

# INSECTS & OTHER ARTHROPODS

THIS CHAPTER AIMS TO PROVIDE AN UP-TO-DATE review of the arthropod fauna of the United Arab Emirates, although it should be noted that it provides a provisional rather than a definitive account of the country's insects, scorpions, spiders and other arthropods. Over the last 20 years or so, particularly after the publication of *Natural Emirates* (Vine and Abed 1996), this fauna has become better known. Even so, much further work is needed to better understand the biodiversity and ecology of arthropods in the Emirates. Currently, little professional entomological work is being undertaken, the knowledge base being enhanced by the efforts of enthusiastic amateurs.

The fauna is complex since the Emirates is situated where three major faunal regions of the Old World all converge, namely the Afrotropical, Palaearctic and the Oriental. The UAE is also in the middle of the Old World desert or Saharo-Sindian region, which has its own distinct Eremic fauna derived from elements of the other three zones. Many of the UAE's arthropods are small, cryptic animals, largely unstudied even in neighbouring countries. There is a high probability of many undescribed species being found, especially amongst such insect groups as beetles, wasps, true flies, micro-moths, true bugs, planthoppers and bristletails.

## ARTHROPOD DIVERSITY

The fauna of the Emirates, as for most countries, is dominated by the phylum Arthropoda, in terms of the numbers of both species and individuals. Amongst the arthropods, the insects are by far the most numerous, but other interesting groups occur, including true spiders, camel spiders, scorpions, pseudoscorpions, ticks, centipedes and isopods or woodlice. All available major habitat types in the UAE have their own insect populations, together with at least some representatives of other arthropod groups. Even in the desert, close observation reveals much invertebrate life. Mobile sand dunes totally bereft of vegetation still host a variety of bristletails, beetles, flies, wasps, moths and spiders. Many are specialised psammophiles and their cryptic colouration and strictly nocturnal habits ensure that they go largely unnoticed.

In well-vegetated habitats, such as coastal sand dunes, gravel plains, wetlands, irrigated plantations and mountain wadis, the diversity of the invertebrate wildlife is readily apparent even during daytime, with butterflies and moths, grasshoppers, mantids, ants and numerous beetles, both large and small, as well as myriads of flies, wasps and bees.

## OVERALL COMPOSITION OF THE INSECT AND ARTHROPOD FAUNA

The size of the UAE invertebrate fauna, in terms of total numbers of species, is unknown and difficult to estimate. There are fairly accurate counts for some orders of insects, such as dragonflies and damselflies, grasshoppers and butterflies and moths, but these only make up a small part of the total. Most species are beetles, true

or two-winged flies (hereafter 'true flies') and ants, bees and wasps, many small and difficult to identify, and their study is still in its infancy in the UAE. An educated guess suggests that there are probably more than 5,000 different species of insects and several hundred other species of terrestrial arthropods in the country. Further studies will eventually refine these relatively crude estimates.

The arthropods are classified into four subphyla containing ten classes, of which the Insecta is by far the largest. Classes group together a number of orders, each of which includes several families, divided into genera and, finally, individual species. There is no consensus amongst scientists as to the exact number of different orders of insects, but the 28 recognised in Parker (1982) provide a realistic system and one which has been applied here, with the addition of the springtails (order Collembola). A further order (Mantophasmatodea) was recognised for the first time in South Africa in 2001, making 30 overall. Of these, not all are present in the UAE, since some are small groupings of specialised insects with limited geographical distributions.

BACKGROUND PHOTO:  
*Diadem butterfly*  
*Hypolimnas misippus*  
LEFT: A member of the  
oil beetle family  
*Meloidae*

