr in 1997 (Hellyer, *pers.* comm.). These represent the only known occurrences west of Jebel Ali.

T. *palustris* in mangrove environments on the Gulf of Oman coast

Gulf of Oman mangals

In September-October 1999 and August 2000 the author reconnoitered the entire Gulf of Oman coast north of Sur, Oman, looking for both mangroves and T. *palustris.* Six mangals were confirmed, all with T. *palustris (Fig. 3).* Four of these sites are on the Batinah coast, the broad and relatively populous coastal plain NW of Muscat, extending north to the UAE border. These are, from N to S: Khor Kalba in the UAE, just N of the border with Oman, Shinas and Harmool (near Liwa) in the northern Batinah, and Qurm, a NW suburb of the Muscat capital area. The mangals at Qurm, Shinas and Harmool have all been turned into simple nature reserves, with small areas developed for easy access and viewing. The beach at Qurm is a popular public recreation area. The other two sites are located along the more rugged coast SE of Muscat: Bandar Khayran, a steep-sided bay, and Qurayat, a more typical estuary.

The Batinah coast mangals

The Batinah sites, including Khor Kalba, are similar in most respects. All are "hard-bottomed mangals (Sheppard *et al.,* 1992), having only a relatively thin veneer of sediment overlying bedrock in the near subsurface. The only mangrove species present, as elsewhere in SE Arabia, is *Avicennia marina,* the species most tolerant of high salinity and most resistant to both high and low temperatures (Sheppard *et al.,* 1992; Plaziat, 1995). At each site the mangal consists of an area of 4-8 km of branching tidal channels and flats set in a depression behind and parallel to a broad ridge of sand that forms the beachfront. The beachfront is 100 to 200 m wide, crossed obliquely by an channel that fills and drains the mangal. Qurm has two such channels, one at either end. At Khor Kalba both the beachfront and the inlet channel are very wide and the inlet has been improved for use as a harbour for small fishing boats.

Mangrove growth *is* densest adjacent to the tidal channels but extends to almost the mean high water mark. Beyond this is normally a zone of barren, saline ground with a disrupted surface indicative of intermittent inundation and desiccation between the highest spring tides. Still further from the channels the growth of saltbush begins.

T. *palustris* is locally abundant at all of the Batinah sites. Some differences in distribution were observed, but are

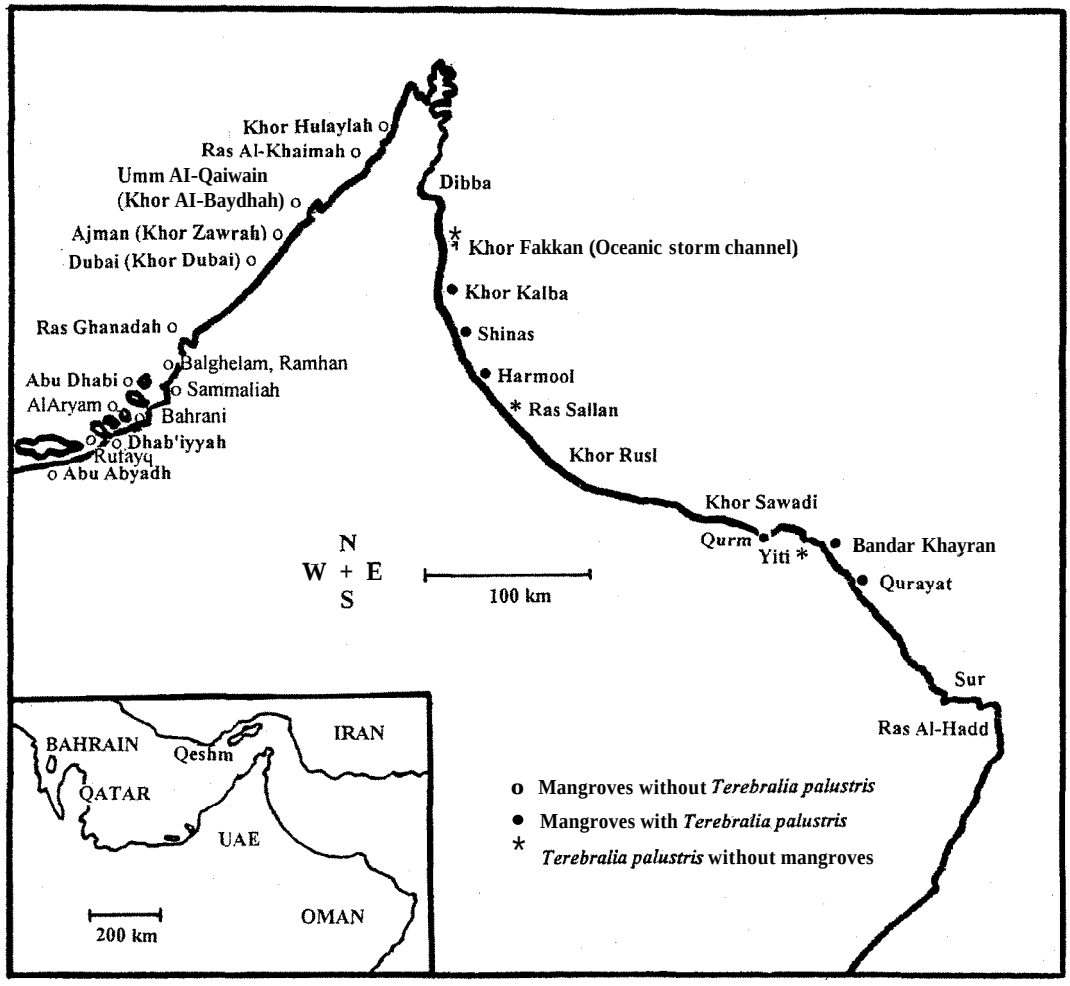

Plate 3: Distribution of *Terebralia palustris* in south-eastern Arabia

of uncertain significance. For example, at Qurm T. *palustris* was common beginning in the most seaward mangroves and the smaller mud creeper *Cerithidia cingulata* was essentially absent. In contrast, at Shinas T. *palustris* was absent for the first kilometre of the main channel, whereas C. *cingulata* was hyperabundant there, declining and disappearing as *T. palustris* became more abundant upstream. T. *palustris* was present in the most distal reaches of mangrove channels at Khor Kalba and Harmool, but at Shinas it was absent for half a kilometre below the uppermost mangroves. T. *palustris* shells in excess of 100 mm were common at Shinas and Harmool. The largest measured was 113 mm. In contrast, of hundreds of T. *palustris* observed by the author along the bank of the westerly channel at Qurm, only a few measured 90 mm or more, most being in the range of approximately 50-85 mm.

T. *palustris* can reportedly survive for as long as three months out of water and without flood (Houbrick, 1991, citing Soemodihardjo and Kastoro, 1977). Survival times even a fraction of that would have made it a very convenient portable source of fresh protein for earlier human residents. *T. palustris* at Qurm has been eaten by the local population in modern times (Biagi et al., 1984-85), and continues to be eaten on occasion (Green, pers. comm.) in spite of its protected status there. The same has been reported for Shinas (Curtis, pers. comm.). The modern practice appears to resemble the ancient one, and typically involves breaking at least the outer lip of the aperture in order to extract the shellfish, which is cooked over an open fire (Biagi et al., 1984-85; Franke-Vogt, 1987; Green, pers. comm.). In contrast, T. *palustris* at Khor Kalba appears to be ignored by the modern East Coast populace of the UAE, who nevertheless hunt other mangrove denizens.

Khor Kalba

At Khor Kalba, where live T. *palustris* went unremarked until the 1990s, the largest shells are generally 90-95 mm and the largest measured was 103 mm. Large shells are common, but there are also areas, both within and at the edge of the mangal, where medium (60-80 mm) or small (20-60 mm) shells prevail. T. *palustris* was found on substrates ranging from mud to sand to fine gravel, including the bottom of fast flowing tidal channels, but it was most common on mud in the shade of mangrove trees or shrubs or among pneumatophores, especially where the surface remained damp or puddled. The number of T. *palustris* at Khor Kalba is estimated at a minimum of 25,000, as follows: 10 km of suitable channel bank; an average of 2.5 m of suitable substrate along such banks; and an average density of 1.0 individual per sq.m on suitable ground. These parameters are believed to be conservative and the actual number of *T.* palustris may be as many as 100,000 or more. The maximum observed density of adults was approximately 30 per sq.m.

A small number of adult *T. palustris* (>60 mm) at Khor Kalba were observed to climb pneumatophores. This occurred at a single site and on a single occasion, in the uppermost channel in an area of very fine mud, still

submerged at low tide to a depth of 10-12 cm. Such behaviour is not known to have been mentioned in the literature, although *T. palusfris* has been depicted leaning itself vertically against the prop roots of mangroves to spawn (Houbrick, 1991, citing Shokita *et al.,* 1984). An alternative stimulus could be some aspect of water quality, and it might be significant that a number of decomposing *T. palustris* were found in an emergent area of open mud nearby. Confusingly, a distinctive hermit crab occupies the empty shells of adult T. *palustris* along the Gulf of Oman coast and is locally common within the mangroves at Khor Kalba, where it often climbs submerged pneumatophores.

The problem of juveniles

Except at Khor Kalba, *T. palustris* shells smaller than 50 mm were scarce along the Batinah coast. At Shinas and Harmool smaller shells were not seen at all (but interior areas were not thoroughly investigated) and at Qurm the few shells smaller than 50 mm were inhabited by hermit crabs. It may be a sufficient explanation that juveniles have a somewhat different diet and habits from adults, as mentioned above, favouring tidal channels (Plaziat, 1984; Houbrick, 1991; Glover, 1999), but it is surprising that virtually all juveniles could remain hidden, especially in light of experience at Khor Kalba, where juveniles were evident and locally abundant on a variety of substrates, both with and without adults. Juveniles were also readily observable among adults in other mangrove and non-mangrove populations, as reported below. A possible alternative explanation could be that recruitment is not successful at every locality in every year, for one reason or another, with the result that not all age groups are represented in a given neighbourhood. This hypothesis would discount significant migration within the mangal.

Bandar Khayran and Qurayat

Bandar Khayran is a digitate, deep water embayment along a mountainous stretch of coast. It represents the drowned confluence of several wadis. Mangrove forest is best developed at the mouths of the three largest (dry) tributary watercourses. Glover (1999) reported *T. palustris* from the western lagoon and the author found abundant *T. palustris* in the eastern lagoon, the area of most extensive mangrove, in mixed sizes from c. 35-105 mm. Exceptionally for SE Arabia, mangrove is also developed here as a narrow fringe at various places along the steep shoreline.

Adjacent to the town of Qurayat, mangrove forest is well developed within a long (>2 km) sinuous estuary that traverses the coastal plain and represents the terminus of a substantial drainage area in the hinterland. Time and tide did not permit the author to enter this mangal, but Glover (1999) reported *T. palustris* from "near Quriyat" and there is no reason to doubt this.

The Qurayat area, for 10 km SE to Daghmar, represents the last development of an alluvial. coastal plain in the area north of Sur. From Daghmar for 90 km S to Sur the coast is an uplifted terrace of variable width, developed at the foot of the Jebel Bani Jabir massif which rises inland to more than 2000 metres. The modern shoreline everywhere drops to the sea in cliffs of several metres or more. The terrace is cut by numerous wadis but all are steep-sided with coarse gravel bottoms all the way to the sea. There are no mangroves and no *T. palustris.* Glover (1999) implies that this is due to aridity, but it appears to be due at least equally to geology and geography.

T. palustris in non-mangrove environments on the Gulf of Oman Coast

The Oceanic storm channel

A chance observation in May 1998 revealed a large and apparently healthy population of thousands of *T. palustris* on the East Coast of the UAE at Khor Fakkan, in shallow water in the lower reaches of a large, open, flat-bottomed concrete storm drainage channel *(Plate 4).* The nearest mangrove trees are more than 40 km to the *S,* at Khor Kalba. The significance of the occurrence of T. *palustris* without mangroves was recognised and the

Plate 4: *Terebralia palustris* exposed in the Oceanic Hotel storm channel, Khor Fakkan, UAE

site was re-visited for further study by Maria Larkworthy in May 1998 and by the author in October 1998, June 1999 and January, March, July and October 2000. The measurements given below are approximate, but measurement and orientation along the channel are facilitated by the fact that the concrete banks are jointed at roughly 3 m intervals.

The storm drainage channel was constructed more than a decade ago to divert storm runoff from a small foothills watershed away from areas developed for residential use. Being situated just north of the Oceanic Hotel in Khor Fakkan, the channel is herein called the Oceanic storm channel. It is approximately 660 m long, extending inland in a gentle arc to the base of the coastal foothills, where it is fed by two smaller catchment channels which end after a few hundred metres *(Plate* 5). The main channel is crossed by three small bridges, one at about 350 m inland for the main coast road and two for residential streets, one at about 425 m and one at its terminus at 660 m inland.

The bed of the channel is 10 m wide and is set 2.5 m below the ground surface. The channel walls slope upwards at a 26.5 degree angle to a channel width of 20 m at ground level. Nearest its mouth at the beachfront, the banks are built up above ground level to maintain constant channel depth. At low tide the seaward end is separated from the water's edge by a low and variable berm of sand, coarse gravel and rock about 10 m wide. In addition, the channel appears to have been constructed with a slight landward gradient in its nearshore reaches. The combined effect is that the channel remains permanently inundated, even at low tide, for a distance of at least 370 m inland (just beyond the first bridge). The minimum water depth in most of this area is from 17 to 40 cm.

The depth of permanent water depends to some extent on the height and condition of the seafront berm, so it varies somewhat over time in response to wave action and storm flushing. In May and October 1998, the channel emptied above the first bridge (>370 m) at low tide, but the area between the first and second bridges has since been permanently inundated by at least a few cm. At neap tides with a high berm, the sea may not enter the channel for several days in succession. According to local tide tables, the highest spring tides may be as much as 85 cm above lowest neap highs. However, observation suggests that the customary 'tidal' range within the channel is much less, being from 0 - 40 cm. At spring high tides, at least a tongue of high water reaches the third bridge (660 m.). Exceptionally, water depths there can reach 30 cm, but the uppermost channel bed is seldom flooded to more than a few cm.

There is no evidence of regular fresh water input, either natural or artificial, other than from storm runoff. The water has always appeared clean and smelled fresh, although the site is not particularly attractive. Some construction waste is present, plus a small amount of litter. Where it is permanently inundated, the bed of the channel is covered in a thin (c.1-8 cm) layer of dark, organic rich mud topped by a dusting of pale green-brown debris that appears to be primarily the disaggregated remains of *T. palustris* faecal pellets. When fresh, these distinctively sculptured 5-6 mm pellets have the appearance of a tiny human ribcage. Clean gravel predominates near the mouth of the channel where tidal flow is faster.

The sloping concrete banks are covered by a thin film of algae up to the low water level. In the uppermost reaches of the channel the bottom is saline mud exhibiting surface features characteristic of intermittent prolonged desiccation. The site has not been observed during storm runoff or its immediate aftermath, but Khor Fakkan is not known to have experienced significant rain during the 2-1/2 year period of observation reported here.

T. palustris is the most abundant mollusc in the channel. The population includes snails ranging from 15 to 95 mm in length, indicating that several generations are present, although medium and large shells are the most common. The majority are concentrated on the bed of the channel nearest the sloping banks, on or in the mud. Many adults also cluster at the waterline along the sloping concrete bank, typically with aperture and shoulder partly emergent. This is most apparent on a falling tide

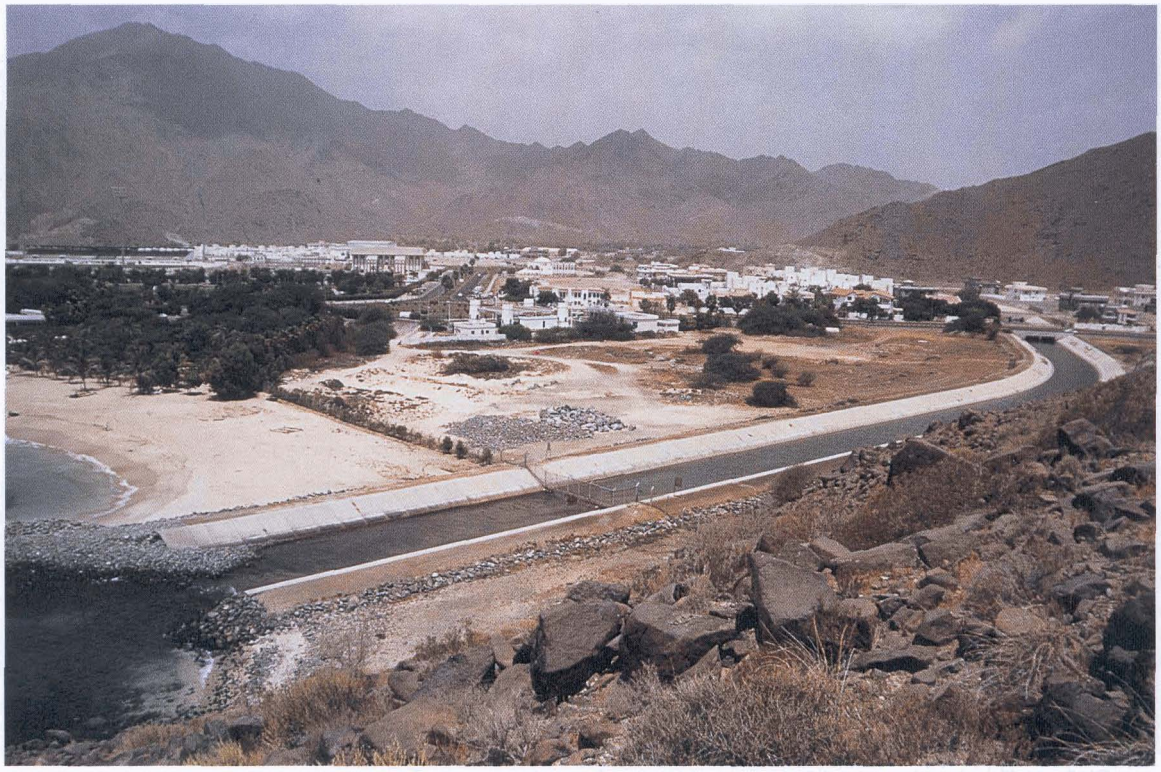

Plate 5: The Oceanic storm drainage channel, Khor Fakkan, UAE

and numbers are greatest when the low tide occurs at night or in the early morning. Presumably it represents a retreat after feeding in the intertidal zone at high water. Slime trails show that some individuals crawl above the waterline at night. After nighttime spring tides, a small number have been observed as much as 50 cm from the low waterline, attached to the concrete wall or lodged in joints in the concrete.

There are somewhat fewer shells in the centre of the channel and a small proportion there (c.1 in 10), but including many of the smaller ones (Larkworthy, *pers. comm.),* were found to be dead or inhabited by hermit crabs. Small shoals of dead shells were recognised above the first and second bridges. Two new such shoals were observed in October 2000, totalling more than 1000 shells.

In June 1999 the author estimated a minimum population of 7,000, using the joints in the concrete to facilitate counting and allowing for at least 10% dead shells overall. However, mathematical extrapolation from estimated average densities observed adjacent to the channel banks (c.8 per sq.m) suggests that the actual population may equal or exceed 14,000.

The range of *T. palustris* within the channel has varied over time. The cause of these migrations is unknown but the capacity is evident. The landward limit varied in May 1998 from 0-30 m seaward of the first bridge, but in October 1998 abundant *T. palustris* were exposed at low tide between the first and second bridges and since then they have regularly been found above the second bridge, to 490 m. Similarly, the most seaward *Terebralia* in June 1998 were at about 105 m from the channel mouth. Occasional shells found below this point were inhabited by hermit crabs. In January 2000, however, T. *palustris* was found seaward as far as 50 m, even on gravel substrate, and in July 2000 more than 1000 live *T. palustris* were clustered on gravel and even among brick-size rocks in the very first few metres at the channel mouth. This latter occasion witnessed *T. palustris* densities of c.250 per sq.m. *(Plate 6),* higher than the maximum of 150 per sq.m. reported by Plaziat (1984) from Pacific mangrove environments. A channel-flushing event of some sort was suspected, but local residents said that there had been no rain and observations in the upper channel revealed no evidence of recent flushing. Three months later the same area had no adult T. *palustris,* but hundreds of 35-45 mm juveniles were scattered throughout the first 30 metres.

As in the mangrove environment, few other molluscs are associated with T. *palustris* in the Oceanic storm channel. All are found on the sloping banks of the channel, not on the mud/algae bottom. *Cerithidea cingulata*, *Planaxis sulcatus* and *Clypeomorus bifasciatus persicus* are all found in the lower channel in variable numbers, declining gradually from 170 to 240 m. Occasional nerites, *Siphonaria* sp. and *Cronia* sp. have also been found in the lowest reaches and the dead, attached shells of one or two oyster species are abundant on the submerged banks from 110 to 180 m.

T. *palustris* is the dominant mollusc above c.135 m from the mouth of the channel and is one of only four species found living above 240 m. *Nodilittorina arabica,* a small supratidal winkle, was present in modest numbers to 440 m in June 1999 but only a single one was found in January 2000. Small numbers of another winkle, *Littoraria (Littorinopsis) intermedia,* were found between the first and second bridges (360-420 m) in October 1998 when this area was exposed at low tide, but not on any other occasion (L. *intermedia* is the local mangrove tree snail, but also inhabits sheltered intertidal rocks). A few live C. *cingulata* were present in isolation on gravel at 430 m in July 2000.

The Oceanic storm channel is also home to some half dozen species of crabs and small schools of at least six species of marine fish, some of which were seen as far up as 460 m. The fiddler crab *Uca annulipes* overlaps with the uppermost *T. palustris,* but mostly occupies the higher, drier, saline mud where the channel bed is flooded less regularly and more thinly.

Perhaps the most salient observation at the Oceanic storm channel, apart from the very presence of *T. palustris* in a non-mangrove environment, is that most of the *T. palustris* there are seldom or never fully exposed by the tide. This represents a significant difference from

Plate 6: Concentration of T. ***palustris*** at the mouth of the Oceanic storm channel

Plate *7:* The khor at **Ras** Sallan, Oman

the behaviour and ecology of the species as it is typically described.