## A BRIEF HISTORY OF INSECT COLLECTION IN ARABIA

INSECT COLLECTING IN ARABIA has a long history, given extensive treatment by Larsen (1983), writing from the perspective of butterflies. However, from the earliest days, most expeditions and visitors to the region with an interest in insects obtained material from all available orders. The first organised expedition to Arabia was an ill-fated Danish one, which left Europe in 1761 and reached the south-western part of the peninsula the following year (Hansen 1962). Much of the material collected (plants, fish and crustaceans, as well as insects) was lost at sea. Enough survived to make the enterprise a scientific success, although four of the five expedition members died, including Peter Forskål, the expedition's botanist and chronicler. Several expeditions followed and in the nineteenth century, expatriate residents began to send back material, much of which found its way to the British Museum (Natural History) and to other European museums. Major J.W. Yerbury at Aden and Lt.-Col. A.S.G. Jayakar and M. Maindron, based in Muscat, are amongst the most prominent of these early collectors, all having species named after them. In the early twentieth century, expeditions continued, most notably that to Aden by the Imperial Academy of Sciences from Vienna and by Scott and Britton of the British Museum to south-western Arabia in 1936. Increasingly, however, organised collecting efforts began to give way to the enterprises of individual collectors, some private visitors, some long-term residents and others employed by the various anti-locust organisations active around the middle of the twentieth century. Names associated with the collection of Arabian insects include some of the great European explorers of the region. Bertram Thomas was a British Minister serving the Sultan of Oman and made the first crossing of the Rub' al-Khali or Empty Quarter, collecting insects such as the desert leopard butterfly *Apharitis myrmecophilia*. Specimens of Arabian butterflies or beetles labelled 'B. Thomas & Ali Muhammad' can still be found in museums or catalogues. H. St. John Philby, the explorer, lived in Saudi Arabia for more than 25 years, collecting much insect material. Sir Wilfred Thesiger, another explorer, was also employed

by the locust control organisations. He too collected a large number of insects, including the first material from the Al Ain region, such as the neuropteran *Dielocroce elegans*. In Kuwait, the Dicksons were responsible for amassing many specimens of insects. Professional entomologists and other scientists were also employed by the Middle East Anti-Locust Units and had free access to most of Saudi Arabia. The orthopterists B.P. Uvarov and George Popov and the botanist D. Vesey-Fitzgerald, amongst others, collected



significant numbers of insects from Saudi Arabia. Popov also collected in Oman and the Emirates.

Gradually more people took an interest in collecting and recording Arabian insects. These include K.M. Guichard, who visited much of Arabia, including Oman, from the 1950s; E.P. Wiltshire, resident in Bahrain in the late 1950s and early 1960s; Michael Gallagher, who collected in Bahrain, Oman and the Emirates in the early 1970s; D.A. Picher, D.H. Walker and A.R. Pittaway in eastern Saudi Arabia in the 1970s and 1980s; T. Larsen who visited Oman in 1979 and 1981 and Yemen in 1980 and 1981; Professor W. Büttiker and his wife and later, since the late 1970s, Dr W. Wittmer, in Saudi Arabia and Oman.

The copious amounts of material collected by Büttiker and Wittmer are mainly deposited in the Basel Natural History Museum, Switzerland. Much has been published in numerous papers in the impressive series *Fauna of Saudi Arabia*. The activities of Walker and Pittaway eventually led to the publication of the only general book on Arabian insects (Walker and Pittaway 1987), whilst those of Larsen resulted in two popular books on the butterflies of Oman and of Arabia as a whole (Larsen 1980; 1984). Extensive

collecting work resulted in an insect fauna of Kuwait being published in 1989 by a young national entomologist, Al Houty. In Oman, surveys of flora and fauna covered the Jebel Akhdar region in 1975, Dhofar in 1977 and the Wahiba Sands in 1985/87. The results enormously increased knowledge of that country's insect fauna and were published as three Special Reports in the *Journal of Oman Studies*.

Exploration of the UAE fauna and its arthropods has been less systematic and, with the exceptions noted above, comparatively much more recent.