Ras Sallan

The discovery of T. *palustris* in the Oceanic storm channel prompted investigation of other non-mangrove, khor-like environments along the Gulf of Oman. To the north, within the UAE, the foothills of the Hajar mountains extend to the coast intermittentlv as rocky headlands, and no promising sites were recognised. To the south, however, on the Batinah coast of Oman, a population of 2,000-4,000 *T. palustris* was found at Ras Sallan, the first significant khor SE of the mangroves at Harmool, c.25 km distant.

Ras Sallan is a small cape with a central khor which constitutes the terminus of Wadi Jizzi, a major but intermittent effluent of the Hajar Mountains. The khor is essentially linear, 1.0 km long by 100-150 m wide (Plate *7*). Upstream of the khor. the wadi consists of coarse gravel and supports terrestrial vegetation including shrubs and scattered trees.

The khor is fed from the sea by a sinuous channel of varying width that obliquely crosses some 200 m or more of sandy beachfront. At its junction with the khor itself, this channel is about 4 m wide and about a metre deep at low tide. It appears to be open to the sea at all times, so that the khor fills or drains continuously throughout the tidal cycle. The tidal range appeared to be only about 30 cm on a full moon. The depth in the centre of the khor at low tide was somewhat less than one metre and children waded in to check a few traditional fish traps. The depth of much of the upper khor at low tide was 15 cm or less, with parts emergent.

The khor is flanked on the NW by traditional agricultural plantations (primarily date cultivation) and the bank is mostly compacted silt. The SE shore is now stabilized by a concrete embankment which buttresses a large public park adjacent to the khor. The bed of the khor varies from gravel near its head, where a two-lane paved road crosses, to sand, silt and mud towards the seaward end. A few accumulations of dark green seaweed were present towards the seaward end, but landward a thin coating of pale green algae prevails.

T. palustris was found along almost the full length of the NW shoreline of the khor, and on a variety of substrates (Plate *8*), except near the inlet channel where the banks were steep and composed of well-washed beach sand. The smaller Potamidid C. *cingulata* was the only other gastropod seen and was the more common of the two,

Plate *8: Terebralia palustris* on gravel at Ras **Sallan**

except in the shallow upper half of the khor where coarse sand and gravel substrates predominated.
Unlike mangrove populations, but like the Oceanic storm channel population, the vast majority of *T. palustris* at Ras Sallan remained submerged at low tide. This, plus the fact that visibility in the turbid water was effectively limited to 30 cm or less, made the abundance of T. *palustris* difficult to appreciate except at or near low tide. Fewer than a dozen *T. palustris* were seen above the water's edge, most of these on a single bank of sand among C. *cingulata.* None were more than about 45 cm from the water's edge and the few furthest individuals had apparently abandoned the attempt to return to the water and instead had dug themselves into a shallow groove in the sand. Many individuals seen underwater in sand near the shoreline were also anomalous in being partly buried, although it was not ascertained whether this was a matter of behaviour or of the physics of the sandy substrate and the gentle surface waves.
The size of *T. palustris* at Ras Sallan ranged from 50 to 85 mm. Those in the inland half of the khor tended to be larger, but a few 80 mm shells were found even in a calm, sandy embayment of the inlet channel, just behind the main beachfront berm. At five selected locations whew larger concentrations were observed, it was possible to count at least 100 individuals along a stretch of shoreline ranging from 3 to 8 m. *As* T. *palustris* was also present in modest numbers between these concentrations and as not all *T. palustris* could be readily observed, it is estimated that the minimum population is 3-4 times the sample count, or 1500-2000 individuals, and the actual numbers could be as much as 4,000. Although not a large population by the standards of *T. palustris*, this number is not negligible.

Khor Rusl

Khor Rusl is about 60 km SE of Ras Sallan, near the coastal town of Khabourah. It is the principal modern day outlet of Wadi Hawasina and bears a strong resemblance to the khor at Ras Sallan, except that it is slightly shorter and shallower overall (c.700 m long by 100-150 m wide, with an estimated maximum high tide depth of 60 cm). t is flanked by traditional agriculture and waste ground on both sides, Despite these similarities, only a single 33 mm *T. palustris* was found here, alive, on a thin layer of algae over gravel substrate near the head of the khor, in just a few cm of water.
C. *cingulata* was also present at Khor Rusl, but in atypically modest numbers, mostly near the junction of the sandy inlet channel. It was absent from most of the upper intertidal zone, which here was especially flat and muddy on the southeast shore and was occupied instead by burrowing crabs, which were more common than at Ras Sallan. This limited range, coupled with water turbidity and the shallow gradient, made it difficult to locate any gastropods at all except at lowest tide.

Khor Sawadi

Khor Sawadi is the next major khor to the E, another 80 km distant, and 75 km from the Qurm mangal. Khor Sawadi corresponds to the outlet of Wadi Bani Kharus, but, unlike the khors to the NW, described above, it is not linear in form. Instead it is a broad sub-circular tidal flat, more than 2 km in diameter, connected to the sea by a winding 500 m channel through the sandy beachfront. Khor Sawadi, surprisingly, is understood to have no mangrove growth (Gallagher, *pers. comm.*) and was visited briefly n order to investigate whether *T. palustris* might be able to thrive over such a large area in a purely estuarine environment. This was not the case, at least at Khor Sawadi. At low tide on a full moon the khor appeared almost empty. Only on closer approach could 'it be determined that a few narrow channels continued. generally no more than about 10 cm deep. for kilometres inland. Two such channels were examined for a distance of approximately 1 km each. C. *cingulata* was abundant and dozens of ghost crabs (*Ocypode* sp.) were seen, but the only *T. palustris* were dead shells found where the inlet channel cuts deeply through the subfossil deposits of the beachfront.

Yiti

Glover (1999) lists Yii as a *T. palustris* site, implicitly *in* association with mangroves?but her precise authority is ambiguous. *T. palustris* is present at Yiti, but there are now no mangroves and no indication of any in the recent past. The main khor is a 1.5 km long, shallow estuary connecting inland with the channels of two converging wadis, Wadi Mayh and Wadi Jibbah, and protected from the sea by a low barrier beach. The seaward portion of the estuary is used as a harbour for small fishing boats, which enter at high tide via a shallow inlet.
T. *palustris* is found in the seaward portion of the channel of Wadi Jibbah, which remains inundated for almost another kilometre inland, 'even at low tide. An estimated 500 T. *palustris* were present at this site in August 2000 along the shallow banks of a half-kilometre stretch of channel. They ranged in size from 20 to 98 mm, approximately half being longer than 50 mm. The substrate is dark grey, soft, presumably organic-rich mud with a cover of bright green filamentous algae. C, *cingulata* was hyperabundant in the same area but most individuals of both species were faund only in the lowest intertidal zone, either In a thin film of water or on puddled surfaces. They are therefore relatively difficult to observe except at lowest tide- The exception was on the north bank of the channel, bordered by rock cliffs, where a number of larger *T. palustris* were found at low tide more than a metre from the waterline, on firmer silty mud and algae (*Plate* Q). Local children gave no indication that they were aware that T. *palustris* was an edible or otherwise significant species.

Plate *9: Terebralia palustris* beside *a cliff* at Yiti

Discussion

Mangrove "obligacy"

The presence of apparently healthy populations of T. *palustris* in estuarine habitats not at all associated with mangroves is substantially different from what has been described for this species. As a result, further discussion is merited, not to mention further observation and study. These may help to better define the environmental limitations within which T. *palustris* can thrive, and thereby help to explain why it has not been found in the Arabian Gulf in recent times.

At a minimum, the characterisation of *T. palustris* as a "mangrove obligate" must be re-evaluated. The relationship between T. *palustris* and mangroves is better described as one of covariance, with each of them adapted to similar but not necessarily identical conditions. This should not be a surprising conclusion, since it is a commonplace of mangrove studies that very few organisms are in fact restricted to the mangal (see, *e.g.,* Sheppard *et al.,* 1992; Plaziat, 1995). Indeed, not all authors have seen fit to highlight the mangrove association of T. *palustris (e.g.* Bosch, 1982; Springsteen & Leobrera, 1986; Wye 1996).

Mangroves without T. *palustris:* The Arabian Gulf

The Arabian Gulf is characterised by high salinity, high water temperatures and high annual water temperature variation, relative to tropical and subtropical marine waters generally. These factors affect both the diversity of species found there and the development of individual organisms, many of which live, at least seasonally, at the margin of their environmental tolerances (McKinnon, 1990; Dance, 1995). The physiology of T. *palustris* has not been studied, but it seems most straightforward to assume in the first instance that it is the known rigours of the Arabian Gulf which account for its general absence there, despite the modest success of the mangrove *Avicennia marina.* From this perspective, it is the presence of T. *palustris* along the Arabian Gulf coast of the Northern Emirates in recent prehistoric times that requires explanation. It is beyond the scope of this paper to resolve that question but local studies suggest some potentially profitable lines of inquiry.

Because *T. palustris* is able to employ behavioral alternatives to deal with atmospheric temperature (discussed below) and because the relatively deep littoral waters of the Northern Emirates buffer the Gulf's most extreme water temperatures, salinity seems somewhat more likely to be a limiting factor, acting on either the adult or larval population. Thus, in anticipation of further study, it is suggested that the former presence of T. *palustris* in the Northern Emirates can be plausibly attributed to a period of locally reduced *(i.e.,* normal) salinity, due possibly to better mixing with the waters of the Indian Ocean through the nearby Straits of Hormuz, or, somewhat less speculatively, to increased freshwater influx from the adjacent hinterland. In a similar manner, freshwater input from the Tigris-Euphrates waterways into the northern Arabian Gulf today influences the composition and development of the intertidal and marine fauna there (McKinnon, 1990; Sheppard *et al.,* 1992; Dance, 1995).

It is generally accepted that the climate of the Arabian Gulf and the surrounding region was substantially wetter and milder during the so-called Climatic Optimum from approximately 10,000 to 6,000 years BP (Glennie, 1997; Potts, 1997; Sanlaville, 1998; Uchupi *et al.,* 1999) and thereafter deteriorated to present day levels of aridity. What does not seem to be well established is the rate and/or episodicity of this deterioration. It is thought that in the Northern Emirates a more humid environment continued until at least 3000 BC (Potts, 1997, citing Glennie *et al.,* 1994; Blanchet *et al.,* 1998) and possibly 2500 BC or beyond (Hellyer, 1998; Sanlaville, 1998, Fig. 2; Uchupi *et al.,* 1999). The shift in resource use from terrestrial animals to marine resources during the Wadi Suq period (c.2000-1200 BC) at Tell Abraq and Shimal (Potts, 1997) can be interpreted (although not conclusively) as evidence of a significant increase in aridity at a still later date. Thereafter, archaeological evidence of climate may be somewhat camouflaged by the introduction of *falaj* irrigation in the area.

Estimates of the onset of present day climatic conditions range from 5000 BP (Blanchet *et al.,* 1998) to 3000 BP (Uchupi *et al.,* 1999). The overall picture is not inconsistent with a parallel decline in both freshwater influx and the abundance of T. *palustris* in the Northern Emirates, during the course of period from the late 2nd millennium through the 1st millennium BC, particularly if it is recognised that subterranean groundwater systems may lag significantly behind climatic change *(e.g.,* Sanlaville, 1998).

In a wetter climate, freshwater input would have been increased, along with an expansion in estuarine conditions, a reduction in evaporation rates, an increase in terrigenous sediment and nutrients, and a decrease in the salinity of Gulf waters generally and littoral waters in particular. In the case of T. *palustris,* given a climate only somewhat less arid than today, the Hajar Mountains of the UAE (including the high peaks of the Musandam Peninsula) may have played a critical role by inducing precipitation and channelling it to the coast of the Northern Emirates, allowing T. *palustris* to flourish there although it remained unable to survive elsewhere around the Arabian Gulf. This hydrologic system is at present largely latent but perhaps not unobservable; the author is aware of unconfirmed reports of freshwater springs within a mangrove khor near the foot of the mountains north of Ra's al-Khaimah. By way of comparison, Glennie *et al.* have proposed that continuing humidity in the 4th millennium BC, following the Climatic Optimum, was the result of wind systems weaker than those at present, "permitting convection-induced thunderstorms in coastal and mountainous areas" (Glennie *et al.,* 1994, cited in Potts, 1997).

One indicative test of the above hypothesis might be to confirm (or deny) the presence of T. *palustris* in the extensive mangroves inshore of Qeshm Island, Iran, in the Straits of Hormuz. This site is more northerly than Bahrain but it is situated between the delta of the seasonal Mehran River and the mouth of the Kol River, where freshwater influx may remain relatively high in comparison to other southern Gulf locations.

Glover (1999) related the decline of T. *palustris* to the decline of mangrove forestation and appeared to favour the hypothesis of decreased freshwater flow on the grounds that freshwater influx is important for mangrove growth, but it is not clear that this reasoning is applicable to the mangrove *Avicennia marina,* which is able to colonize small oceanic islands throughout its range, including the Arabian Gulf.

The possible significance of freshwater input generally is suggested by the nature of the extant T. *palustris* sites in SE Arabia. The Batinah coast sites do not receive any surface flow of freshwater, save under exceptional circumstances, but the agricultural fertility of the Batinah coast as a whole results from the fact that underground aquifers bring groundwater from the Hajar Mountains close to the surface in this area. Glover (1999) reports that the Qurm lagoon is in fact fed by a permanent freshwater spring. The T. *palustris* sites at Ras Sallan, Yiti and Qurayat are all associated with major, albeit ephemeral, watercourses.

Another indicator of fresh water influence may be the presence of the small Potamidid *Potamides conicus,* generally considered a brackish water species, found at the uppermost extremities of tidal channels at Khor Kalba and Shinas, bordered only by saltbush. Smythe (1983) also reported *P. conicus* at Qurm in the "outer channels . . . and in the outflow." This species is apparently tolerant of hypersaline conditions as well, and

is abundant at a number of restricted circulation sites in backbeach environments along the Arabian Gulf coast of the Northern Emirates as well as the Gulf of Oman coast between Quravat and Sur, without either T. *palustris* or mangroves.

Human over-exploitation of both T. *palustris* and mangroves is another factor that has been advanced to account for the apparent extinction of T. *palustris* in the Northern Emirates *(e.g.* Franke-Vogt, 1987). This is a superficially attractive explanation, given the archaeological evidence of extensive harvesting and the growing awareness that primitive cultures were not necessarily wise custodians of natural resources, but it is open to question whether human predation can reasonably account for the complete extermination of a species that replenishes itself by means of pelagic larvae. At a minimum, this implies that Arabian Gulf populations of T. *palustris* had come to be dependent on dispersal of larvae from sources exclusively within the Gulf itself.

Glover (1999) has suggested the "failure of larval recruitment" as an independent variable to explain the absence of T. *palustris* in the Arabian Gulf. However, to the extent that successful recruitment (at what are perceived to be otherwise suitable sites) does not depend on factors such as temperature, salinity and freshwater input, this suggestion seems to invoke either the failure of ocean currents to transport the larvae, or marine predation enroute. While the latter factors cannot be ruled out, it is worth noting that the mangrove tree snail of the Arabian Gulf, *Littoraria (Littorinopsis) intermedia* (which is not a mangrove obligate and also occurs on rocks in sheltered intertidal environments), disperses by means of pelagic larvae (Reid, 1986) and is present in diverse Arabian Gulf locations including Bahrain (Green, *pers. comm.),* Abu Dhabi (Hornby, *pers. comm.)* and the Northern Emirates.

T. palustris without mangroves

The above factors can perhaps explain why the mangrove *Avicennia marina,* which is notoriously tolerant, can occur in the Arabian Gulf without *T. palustris.* But how does T. *palustris* occur without mangroves? It appears that the animal is more plastic or has somewhat different requirements than recognised to date.

For example, T. *palustris* has commonly been said to "prefer" shade, if not require it. The author's observations in SE Arabia do not contradict this as a generalisation true of mangrove areas (although not all T. *palustris* in mangals are found in shade), but the association may be secondary. The primary association is perhaps with concealment, but more likely with a damp substrate (to facilitate both moisture conservation and feeding) andlor the avoidance of overheating. In the absence of shade, as at the Oceanic storm channel, Ras Sallan, and Yiti, T. *palustris* appears to satisfy the same imperatives by the simple strategy of remaining underwater.

Even the concrete substrate of the Oceanic storm channel is not as unsuitable as it seems at first, at least with a thin veneer of mud and/or algae. T. *palustris* is normally found on mud or silt but it is not a burrower and can also be found on sand and locally even on gravel, as at Khor Kalba and Ras Sallan. The protoconch of T. *palustris* shells is invariably dissolved or eroded in the acidic mangrove environment. The same is true, however, of shells inspected at the Oceanic storm channel, even 35 mm juveniles. This presumably reflects a similarly acidic micro-environment, which may be additional evidence of the organic-rich nature of the mud and algae substrate there.

The presence of a T. *palustris* population in a storm water drainage channel inevitably encourages speculation that freshwater input may somehow be significant. *T. palustris* evidently does not absolutely require brackish water to survive, but perhaps seasonal or occasional influxes of freshwater may play a role in the normal life cycle of the species, *e.g.* spawning, which is said to be seasonal elsewhere (Houbrick, 1991, citing Shokita *et al.,* 1984). Freshwater streams no longer reach the mangrove khors or other estuaries of the Arabian Gulf coast, but may have done so at least seasonally at the time when T. *palustris* was abundant in the archaeological record, as discussed above.

Whatever the reasons, regional differences in habitat range are not without precedent within the genus Terebralia. The smaller T. *sulcatus* of tropical and subtropical Australasia is restricted to mangrove environments in Western Australia but is found in Hong Kong on sandy and rocky habitats among salt marsh and in protected bays from which mangroves are absent (Houbrick, 1991, citing Wells, 1983).

The diet of T. *palustris*

Plaziat (1984) reported that adult T. *palustris* in New Caledonia feed on fallen mangrove leaves of *Rhizophora* sp. Houbrick (1991) reviewed and endorsed similar conclusions. Studies in Kenya credit T. *palustris* with a significant contribution to the recycling of fallen mangrove leaves of *Ceriops tagal* (Slim *et al.,* 1997). Nevertheless *T. palustris* does not appear to eat mangrove leaves within the mangals of SE Arabia. Adult shells are seldom found with their apertures atop fallen mangrove leaves and, although leaves can be observed which resemble the rasped leaves depicted by Plaziat (1984), these are greatly outnumbered by intact leaves. This discrepancy is apparently resolved by the unpublished work of Crowe, who has found that caged *T. palustris* actively rasp *Rhizophora* leaves, and to a lesser extent *Ceriops,* but avoid *Avicennia* leaves (Crowe, *pers. comm.*).In any case, *T. palustris* at sites such as the Oceanic storm channel and Yiti are able to reach fully adult sizes in the total absence of mangroves. Both subtidal or lower intertidal distribution and an algae/detritus diet are characteristics said to be associated with juvenile T. *palustris* in mangrove environments (Plaziat, 1984; Houbrick, 1991). To this extent it can be said that T. *palustris* has adapted to certain non-mangrove environments in SE Arabia by retaining an essentially juvenile lifestyle. Dietary adaptation by local populations may be facilitated to the extent that even adult T. *palustris* does not directly consume the leaves of the local mangrove, *Avicennia marina.* It would be instructive to examine T. *palustris* specimens from both mangrove and non-mangrove sites in SE Arabia in order to determine whether the developmental changes in radular morphology recognised elsewhere are observed here, and therefore to what extent those changes are genetically programmed versus environmentally modulated.

Environmental Reconstruction

Because *T. palustris* has become firmly associated in SE Arabian archaeological literature with mangrove swamps, its current absence in the Arabian Gulf has generally been attributed in a somewhat circular fashion to the supposed decline in mangrove forests along the UAE coast (Boucharlat *et al.,* 1991; Glover, 1991, 1999). Independent evidence for the decline of the mangrove may be thought to come from the understanding that mangrove limbs were formerly used for building purposes, which could not reasonably be contemplated in most areas today. However, it is now recognised that mangrove or other timber for construction use may long have been imported from India andlor East Africa (Kennet, 1992, *pers. comm.).*

Further study of the non-mangal populations at the Oceanic channel, Ras Sallan and Yiti may contribute to the task of palaeo-reconstruction of the natural environment of UAE coastal archaeological sites. In

particular, it could mitigate the need to invoke extensive mangrove swamps to account for the presence of *T. palustris,* a hypothesis which should not be taken as conclusive in the absence of corroborating evidence. Thus, Glover (1999) makes regular reference to additional phenomena such as shells of the rugose oyster *Saccostrea cucullata* bearing the scars of attachment to mangrove pneumatophores. The newly recognised non-mangal populations of T. *palustris* suggest that in some cases it might have been sufficient to have had an estuarine environment (as has been independently postulated for areas such as Ad-Door and Tell Abraq from site evidence, geological evidence and aerial photography), provided there existed areas subject to shallow but relatively permanent inundation. Such conditions could well have been more common a few thousand years ago due to the twin phenomena of somewhat higher rainfall and a slightly higher sea stand.

The role of sea level *per se* is not conclusive, however. 6000 BP, coinciding with the end of the Climatic Optimum, is the date generally given for the highest Holocene (post-glacial) global sea level stand, which in the Arabian Gulf is thought to have been from one-half to two metres higher than today (Dalongeville *et al.,* 1991; Lambeck, 1996; Potts, 1997; Blanchet *et al.,* 1998). Geological studies of shorelines in Abu Dhabi now confirm a somewhat later sea level maximum at around 4000 years BP (Hellyer, 2000), and the same may be true for Qatar (Lambeck, 1996). These dates span most of the heyday of T. *palustris* in the Northern Emirates, but increased aridity and falling sea levels thereafter did not necessarily reduce the amount of estuarine habitat potentially available, since coastal geomorphology is subject to many smaller scale influences (see Dalongeville *et al.,* 1991). Moreover, consideration of sea level changes alone fails to take account of the parallel role of the tectonic subsidence of the Musandam Peninsula, affecting at least the area from the city of Ra's al-Khaimah northward and having an estimated maximum of more than 60 m in the past 10,000 years (Vita-Finzi, 1973).