Nevertheless, much work has now been undertaken and a considerable knowledge base is being built up. A pitfall-trapping project was carried out in Abu Dhabi by B. Tigar, an entomologist working for the National Avian Research Centre (now part of the Environment Agency – Abu Dhabi (EA-AD)) in a study of the diet of the houbara (Tigar 1996). Jebel Hafit was surveyed in 1997–1998 (Gillett 1998d). A preliminary survey of Marawah Island, Abu Dhabi, was made by the authors in 1998 (Gillett and Gillett 2003). Contributions to the study of the UAE arthropod fauna continue to be made by visiting enthusiasts and long-term residents, including members of the Emirates Natural History Group (ENHG) and its associated groups in Al Ain and Dubai. Some of the first records of insect species new to science in the UAE resulted from the activities of C.G. Roche and I. Hamer in the 1980s, both of whom collected bees and wasps. Much of this work was published in the Abu Dhabi-based journal *Tribulus* or its predecessor, the *ENHG Bulletin*. Other collectors in the Emirates at around the same time included J.N. 'Bish' Brown (insects in general), E.A. Sugden (caddisflies), P. Barker, P. Dickson and C. Furley (all butterflies). More recent contributors to knowledge of the UAE's insect or arthropod fauna include A. Legrain (moths), G. Giles (dragonflies), G.R. Feulner (scorpions, damselflies, owl flies, butterflies), M.L. Eiland (mantids), C. Collingwood (ants), E. Awad (hawkmoths), P. Cunningham and K. Thompson (ticks), B. Howarth (flies) and the authors (beetles, butterflies, moths, grasshoppers, owl flies and insects in general).

## SYSTEMATIC ACCOUNT OF INSECTS

PRIMITIVE INSECTS  
(APTERYGOTA)

In the Emirates, two groups of primitive wingless insects occur, the springtails of the order Collembola and the bristletails or silverfish of the order Thysanura. Very little is specifically known about either group. The springtails are minute soil-dwelling insects, preferring wet conditions and often found outside in oasis areas and gardens after rain, although they can occur in huge numbers in damp houses after water leakage. No specific identifications are known for the UAE. The Thysanura are also present although, again, few species have been properly identified. Different species are found in houses (e.g. *Thermobia domestica*), in caves, in sterile sand dunes and under stones and debris in mountains and gravel plains (e.g. *Lepisma saccharina* and *Ctenelopisma ciliata*). *Psammophilous* species often show morphological adaptations for life in sand (Irish 1991), but, in general, all bristletails are nocturnal scavengers that feed on any available organic material.

INSECTS WITH INCOMPLETE METAMORPHOSIS  
(EXOPTERYGOTA)

The UAE fauna contains representatives of 12 orders of these insects, which differ from the more advanced endopterygote insects by not having a pupal stage before attainment of adulthood. The young feeding and growing stages of the insects, commonly called nymphs, often closely resemble the adults, although they lack functional wings and developed sex organs. Two of the largest orders in the Emirates are relatively well known and are dealt with separately on pages 176 and 178: Odonata (dragonflies) and Orthoptera (grasshoppers and crickets). Other large orders include Blattaria (cockroaches), Mantodea (mantids) and Hemiptera (true bugs), and while most of the remaining orders have few species in the Emirates, these may be economically important, for example insects such as termites (order Isoptera) and biting and sucking lice (orders Mallophaga and Anopleura). Barklice (sometimes called booklice or dust lice) belonging to the Psocoptera, are a newly recognised order from the Emirates, but no identification is yet available as to species. These tiny insects are found under dead bark of trees in mountain areas.

Termites abound in sandy areas of Arabia (Chhotani and Bose 1991). While the number of species is small, the number of individuals can be very large, and so, consequently, can be the damage that they cause. Only a few species have so far been determined specifically for the Emirates. Anopleurans include the medically well-known and cosmopolitan sucking lice that affect mankind, whilst biting lice may cause serious damage to livestock as well as feeding on wild species of animals.

Several other orders are of no economic importance and are very poorly represented in the UAE. Mayflies (Ephemeroptera) are shortlived as adults, although larval development in aquatic habitats may be prolonged. Arabia as a whole, including the Emirates, has very few species (Sartori and Gillies 1990). Webspinners or Embioptera are known from a single species, *Parembia persica*, in Al Ain, probably introduced from further east via ancient trading links (Gillett 1994). Stick insects (Phasmida) have only recently been found in the UAE. Previously, small nymphs were known from the Mahdah area of Oman, but unidentified adult insects have now been found in grassy areas of sand desert near Al Faqah, Abu Dhabi. Only a few species of earwig (Dermaptera) occur in the UAE, the commonest being the large species, *Labidura riparia*. As its name suggests, it likes damp places and has recently become very common on the irrigated slopes at Mubazzarah, Jebel Hafit. The old order Dictyoptera used to include both the medically important cockroaches and the less important, but fascinating, praying mantids, here split respectively into two orders, Blattaria and Mantodea. All of the cosmopolitan cockroaches, such as the American cockroach *Periplaneta americana*, Oriental cockroach *Blatta orientalis* and German cockroach *Blatella germanica*, occur mainly in buildings, but there are several indigenous species that live outdoors. The mantids in the UAE include both praying mantids and ground mantids, most recently studied by Eiland (1998). A total of 46 species are known from Arabia (Kaltenbach 1991) and many are likely to occur in the Emirates. One of the best known is the beautiful green and white Lappet mantis *Blepharopsis mendica nuda*, found on vegetation such as *Euphorbia larica* or, in the case of the male insects, attracted to lights at night. Another common species is the cryptically coloured ground mantis *Eremiaphila baueri*.