Whatever the reasons, estuarine conditions more extensive than today appear to have persisted in the Northern Emirates long after the decline and fall of T. *palustris,* as at the major trading settlements of Ad-Door (c.0-200 AD) (Potts, 1997) and Kush (c.400-1300 AD) (Kennet, 1999). To some extent these sites may record only the migration, rather than expansion or contraction, of estuarine conditions. However, in Ra's al-Khaimah, shell mounds containing T. *palustris* are found in the Falayyah area, today some 4 km inland from the head of Ra's al-Khaimah khor, and local historical records indicate that this area was accessible by boat as recently as 200 years ago (Velde, *pers. comm.).*

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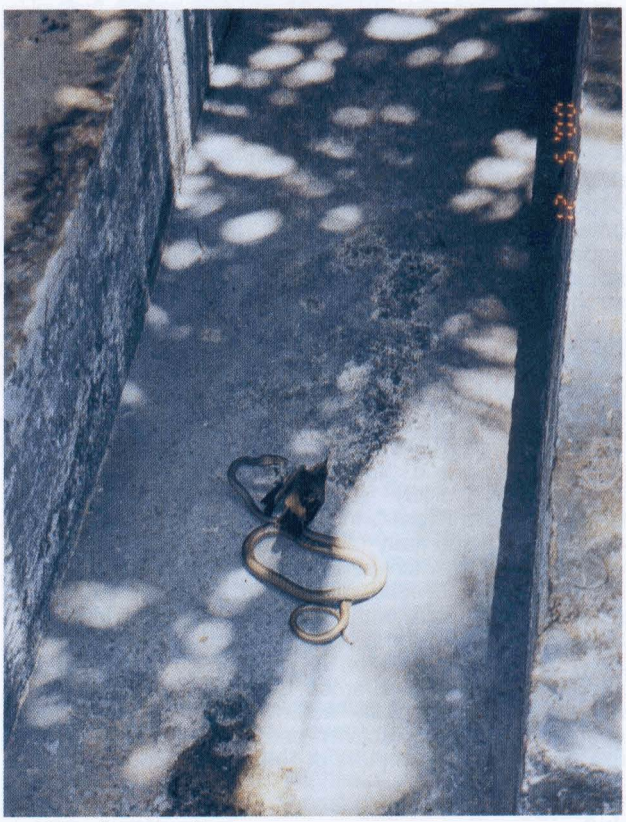
Sand Snake *Psammophis schokari schokari* (Forskål 1775): an arboreal hunter

by Dianne Handley & Peter Cunningham

The diurnal **Sand Snake** also known as the Variable, Tree or Hissing Sand Snake is a member of the family **Colubridae** and has a wide distribution range. In Africa it occurs from the extreme west, southeast to Chad, Ethiopia and Somalia and northeast to Egypt.
It is also widespread throughout the Arabian Peninsula, southwest Asia eastwards to northwest India and central Asia (former USSR)', (Arnold 1980, Gallagher 1993, Gasperetti 1988, Leviton *et* al. 1992, Schatti & Gasperetti 1994). According to Gasperetti (1988) and Schätti Q Gasperetti (1994), it is ubiquitous in Arabia from sea level to the highest elevations. Although usually found in bushy or arboreal situations, it also inhabits areas devoid of vegetation (Schatti & Gasperetti 1994).
In the UAE, Hornby (1996) classifies it as being locally frequent with a general description of the habitat indicated as "desert, wadis and trees".
At midday on 12 May 2000, in Wadi Khutwa (+/- 25 km east of Al Ain in the Sultanate of Oman), a large adult Sand Snake (almost 1 meter in total length) was observed subduing an adult **Red-tailed Wheatear** *Oenanthe xanthoprymna*.
When first observed, the snake was gripping the wheatear, then still alive, by the breast. Once the snake realised it was being observed, it released the Wheatear, which died shortly thereafter, indicating that venom had been injected, and fled down a cement *falaj*. Although Sand Snakes are known to be good climbers and most often arboreal (Baha El Din 1996, Gallagher 1993, Gasperetti 1988, Gillett 1996), little is known about their diet and references to specific bird species included in their diet are rare.
Arnold (1980) says that their diet appears to include a substantial proportion of birds, while Gillett (1996) states that they prey mainly on birds and lizards. Barnes (1992) mentions them often being seen hunting rodents and geckos in urban gardens.



Sand snake *Psammophis schokari* subduing a Red-tailed wheatear *Oenanfhe xanthoprymna.*
Picture *by D.L.* Handley

A survey of 100 stomach contents of *P.schokari* were analysed from the Abu Dhabi area without any reference to birds being included in their diet (Brown 1989). Items that were however discovered in the stomach contents include lizards from the family **Lacertidae,** possibly *Acanthodactylus schmidti,* and one case of cannibalism. Baha El Din (1996) observed them actively pursuing *A.s chmidti* during a survey of reptiles from the Abu Dhabi Emirate and has documented Desert Chameleon *Chamaeleo chamaeleon* being included in their diet in Egypt (Baha El Din 1998).
This record of a Red-tailed wheatear caught by *P.schokari* confirms that birds are included in their diet in southeast Arabia. As far as could be determined this is also the first recorded direct observation of a bird being preyed on by *P.schokari.*

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Summer time budget comparisons for a population of Spiny-tailed Lizard *Uromastyx aegyptius microlepis* (Blanford, 1*874)* from the Al Ain region, U.A.E

by Peter L. Cunningham

Abstract

A study of the daily activity pattern of 20 Spiny-tailed Lizards *Uromastyx aegyptius microlepis* individuals during two consecutive summers indicates that they emerge early, with a peak period of emergence between 0700 and 0800. A peak basking period occurs between 0700 and 1000, while a peak foraging period occurs between 0900 and 1100. The lizards retreat underground when the mean ambient temperature approaches 40 deg. C. Their activitfes above ground are strongly correlated with ambient temperature.

Introduction

Spiny-tailed lizards *Uromastyx aegyptius microlepis* (Ar. 'dhub') are common and widespread in the United Arab Emirates, especially in inter-dunal plains and areas with compact sand and gravel plains (Baha El Din 1996; Brown 1982; Hornby 1996). Their distribution includes northern and eastern parts of Arabia as well as Egypt, Jordan, Iraq and Iran (Arnold, 1986; Gallagher 1971; Joger 1987 & Leviton *et al.* 1992). Research related to the ecology of individual reptile species from the Arabian peninsula is sparse, with virtually no work having been done on Spiny-tailed lizards, especially in the UAE. Although their distribution is widespread and they are perceived as being common in the UAE, very little is known about their daily activity patterns. This paper compares the daily activity pattern of 20 Spiny-tailed lizards during the summers of 1999 and 2000.

Methods

The study area is located in the Emirate of Abu Dhabi, approximately 35 km. nortrh-west of Al Ain (24 deg. 25 mins. 07 secs. N; 55 deg. 35 mins. 01 secs. E), at an altitude of 278 m. The landscape is comprised of gravel plains and compacted sand with scattered low outcrops of sedimentary rock formations, bordered by dunes. The vegetation is typical of the Al Ain geomorphological unit, with *Haloxylon salicornicum, Pennisetum divisum* and *Stipagrostis* sp. being common (Boer & Gliddon 1997).
Rainfall is highly variable, with a mean monthly rainfall of less than 5 mm documented for the months May to July (+/- 100 mm annually) while temperatures are extreme, with summer monthly mean maxima between 40 - 45 deg. C (Bottomley 1996).
Twenty *U.a. microlepis* individuals were each observed for one day at a time, from sunrise to sunset, between the months May and June 1999 and September 2000. Active burrows *(i.e.* burrows with obvious evidence of occupancy, such as fresh faeces & tracks) were identified in advance, and observation points were established at a distance of approx. 100 m. from the burrows. A pair of 8 x 40 binoculars was used for observation, with the activities of the individuals monitored on a continuous basis from emergence to retreating underground. Activities noted were: time of emergence, basking, den cleaning, foraging, return to den and retreat underground. A total of 480 hours of observation were conducted. SD +/- 1 and CI = 95%.

Results

Emergence: *U.a.microlepis* emerge early during summer, with a peak emergence period between 0700 and 0800 (65% - 1999 & 60% - 2000) (*Fig.* 1). Summer emergence during 1999 occurred with the average ambient temperature at 30.4 deg. C (n=20), compared to 28.5 deg. C (n=20) in 2000. The earliest and latest emergence observed was at 0655 (27 deg. C) and 0921

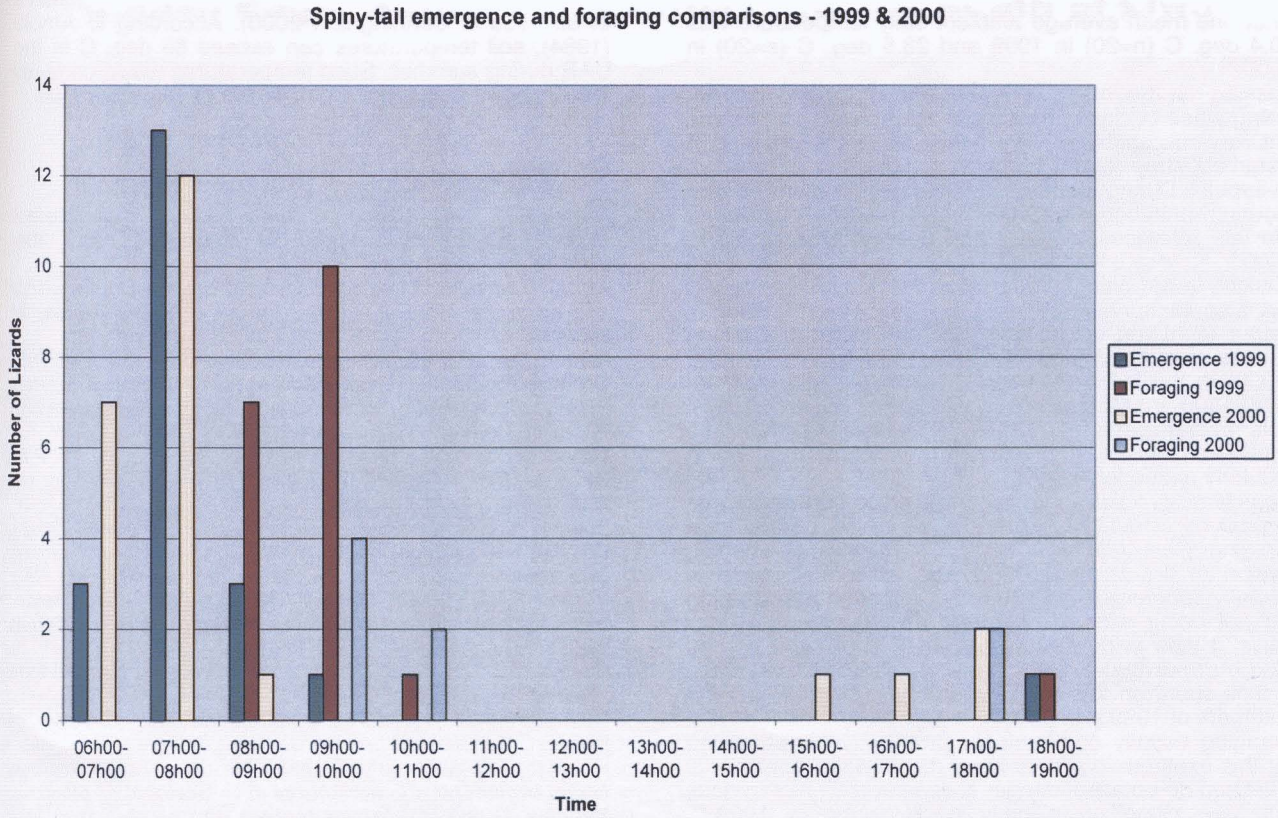

Figure 1. Comparisons between the emergence and foraging of a Spiny-tail Lizard population in the Al Ain region during the summers of 1999 and 2000.

(41 deg. C) in 1999 and 0629 (26.5 deg. C) and 0852 (33 deg. C) in 2000. Strong positive correlations existed between the time of emergence and the ambient temperature at emergence in both years (1999: r=0.63; DF=1; F=30.31 and 2000: r=0.21; DF=1; F=4.85).

Basking: A peak basking period was noted between 0700 and 0900 in 1999 and 0700 and 1100 in 2000. An average time of 108 +/- 12 minutes (n=20) was spent basking per individual in 1999 and 154 +/- 5 minutes (n=20) in 2000. Negative correlations were observed between time spent basking and the temperature at emergence (1999: r=26; DF=19; F=10.22 and 2000: r=0.25; DF=1; F=5.89).

Den Clearing: Den clearing (expulsion of sand from the burrow was observed on a daily basis in 1999, with 60 % of observed individuals spending an average of 3 minutes each on this activity. In 2000, only 7 individuals (35%) were observed den clearing, with each individual spending 3 +/- 0.4 minutes on average.

Foraging: Peak foraging hours were between 0900 and 1000 (1999) and 0900 to 1100 (2000). The average time spent foraging varied from 36 +/- 1 minute (n=18) per individual in 1999 to 35 +/- 9 minutes (n=6) per individual during 2000. The earliest and latest an individual ventured out to forage was 0830 and 1008 in 1999 and 0909 and 1007 in 2000. Mean average ambient temperatures at the beginning and end of foraging were 36.9 deg. C and 39.6 deg. C in 1999 (n=18) and 35.1 deg. C and 38 deg. C in 2000 (n=9).

During 1999, only 1 (5%) individual ventured out to forage during the afternoon, compared to 2 (10%) in 2000.

The furthest distance travelled to forage from the burrow was on average 61 +/- 4 metres (n=18) in 1999 and 106 +/- 21 metres (n=6) during 2000. The shortest and furthest distances travelled by an individual in 1999 were respectively 18 m. and 280 m., compared to 28 m. and 198 m. in 2000.

Afternoon foraging distances varied between 3 m. (3 minutes) during 1999 to 10 m. (33 minutes) and 12 m. (15 minutes) during 2000.

Strong positive correlations were observed between the time spent foraging and the furthest distance travelled from the burrow while foraging (1999: r=0.59; DF=19; F=25.75 and 2000: r=0.94; DF=1; F=66.13).

Retreat underground: The lizards retreated underground at an average ambient atmospheric temperature of 39.6 deg. C in 1999 and 35.6 deg. C in 2000.

Discussion

Uromastyx are strictly diurnal (Baha El Din 1996; Hornby 1996; Highfield and Slimani 1998 and *pers. obs.*) with most activity taking place beteen 0600 and 1000 during summer. A few individuals (1 in 1999 and 5 in 2000) were active during the afternoon, mainly between 1600 and 1800.

During summer, the high ambient temperatures result in the early emergence of *U.a. microlepis* (50% between 0700 and 0730 in both 1999 and 2000). The strong positive correlations between the time of emergence and the ambient temperature at emergence indicates that the emergence of these lizards from their burrows is related to temperature. This reflects the typical behaviour of most ectotherms, active from soon after sunrise to around noon (Lovejoy 1993) or during the warmer hours of the day (Zari 1996). According to Jongbloed (1997), they do not emerge early every day (n=2), and during cold days they do not emerge at all (Zari 1996; Cunningham *in press*). Highfield and Slimani (1998) state that in Morocco *U. acanthinurus* emerge only when outside temperatures exceed 20 deg. C, while Zari (1998) states that during spring in Saudi Arabia, *U. philbyi* are most active between 0900 and 1700.

Summer emergence in the UAE study area occurred when the mean average ambient daily temperature was 30.4 deg. C (n=20) in 1999 and 28.5 deg. C (n=20) in 2000.

Basking is the most common above ground activity taking place in close proximity to the burrow. The lizards are very susceptible to disturbance while basking, and, if disturbed, they retreat underground and do not always re-appear. During summer, basking occurs mainly in the morning, although 4 individuals (20 %) emerged during the late afternoon in 1999 and 5 individuals (25%) in 2000.

Basking is not only used to raise the body temperature, but also to survey the area for any possible threats before venturing out to forage. Peak summer basking periods were between 0700-0900 (1999) and 0700-1000 (2000) in the UAE study area, compared to a peak of 1100-1300 in Morocco (Highfield and Slimani 1998). This earlier period for basking in the UAE can be explained by the high summer temperatures, which regularly exceeded 40 deg. C after 10.00.

Den clearing activities usually take place between bouts of basking or directly after returning to the burrow from foraging. Den clearing is done in a backward-sweeping motion of the fore and hind legs while the animal is partially submerged in the burrow. Although den clearing did not occur with all observed invididuals on a daily basis, it was evident from the build-up of sand around their burrows that it takes place regularly. No difference in time spent on this activity was observed between the summers of 1999 and 2000.

Foraging usually commences once body temperatures for this exothermic animal have reached the operational level and no potential danger is observed. Foraging does not take place on a daily basis, since in 1999 2 individuals retreated underground without venturing to forage, while in 2000 only 6 of the study group ventured out to forage at all. The lack of rainfall in the study area between 1999-2000 may have been responsible for the lizards not venturing out to forage on a daily basis. Vegetative growth during this period was poor and no annuals were present. The area also suffered intensive grazing pressure from domestic stock, especially camels and sheep, during this period.

Foraging mainly occurs during the mornings during summer, although 1 individual ventured out to forage during the afternoon in 1999 and 2 during 2000. These afternoon foraging spells took place close to the burrows (3 m. in 1999 and l 0 m. and 12 m. in 2000).

When foraging, the animals are initially very cautious, with the pace picking up once they are confident and perceive no danger. The average'time spent foraging per individual was very similar in both years (1999: 36 +/- 1 minute, n=18 and 2000: 35 +/- 9 minutes, n=6). Foraging usually takes place close to the burrow, although in 2000 the average distance travelled to forage was further (106 +/- 21 m., n=6) than in 1999 (61 +/- 4 m.). This may reflect the lack of, or poor quality of, vegetation available during 2000, resulting in the lizards needing to forage further to obtain their nutritional requirements.

During summer, the lizards usually retreat underground when ambient temperatures approach or reach 40 deg. C. During 1999, the retreat underground took place at an average ambient temperature of 39.6 deg. C, compared to 35.6 deg. C in 2000. Temperatures are relatively stable at 30 cm. underground (Lovejoy & Knight-Eloff 1988) and are, therefore, exploited by desert dwelling animals when conditions are severe on the surface. Highfield and Slimani (1998) also state that temperatures in U. ananthinurus burrows are fairly constant at between 20-25 deg. C. In the UAE, burrow temperatures are on average 6 deg. C lower at 30 cm. underground than the ambient temperature in summer (Cunningham in press).

The burrows are used as a thermal refuge by *U.a. microlepis* as well as by **Desert Monitor** Varanus *griseus* (pers. obs.) and several species of lark (Williams et al. 1999 & Cunningham 2000). According to Arnold (1984), soil temperatures can exceed 65 deg. C in the UAE during summer. Such temperatures would certainly influence the above ground activities of *U.a.* microlepis.

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Golden Eagle *Aquila chrysaetos* breeding south of Liwa

Picture by Abdul Munim Al Kindy

There are less than 12 accepted records of **Golden Eagle** *Aquila chrysaetos* in the United Arab Emirates, the first confirmed record coming as recently as 1990. The species is accorded the status of "Vagrant/ resident breeder?" (V/rb?) in the most recent national checklist, (Richardson & Aspinall, 1998), which states that the species "breeds around-the Rub al-Khali, which extends across Abu Dhabi, Oman and Saudi Arabia."

The species was first proven to breed in the UAE in 1999, when a pair was found at an established eyrie at a location south of the Liwa Oasis (Aspinall & Hellyer 1999). The picture of a young chick, above, was taken in February 2000 and is believed to be the first photographic evidence of a Golden Eagle *pullus* in the Emirates. Remains of prey **Cape Hares** *Lepus capensis* are visible. The nest is in a restricted zone south of Liwa and details of its precise location are withheld for security reasons.

m e presence of breeding Golden Eagles in adjacent areas of Oman had already been proven by the late 1970s. Unfledged chicks were delivered almost annually to the Al Ain Zoo between 1978 and 1987 **(1)** suggesting that the species may indeed have been nesting in the Emirates at that time. The possibility exists that the nest shown above may have been a source of the eaglets delivered to Al Ain Zoo in the 1980s.

The total population in Arabia probably numbers only a few tens of pairs. Around ten active eyries are currently known in Oman's central desert regions, all of which are eyries in trees, although breeding has been confirmed in no fewer than 14 of the 50 km. by 50 km. squares used in the database of the Atlas of Breeding Birds of Arabia, with possible breeding in three further squares (Eriksen, 1998). The picture is somewhat confused since not all nests are used on an annual basis **(2).** The closest to the Emirates, as far as is known, is one approximately 300 km. from the Liwa Oasis, although others may be in intervening areas which are difficult of access (3). In no country in the Middle East do population estimates reach three figures. Declines have been noted in some parts of the region, although information is sparse or not readily available.

Acknowledgement:

The authors note, with thanks, the assistance of Abdul Munim al-Kindy, Deputy General Manager of the Abu Dhabi Company for Onshore Oil Operations, ADCO, who took the photograph above and gave permission for its publication.

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by Simon Aspinall & Peter Hellyer

Recent whale records in the Emirates

Whales inside the Arabian Gulf remain extremely rare, with live sightings rarer still, so it must have been quite an event to see a pod of four **Killer Whales** *Orcinus orca* alive and well about 15 km west of Mubarraz island, west of Abu Dhabi on 8 March 2000.
Better still was that the sighting was documented by a Croatian film crew aboard a helicopter hovering overhead. The pod was sighted during an aerial survey of Abu Dhabi waters by the Commission of Environmental Research, part of the Emirates Heritage Club. One young animal was seen amongst the group. This constitutes the first confirmed sighting of killer whale in the UAE's Arabian Gulf waters.
A bull (male) was thereafter reported close to Mubarraz on 30 March. There have been no further reports. The only previous, but unconfirmed, Arabian Gulf record concerns a sighting of six individuals in Iranian waters in 1980.
(The species is reported as occurring "well out to sea" off the UAE's East Coast [Baldwin 19951).