The closely related orders Hemiptera and Homoptera contain the true bugs and the cicadas, planthoppers and aphids respectively. Both groups have economically important representatives in the Emirates. Hemiptera is the largest order in this division of the insect classification and includes many species in the Emirates that are thus far poorly studied. Well over 450 species of true bugs are known from Saudi Arabia (Linnavuori 1986) and, although little recorded, they are also plentiful in the Emirates. Common in desert areas is the brightly coloured harlequin ground bug *Lygaeus equestris*, found on desert plants, including *Calotropis procera*. A larger black species, *Coridius viduatus*, is associated with wild bitter melons in similar situations. In mountain wadis and some oases, a large brown bug *Anoplocnemis curvipes* of African origin, is often common. One of the largest UAE insects is the water bug *Lethocerus patruelis*, a predator of wadi fishes and toads. Also present in similar freshwater habitats are the water scorpion *Laccotrephes fabricii* and smaller species such as water boatmen.

Of the Homoptera, perhaps the best known is the cicada *Platypleura arabica*, common everywhere on trees in the hot months, and apparently, the only cicada occurring in the Emirates, although there are many smaller homopterans, including aphids, scale insects and planthoppers (Dlabola 1979).

#### INSECTS WITH COMPLETE METAMORPHOSIS (ENDOPTERYGOTA)

This division contains the most successful insects. Four large orders are dealt with separately on pages 180–181 (true flies – Diptera), pages 182–183 (butterflies and moths – Lepidoptera), pages 184–185 (ants, bees and wasps – Hymenoptera) and pages 186–187 (beetles – Coleoptera). Other orders present in the Emirates include the Neuroptera (antlions, lace wings etc.), Trichoptera (caddis flies) and the Syphonaptera (fleas). In all cases, development of the insect includes an egg stage, followed by the larva, an active feeding stage, and then by a second resting stage, the pupa. After a suitable period, usually days or weeks, but sometimes many years, the adult insect emerges and is usually completely different to the larval form. In general, adults are winged, but the Syphonaptera is, of course, an exception. There are also flightless Hymenoptera (especially bees), beetles and flies.

Evidence for the presence of the Neuroptera is common in sandy and dusty areas, where the conical pits of antlions (Myrmeleionidae) often abound. Constructed by the larvae (called doodle bugs in the USA), the pits serve to help funnel potential prey like ants into the insect's mouth at the bottom of the pit. Many antlions, however, have free-ranging larvae. There are a number of species in Arabia (Hölzel 1988), including the Emirates. All are nocturnal and strongly attracted to lights, including *Palapares dispar*, a large species with

mottled wings. Smaller species include *Cueta lineosa* and *Nophis teillardi*, both found at Al Ain. Other smaller families of this order found in the Emirates include Ascalaphidae (owl flies) (Hölzel 1983), Nemopteridae (ribbontails) (Meinander 1980), Chrysopidae (green lacewings) (Hölzel 1980) and Hemerobiidae (brown lacewings) (Hölzel 1988). Owl flies are fairly new discoveries in the Emirates (Gillett 1999a) with four species known.

*Ascalaphus festivus* and *Bubopsis hamata* are typical examples, resembling dragonflies except for their long clubbed antennae. In the ribbon tails, the hind wing is extensively modified into a long thin pendant; a common and beautiful example in Al Ain and Dubai being *Halter halteratus*. Green lacewings are generally small, found on foliage and attracted to lights at night. Many, such as *Chrysoperla carnea*, predate on aphids as both adults and larvae. The brown lacewings are similar.