(Sources: Ron Loughland, Abdul Latif Al Hadidi)

A second whale, this time a **Bryde's whale** *Balaenoptera edeni,* was found dead ashore near Jebel Barakah in Abu Dhabi's Western Region, also in early March. This individual was apparently to be disposed of by the Municipality, being seen subsequently under tow out to sea *(source: Ron Loughland),* although there are unconfirmed reports that the skeleton was obtained by a local official.
A third record concerned an unidentified 10m long "black whale caught in a fisherman's nets about a mile off Dibba on the East Coast during April. It was landed by a tug after six hours and was said to have weighed in at 3 tons. This is either a gross under-estimate or the animal's length was exaggerated. The identity remains obscure. The most likely species would again be **Bryde's whale,** which reaches to 14 m, or perhaps **minke whale** *B. acutorostrata* (max. length c ▮▮m), although even at only 10 m either ought to exceed 3 tons in weight (A ton per metre being about average). The local name used by national fishermen was reported to be 'Iram'. It was subsequently released apparently unharmed. *(Source: Gulf News 27 April* 2000)

Finally, a fourth report, *(in Gulf News, 28 October 2000*), concerned what was initially described as a 'rare dolphin,' discovered on the beach at Bidiya. in Fujairah, by Hassan Abduljabber, a scuba-diving trainer Subsequent enquiries suggested that the animal had actually died a few days earlier.
From the photograph accompanying the article, the animal was clearly a small whale and not a dolphin. It was subsequently identified as a young female **Pygmy Sperm Whale** *Kogia breviceps* by a marine expert in the United States after he was sent pictures and details over the Internet. Details again appeared in *Gulf News* (04111100). This constitutes a first record for the UAE. Indeed, no other records are documented from Arabia.
The extremely similar **Dwarf Sperm Whale K.** *simus* has not been recorded in UAE waters, but is known from Oman, both in its Gulf of Oman waters and in the southern Arabian Sea. Specific identification of live individuals at sea is unlikely to be conclusive, and the only confirmed records concern dead animals washed ashore.

Records such as these are held in a UAE national cetacean database maintained by the editors of **Tribulus.** Please send any records of dolphins or whales, dead or live, including second-hand reports, to Simon Aspinall, c/o P.O. Box 45553, Abu Dhabi, UAE.

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Simon Aspinall

Archaeological Round-up

In keeping with the pattern of the last decade or so, the UAE has continued over the course of the last few months to be one of the most active countries in the Arabian Peninsula in terms of archaeological studies.
In Abu Dhabi, further survey work was carried out by the Abu Dhabi Islands Archaeological Survey, ADIAS, during the summer, much of it in association with environmental studies undertaken in the concession area of the Abu Dhabi Company for Onshore Oil Operations, a corporate sponsor of the ENHG.
Several new sites were identified in the south-eastern part of the Liwa Oasis, in Abu Dhabi's Western Region, including Late Islamic pottery scatters and sites with Miocene/Pliocene fossilised ostrich eggshell.
Closer to the coast, a number of Late Stone Age artefacts and previously unrecorded Miocene fossil sites were found on inter-dunal plains in the Rumaitha oilfield, south-west of Abu Dhabi, while further Late Islamic sites were identified on the offshore island of Halat Hail and on an unnamed small sandy island on the southern side of the Khor Al Bazm, south of the island of Rufayq.
Preliminary survey work in the vicinity of Abu Dhabi International Airport, ahead of the planned construction of a second runway, also identified two previously unrecorded sites with Late Islamic pottery.
During a brief survey of the ecology of the island of Abu al-Abyadh carried out in August, ADIAS surveyors also identified further archaeological sites from the Late Islamic period. Although no detailed survey of Abu al-Abyadh has yet been carried out, ADIAS has thus far identified nearly 20 Late Islamic sites on the island.
In late November/early December, ADIAS carried out a second phase of investigations of the only sulphur mines yet identified in the UAE, on the slopes of Jebel Dhanna, in the far west of the Emirate. The work was carried out with support from ADCO, within whose oil export terminal the sulphur mines are located.
Inland, the Department of Antiquities and Tourism of Abu Dhabi's Eastern Region was due to carry out further work in the Hili area, which has produced major sites from the Umm al-Nar period and from the local Iron Age.
A major focus of work for Sharjah's Directorate of Archaeology during the Winter 200012001 season is further excavation of the Late Pre-Islamic fort at Mileiha, which lies under the old road from Madam to Dhaid.
Work by the Sharjah team and a team from France's Centre National des Recherches Scientifiques, CNRS, began in October and was due to be completed by mid-December, with the key objective being that of completing excavation.
Excavation of the site began in 1995, but the central part was then covered by tarmac. During upgrading of the highway, Sharjah Ruler and UAE Supreme Council member HH Dr. Sheikh Sultan bin Mohammed al-Qasimi

ordered that it should be diverted in the vicinity of the fort, to permit the structure to be fully investigated.
Finds from previous work at the Mileiha fort, dating to the early centuries of the 1st Millennium AD, have included a coin mould, the earliest evidence yet identified of minting of coinage in the Emirates.
The Directorate, headed by Dr. Sabah Jasim, began work in early November at Jebel Buhays, continuing excavation of tombs on the mountain that date to the First and Second Millennia BC. Further work in the Mileiha area included the restoration of a circular tomb from the Umm al-Nar period in the late Third Millennium BC. The tomb is the largest of its type yet identified.
A Spanish team is due to resume work in the Al Thuqaibah area on an Iron Age village early in the New Year, while a team from Japan's University of Kanazawa is also due to commence excavation at an islamic site at Luluyyah, just north of Khor Fakkan.
A foreign archaeological team has undertaken work in Dubai again after a gap of several years, as the result of an agreement reached between the Dubai Department of Tourism and Commerce Marketing, responsible for archaeology in the Emirate, and Rome's La Sapienza University.
The Department believes that tourism will be enhanced by better promotion of Dubai's archaeological heritage.
The focus of attention is expected to be on the early Islamic site at Jumeirah, although further work may also take place at sites in Al Sufouh, Qusais and Hatta.
A team from Australia's University of Sydney excavated a Third Millennium BC tomb at Al Sufouh several years ago, while in the early 1990s, a team from Belgium's University of Ghent carried out survey work around Khor Dubai and in Hatta. Apart from these teams, no foreign archaeological team has worked in Dubai since excavations by Iraqi teams in the 1970s.
In Ra's al-Khaimah, a short study season on finds from the late Sasanian-early Islamic settlement at the site of Kush, in the village of Shimal, took place in November and early December, under the direction of Derek Kennet, of Britain's University of Durham, while further studies of the evidence in the Late Stone Age in the Emirate were undertaken by a two-person team from Germany's University of Freiburg from early November for a two month season.
In Fujairah, a team from France's CNRS is due to arrive in early January to study finds from earlier work on Iron Age sites, with a view to planning several seasons of work in the Emirate. Among finds to be studied are those from sites at Bithna, Husn Madhab and Qidfa.
A report on the key results of the winter season of work throughout the Emirates will appear in the next issue of **Tribulus.**

Peter Hellyer

Archaeology Conference

A conference on UAE Archaeology is due to be held in Al Ain in April 2001 under the patronage of Deputy Prime Minister Sheikh Sultan bin Zayed Al Nahyan.
Organised by the Zayed Centre for Heritage and History, in association with the Department of Antiquities and Tourism of the Diwan of the Abu Dhabi Ruler's Representative in the Eastern Region and the Ministry of Information and Culture, the conference will be the first that is specifically devoted to the topic.
Further details are available from:

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and from Peter Hellyer,
External Information Department,
Ministry of Information and Culture.
e-mail: extinfo2.mic@uae.gov.ae

Theses on UAE Archaeology

Lloyd R. Weeks has completed his PhD at the School of Archaeology at the University of Sydney. His thesis title is **Prehistoric Metallurgy of the Gulf.** In 2 volumes, it includes work on material from a number of UAE sites, including Tell Abraq and several on the East Coast.
Two MAs have been awarded in the History of Art and Archaeology at the School of Oriental and African Studies of the University of London involving UAE-related dissertations. **Daniel Hull's** dissertation was **Perceptions of the Past: The Role of Archaeology in the United Arab Emirates,** while that of **Philippa Loates** was entitled: **A Summary of the Archaeology on the Islands of Abu Dhabi: Stone Age - Late Islamic,** essentially a Gazetteer of key sites identified over the last nine years by the Abu Dhabi Islands Archaeological Survey, ADIAS.

Research, Reviews and Miscellany

The Breeding Birds of Hawar. Howard King. (1999). 94 pp. Graphs, tables, numerous colour photographs, hdbk. ISBN 99901-11-00-6. Published by (and available from) the Ministry of Housing Municipalities and Environment, Bahrain.

Bahrain bird recorder, Howard King, with the support of the country's Ministry of Housing, Municipalities and Enviroment, embarked on a lone and single-minded sweat-laden survey of the breeding birds of the entire Hawar archipelago in 1998. This resulting book is an admittedly 'personal' narrative of his findings, every page being presented, one feels, with the enthusiasm of a newly enlightened schoolboy on a Swallows and Amazons type adventure. I wish I had been with him.
Hawar, lying c. 26 kilometres south-east of Bahrain, is indeed an archipelago, comprising six major islands and over thirty smaller ones, which in total cover just over 50 sq. km. The Amir, Sheikh Hamad bin Isa Al Khalifa, has dubbed the islands the 'Priceless Pearls of Bahrain' and, as King notes, they represent 'Bahrain's last remaining true wilderness'.
After pages i-xxii of foreword, preface, executive summary, acknowledgements, contents pages, list of plates and more you finally come to the Introduction. Adequate scene-setting descriptions of the topography, drift and exposed solid geology and habitat are given here. The next chapter details King's methods and, as if to prove the hardship endured, includes a description of the weather experienced during fieldwork. I'm now glad I wasn't with him.
The next 64 pages of the main text is given over to reporting breeding figures and distribution species by species. Migrants receive scant attention, although the significance of wintering slender-billed gull numbers is highlighted and numbers of shorebirds staging and wintering on 'The Rubuds' noted without further detail. The emphasis throughout, however, is on the all-important breeding seabirds, ospreys and sooty falcons, although details of the prey remains at eyries of the last-named together with those found in their caches make for interesting reading.
Hawar's breeding populations were found to be significantly greater than previously thought: (all figures of pairs) c. 350 Western reef herons, over 20,000 Socotra cormorants, 3400 white-cheeked terns, 1850 bridled terns, 23 ospreys and 15 sooty falcons were found. A single colony of 644 pairs of lesser crested

terns was a new breeding species for Bahrain, while Arabia's only colony of Caspian terns was also located (elsewhere only solitary pairs are known).
The author clearly become wholly absorbed in his researches and endeavours. Within what can only be described, not unkindly, as an unconventional style of reporting and layout, King's book has all the essential information, everything you ever wanted to know about the breeding birds of Hawar, in a hybrid of report and popular account including ecological anecdotes (though one such claiming osprey to feed on Socotra cormorant is something I find hard to swallow).
There is liberal use of photographs throughout, mostly from the well-known Hill stable (father and son), although some appear to be over-enlarged or to suffer from low-resolution scanning, rather than from poor printing. The seven shots of different osprey eyries is especially lavish and akin to an estate agent's property board in Country Life magazine.
The late Amir, Sheikh Isa bin Salman Al Khalifa, issued a decree in 1995 to instigate the creation of a sanctuary centred on the Hawar islands. Legislation establishing Hawar as a reserve came the following year, but in his closing commentary, King, in looking at commitment and obligations, bluntly states how nothing sustainable has been done to manage biodiversity. Bahrain is party to the Ramsar convention concerning wetlands ('especially as waterfowl habitat') and, in ratifying this international agreement, put forward Hawar as one of two Ramsar site nominations (in 1997). Nonetheless King calls instead for the creation and administration of Hawar as a national park and uses the word disdain to describe current development proposals being considered despite Amiri decrees, international declaration and convention ratification.
Whether Hawar will be handled with care or not is the main concern, but the data so presented should convince any and all decision-makers as to the value of the archipelago.