Caddisflies belong to the order Trichoptera and are closely related to butterflies and moths. Very uncommon in Arabia, largely because the immature stages are spent in fresh water; most records are from western Saudi Arabia and Yemen (Malicky 1986). However, two species have been found in Wadi Madha, an Omani enclave near Fujairah, including *Setodes sugdeni*, that are as yet unknown in the Emirates.

The fleas of the Emirates have not been studied in detail, but the fauna includes most of the cosmopolitan species occurring on man and his domestic animals, including *Pulex irritans* and *Ctenocephalides felis*. Little is yet known about fleas infesting native mammals and birds.

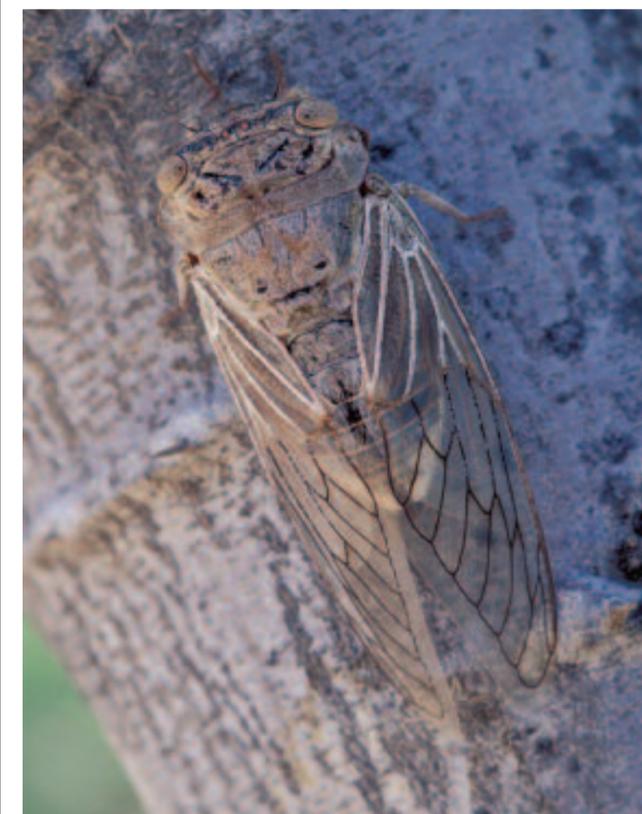
Michael Gillett and Conrad Gillett

#### ACKNOWLEDGEMENTS

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THIS PAGE: Jewel beetle *Julodis euphratica*

OPPOSITE PAGE CLOCKWISE FROM TOP LEFT: Assassin bug, antlion, praying mantis, termites, cicada, stick insect



## THE PHYLUM ARTHROPODA IN THE UAE

The arthropods are an enormous assemblage of species, both marine and terrestrial, that share the common characteristics of having a hard exoskeleton and several pairs of jointed legs that may be used for a variety of purposes including swimming, walking, leaping and digging. The group is divided into a number of subphyla, each containing one or more classes and, in turn, one or more orders. The groups containing terrestrial and freshwater species of interest in the Emirates are outlined below. For the largest group, the insects, a detailed list of orders is given.

PHYLUM ARTHROPODA	COMMON NAMES	NOTES
<b>SUBPHYLUM CHELICERATA</b>		
<b>CLASS ARACHNIDA</b>		
Arachnids		
Order Scorpiones	Scorpions	Terrestrial
Order Araneae	Spiders	Terrestrial and fresh water
Order Pseudoscorpiones	Pseudoscorpions	Terrestrial
Order Solpugida	Camel spiders	Terrestrial
Order Acariformes	Mites and ticks	Terrestrial and fresh water
<b>SUBPHYLUM CRUSTACEA</b>		
<b>CLASS CRUSTACEA</b>		
Crustaceans		
Order Notostraca	Tadpole shrimps	Ephemeral ponds
Order Conchostraca	Clam shrimps	Ephemeral ponds
Order Isopoda	Woodlice	Terrestrial and marine
Order Decapoda	Crabs, lobsters, shrimps	Mainly marine
<b>SUBPHYLUM UNIRAMIA</b>		
<b>CLASS INSECTA</b>		
Insects		
Largest group; <i>see below</i> .		
30 Orders (24 in the Emirates)		
Terrestrial and fresh water		
<b>CLASS CHILOPODA</b>		
Centipedes		
Order Scolopendrida		Terrestrial

### INSECT ORDERS PRESENT IN THE FAUNA OF THE UNITED ARAB EMIRATES

SUBCLASS/ DIVISION		
Order	Common names	Numbers, Occurrence & Habitat
<b>APTERYGOTA</b>		
Collembola	Springtails	Few species – damp places
Thysanura	Bristletails	Moderate – all types of habitat
<b>PTERYGOTA/EXOPTYERYGOTA</b>		
Ephemeroptera	Mayflies	Few – oases and mountains
Odonata	Dragonflies	Moderate – often far from water
Orthoptera	Grasshoppers	Many – all habitats
Phasmida	Stick insects	Few – grassy deserts
Dermaptera	Earwigs	Few – oases and damp places
Embiidina (Embioptera)	Web-spinners	Only one – in gardens
Blattaria	Cockroaches	Moderate – indoors and outdoors
Mantodea	Mantids	Moderate – widespread
Isoptera	Termites	Few – desert/towns
Psocoptera	Booklice, barklice	Few – mainly in mountains
Anopleura	Sucking lice	Three cosmopolitan species
Mallophaga	Biting lice	Few – on animals and birds
Hemiptera	True bugs	Many – on vegetation
Homoptera	Cicadas, aphids	Many – on vegetation
Thysanoptera	Thrips	Few species – in blossoms
<b>PTERYGOTA/ENDOPTERYGOTA</b>		
Neuroptera	Antlions and lacewings	Many – most habitats
Lepidoptera	Butterflies and moths	Many – vegetated areas
Trichoptera	Caddisflies	Few – mountain wadis
Diptera	True or 2-winged flies	Many – all habitats
Siphonoptera	Fleas	Moderate – on animals
Hymenoptera	Ants, bees and wasps	Many – all habitats
Coleoptera	Beetles	Many – all habitats



CLOCKWISE FROM TOP LEFT: Grasshopper sp.; fairy mantis *Oxythepis nilotica*; common ground mantis *Eremiaphila baueri*; caterpillar of striped hawkmoth *Hyles lineata*; Mediterranean pierrot *Tarucus rosaceus*