Simon Aspinall

Wild About Reptiles: Field Guide to the Reptiles and Amphibians of the UAE, Marycke Jongbloed with J.N.B. "Bish" Brown. (2000). 116 pp., numerous colour ill., spiral-bound softback. ISBN 0-9534689-1-7. Barker Trident Communications, London. Sponsored by the Environmental Research and Wildlife Development Agency, ERWDA, Abu Dhabi.

Wild About Reptiles is the first pictorial guide to the reptiles and amphibians not only of the UAE but also of the whole of the Arabian Peninsula. Its actual coverage area is the UAE and adjoining border areas of the Sultanate of Oman. However, since there are no endemic species of reptiles or amphibians in the UAE, all species covered in this field guide are also likely to be present either throughout or in parts of neighbouring countries such as Saudi Arabia, Qatar, Bahrain and Kuwait. The book includes 65 species of reptiles and two species of amphibians that are currently known to occur in the UAE. The UAE does not have any species of frog, freshwater turtle or land tortoise.
This book not only provides a vivid account of the herpetofauna of the UAE but also incorporates meticulously noted field information collected by one of the pioneers of study of the country's natural history, the late JNB "Bish" Brown. I had quite a few intimate encounters with Bish both at Al Ain and in Dubai, which began when he dispatched to me in the mid-1980s several hundred frozen specimens of vipers collected from Sir Bani Yas island. My kids had a special fascination for him and he would often come to our house for a short break and chat with my kids and myself. He used to discuss his fieldwork with me, and also provided me with his first checklist of the herpetofauna of the UAE, something for which I remain deeply grateful..
Wild About Reptiles is a fitting tribute to Bish. Marycke Jongbloed, the author, is a well known naturalist in the UAE. Not only is she fascinated by watching wildlife, but she also has a great capacity to share her acquired knowledge equally with young and old. She has now written several pioneering books on the plants and animals of the UAE, and has received honours and awards not only from within the UAE, but also in her home country, Holland.
Allowing for the fact that a few species are not illustrated, and that a few pictures have been published before, this book is a unique field guide that will be useful to both the novice and the expert in the field. It can be of use even at home - in case you come across a reptile and want to know its identity and whether it is dangerous or harmless to you.

Reza Khan

Books Received

(Mention here does not preclude future review).

Fox, N., Al Bowardi, M., Macdonald, H. & Launay, F. (2000). **A global strategy for the conservation of falcons and houbara.** 74 pp (half English, half Arabic), full colour, hdbk. Published by, and available from, ERWDA, PO Box 45553, Abu Dhabi.

King, G.R.D. **Abu Dhabi Islands Archaeological Survey, Season One.** This book is a translation into Arabic of the original English edition, and represents a valuable addition to the available information in Arabic about the UAE's archaeology. Hdbk. Published by Trident Press Ltd., with support from the Ministry of Information and Culture. ISBN 1900724-14-6.

Journals Received

The following journals with material on the UAE and Oman have been received by, or have been brought to the attention of, the Editors.

Arabian Archaeology and Epigraphy, Vol. 11, No.1, May 2000. Munksgaard, Denmark, ISSN 0905-7916
There are four papers of immediate relevance to the UAE in this journal.
A neolithic site at *Bida Al* Mitawaa in Western Abu Dhabi (P. Crombe). Pp. 9-14
Late pre-Islamic ceramics from the tomb at Sharm, Fujairah, U.A.E. (C. Petrie). Pp. 80-86
Pigment shells from Sharm (K. Masia). Pp. 23-23
Ancient glass from ed-Dur (Umm al-Qaiwain, U.A.E.). 2. Glass excavated by the Danish expedition. (D. Whitehouse). Pp.87-128.
New prehistoric sites along the Omani coast from *Ra,s* al-Hadd to Ras's *al-Jinz* (D. Usai), Pp. 1-8, is of value for comparing with coastal sites in the UAE.

Arabian Archaeology and Epigraphy, Vol. 11, No.2, November 2000. Munksgaard, Denmark, ISSN 0905-7916
There are three papers of immediate relevance to the UAE in the November 2000 issue of AAE, all related to excavations by the University of Sydney at Sharm, in Fujairah.
Metal artefacts from the Sharm tomb. (L.Weeks). Pp. 180-198.
Notes on the shell and bone rings from Sharm. (D. Barker). Pp. 199-203.
Notes on a decorated spiny oyster from Sharm. (D. Barker and T. Hartnell). Pp. 204-206.

Proceedings of the Seminar for Arabian Studies, Vol. 29, 1999. (Seminar for Arabian Studies/Brepols, Belgium).
ISSN 0308-8421 / ISBN 2-503-50829-4.

Several papers of UAE and Omani interest, as follows: *Les importations de ceramiques harappeennes en Arabie orientale: etat de la question.* (M. James Blackman & Sophie Mery). Pp. 7-28.
Industries bifaciales holocenes d'Arabie orientale, un exemple: Ra's al-Jinz. (Vincent Charpentier). Pp. 29-44
Mollusc harvesting along the coasts of Oman: a supplementary diet (Ali Tigani El Mahi). Pp. 45-54.
Identities and economics: mountain and coastal Ras Al-Khaimah (William & Felicity Lancaster). Pp. 89-94.

Journal of Oman Studies, Vol. 11. Ministry of National Heritage and Culture, PO Box 668, Muscat, Oman.

JOS reappeared in the summer of this year after an absence of nearly ten years, and is welcomed back! Copies may be obtained by writing to the Ministry. Papers include *Oman's Humpback Whales* (Robert Baldwin), *Ra's al-Jinz and the Prehistoric Coastal Cultures of the Ja'alan* (Serge Cleuziou & Maurizio Tosi) and *Late Flint Industries from Masirah island* (Margarethe Uerpmann).

Zoology in the Middle East
ISSN 0939-7140. Max Kasparek Verlag, Heidelberg.

This journal, based in Germany, has carried several useful short papers on UAE topics recently. Titles follow, along with a couple of short notes.

D'Aloia, Marie-Ann and Griffiths, R. (1999). *Molecular sexing of the* **Houbara Bustard** *Chlamydotis undulata and other arid-land species.* **Vol. 18: 33 - 40.**

Cunningham, P. & Gross, C. (2000): *Reproduction and development of the* **Arabian Leopard** ***Panthera pardus nimr*** *in captivity.* **Vol. 20: 9-14.**

This short paper reports on captive breeding of the Arabian Leopard at the Breeding Centre for Endangered Arabian Wildlife in Sharjah.
Information included covers the period from 1997, when observations of captive leopards began, until April 1999. The report concludes: "The status of the Arabian Leopard in the wild is disturbing and therefore the extreme measure of captive breeding has been undertaken to ensure their survival as a sub-species. Reintroduction into their natural habitat might be premature at present, but could be envisaged for the future. The survival of this animal is dependent on local perceptions and ideas as well as stricter legislation and adequate protective areas."

Drew, C. [2000]. *The distribution of the* **Cape hare, *Lepus capensis,*** *in Abu Dhabi Emirate, UAE.* **Vol. 20: 15-20.**

This paper by Chris Drew, of Abu Dhabi's Environmental Research and Wildlife Development Agency, ERWDA, summarises the results of recent fieldwork. Two points stand out:
1. Cape hares can be found throughout the Emirate, with the exception of one area (east of Al Ain) where the predominant vegetation, *Rhazya stricta,* is poisonous to herbivores.
2. 3 sub-species are present: *L.c. cheesmani* (Sand hare); *L.c.arabicus* (Arabian hare); *L.c. omanensis* (Omani hare). These are not easily distinguishable.
Survey work showed hares to have a patchy distribution, with the level of their presence affected by the degree of livestock grazing and by anthropogenic disturbance. They are most abundant in ungrazed areas.

D'Aloia, Marie-Ann & Eastham, C.P. (2000). *DNA-based sex identification of falcons and its use in wild studies and captive breeding.* **Vol. 20: 25 - 32.**
D'Aloia, Marie-Ann & Al-Ghais, S.M. (2000). *Preliminary genetic analysis of the* **Green Turtle, *Chelonia mydas,*** *in the Arabian Gulf using mitochondrial DNA.* D'Aloia, Marie-Ann & S. M. Al-Ghais. **Vol. 21.**

Sandgrouse, Vol. 22 (2). Journal of the Ornithological Society of the Middle East, The Lodge, Sandy, Beds., SG19 2DL, UK. ISSN 0260-4736.

The latest issue of **Sandgrouse** contains only one short paper directly related to the UAE, on nests and nestlings studied in the Khatt/Digdagga area in 1998.
Notes on the breeding biology of **Arabian Babbler *Turdoides squamiceps*** *and nestlings of* **Common Myna *Acridotheres tristis*** (Peter Castell), pp. 146-148.

Local birders, however, have contributed notes from a little further afield, *viz.*

The first **Yellow-billed Stork *Mycteria ibis*** *in Qatar and the Arabian Gulf* (Peter Hellyer), pp. 125-126, and *First and second records of* **Crested Honey Buzzard *Pernis ptilorhynchus*** *in Iran* (Marc Duquet and Colin Richardson), pp. 133-134.

As usual, UAE birds figure prominently in the 'Around the Region' round-up.

Colour-ringed Gulls

Readers of ***Tribulus*** resident in the Arabian Gulf are asked to keep a special look out for colour-ringed gulls. The Voorne Bird Observatory in The Netherlands has advised us of its involvement in a number of joint projects in Russia, Kazakhstan, Ukraine and Turkey whereby the following species of gull, *L. armenicus, L.cachinnans, L (?) barabensis, L. (?fuscus) heuglini* and *L. (?fuscus) taimyrensis,* have been ringed with red and white engraved plastic rings. Furthermore Danish researchers have a joint project in Belarus on L. (?) *cachinnans* and Finnish researchers have colour-ringed large numbers of *L.f.fuscus* both in Finland and Russia with white rings.
Birds from all of these countries may migrate to the Gulf in winter.
Observers seeing any colour-ringed gull should note the colour of the ring, on which leg it is placed, and the species (if possible), as well as the time, date and place of the sighting. Additional information relating to the circumstances of the sighting (e.g. was the bird alive or dead; if alive, was it alone or with other gulls of the same or different species), would also be useful.
Reports can be sent either to ***Tribulus*** (by post to PO Box 45553, Abu Dhabi, UAE, or by e-mail to: **hellyer@emirates.net.ae**), or direct to: Voorne Bird Observatory, Schepenenweg 26, 3233 CL Oostvoorne, The Netherlands, (e-mail: **Norman.vanswelm@wxs.nl**).
Further, up to date information and addresses for direct contact with the relevant project leaders can be obtained from the website of **European Colour Ring Birding,** run by Dirk Raes in Belgium (e-mail: **Dirk.Raes@ping.be**)
http://www.ping.be/cr-birding/cr-birding.htm

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تريبيلوس

مجلة الامارات للتاريخ الطبيعي

المجلد ١٠،٢ خريف / شتاء ٢٠٠٠ م