## DRAGONFLIES AND DAMSELFLIES (ORDER ODONATA)

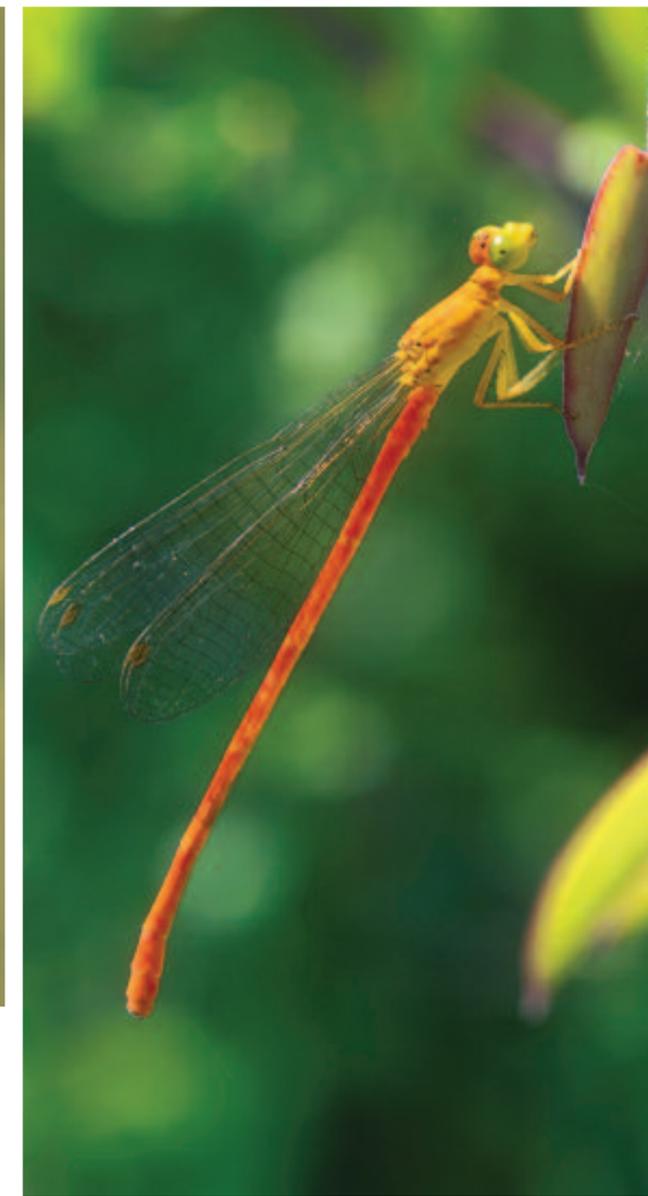


Although the early stages of dragonflies are totally dependent on fresh water, adult specimens can be found in a variety of habitats, including offshore islands and inland sand dunes. Indeed, for a desert country, the UAE has a remarkable and beautiful dragonfly fauna, reviewed most recently by Giles (1998), with some additions by Feulner (1999). Five species of damselflies (suborder Zygoptera) and 17 of dragonflies (suborder Anisoptera) are known from the Emirates with a further small number of species recognised from neighbouring areas of Oman and, therefore, also likely to be found in the UAE.

After the Lepidoptera, the Odonata, including both damselflies and dragonflies proper, is probably the next most colourful insect group in the Emirates. Damselflies migrate at night, but during daytime they are usually not found far from water, as in the wadis of the Hajar Mountains. Particularly colourful damselflies include the endemic powder-blue damselfly *Arabicnemis caerulea* and the bright orange-red *Ceragrion glabrum*. Blues and red also predominate in the colours of the dragonflies. A striking example is the large and iridescent blue male of the emperor dragonfly *Anax imperator*, common wherever there is water for it to patrol. Equally large, the female is more dully coloured. The males of several species have reddish-marked wings and bodies, such as the purple-blushed, gully and orange darter dragonflies (*Trithemis annulata*, *T. arteriosa* and *T. kirbyi*, respectively).

The young stages of all species of Odonata are spent in fresh water. Eggs may be simply dispersed at random over water or the female

may insert single eggs into slits cut into the stems of aquatic plants. After hatching, the nymphs may spend several years growing and developing in the water, before climbing out and giving rise to the mature winged insect in a final spectacular moult. Both young and adults are carnivorous. The adults of dragonflies are very fast and manoeuvrable predators that attack even large insects on the wing. After the adults hatch out, they often migrate vast distances to find feeding areas and new bodies of water for reproduction to begin anew.



OPPOSITE PAGE TOP: Lesser emperor dragonfly, *Anax parthenope*  
BELOW: Purple-blushed darter *Trithemis annulata*

THIS PAGE CLOCKWISE FROM TOP LEFT: Female powder-blue damselfly, *Arabicnemis caerulea*, female globeskimmer dragonfly *Pantala flavescens*, oasis skimmer *Orthetrum sabina*, olive eyes damselfly *Ceragrion glabrum*

## GRASSHOPPERS AND CRICKETS (ORDER ORTHOPTERA)

The Orthoptera is one of the largest of the orders of insects that show incomplete metamorphosis, with over 20,000 described species worldwide. Most are moderately-sized or large insects, nearly all showing enlarged rear legs, modified for leaping and jumping. Apterous forms are known, but most are fully-winged insects in the adult stage. The hindwings may be very colourful, but are only revealed in flight. Grasshoppers and crickets are common in the well-vegetated and warmer regions of the world, but are also found in drier habitats, including deserts (Popov 1980; 1981). In the UAE, orthopterans, although not numerous in terms of species, make up a characteristic and significant part of the insect fauna (Gillett 2000). These insects are sporadic in their occurrence in the UAE, but some species may at times be so plentiful as to become pests. Among these, the desert locust *Schistocerca gregaria*, although now generally uncommon, must be mentioned for historical reasons (Popov 1988).

The taxonomic arrangement of the order Orthoptera is extremely controversial. The following is a simple scheme, showing only the families so far recorded in the UAE:

## Suborder Caelifera

Family Tetrigidae (Groundhoppers)

Family Pyrgomorphidae (Small grasshoppers)

Family Acrididae (Grasshoppers &amp; locusts)

## Suborder Ensifera

Family Tettigoniidae (Bush crickets)

Family Gryllidae (Field crickets)

Family Gryllotalpidae (Mole crickets)

The groundhoppers, Tetrigidae, are amongst the smallest orthopterans in the UAE, as well as being the least studied. The commonest species is found on gravel beds, at the side of running water in mountain wadis and is referable to the genus *Euparatettix*. One other species, *Paratettix ocellatus*, is found in similar localities. Two further species are also known from the Al Ain area, but have not yet been identified. The Pyrgomorphidae contains just a few species of small grasshoppers in the Emirates, whilst the family Acrididae contains the true or

shorthorned grasshoppers, including the locusts. Its members are relatively numerous and well studied (Popov 1980; Gillett 2000) with about 45 species recorded from the Emirates. One interesting group contains grasshoppers with brightly coloured hindwings, shown in flight and then covered up again as soon as the insect settles. Coupled with the cryptic colouration of the forewings, this makes it difficult for potential predators to locate the insect once it lands. Good examples are *Scintharista notabilis* and *Sphingonotus octofasciatus*, the former



having yellow or red and the latter red and black hindwings. Another protective strategy used by some of these grasshoppers, like *Sphingonotus rubescens*, is crepitation, a loud cracking noise made by the wings in flight, often by several insects simultaneously. The objective seems to be to distract and confuse predators if the insects are disturbed. Four large species of the genus *Truxalis* are found in the Emirates. The females are elegant elongated grasshoppers with very long hindlegs and coloured hindwings; males are much smaller, but similar. The commonest species is *T. procera*.

Compared to the grasshoppers, there are few species belonging to Ensifera in the Emirates. The bush crickets (Popov 1981) are represented by about five species, including *Decticus albifrons*, a green insect. True crickets (Gorochov 1993) include the tropical field cricket *Gryllus bimaculatus*, a stout black nocturnal insect common in cultivated areas. There are several mole crickets *Gryllotalpus*, potential pests of market garden crops, and all of similar appearance and adapted for tunnelling just below the surface of the soil in damp places.

The orthopterans of the Emirates make up a rather mixed group of insects, some being all too common whilst others, including several of the more beautiful species, are seldom or only sporadically seen. They include both minor pests of grass, such as *Ailopus thalassinus* and potentially devastating locusts, including both the desert locust and the migratory locust.



OPPOSITE: *Gangling grasshopper*  
*Truxalis procera*

THIS PAGE CLOCKWISE FROM TOP RIGHT:

*Locust sp.*

A common grasshopper in the Emirates,

*Pseudosphingonotus savignyi*

One of the larger grasshoppers in the UAE is

*Anacridium melanorhodon arabafrum*.

The rare and elegant grasshopper *Truxalis longicornis*

is known from the Hajar Mountains and an isolated population in the Air Mountains of Niger.

Long horn grasshopper



## TRUE OR TWO-WINGED FLIES (ORDER DIPTERA)

The Diptera are the second largest order of insects with over 120,000 described species worldwide, one tenth of all animals so far described. This preliminary analysis of the UAE Diptera draws together all published records and recently collected material, and includes families not previously recorded or documented. The checklist includes 18 families. Many more families are present, but their UAE fauna has not yet been studied.

The name Diptera originates from the Greek words *dis*, meaning two, and *pteron*, meaning wing, thus describing the main character of flies, all having two wings, except in a few cases where the wings are absent. Behind the wings are a pair of halteres, small, club-like structures that evolved from the hind wings, and act as balancing organs during flight.

Flies undergo complete metamorphosis during their life-cycle. In most cases, adult females lay eggs into or near suitable material from which soft-bodied larvae, often called maggots, hatch. These eventually pupate, often inside a puparium formed from the hardened larval skin, until the adult emerges. A number of species, however, retain their eggs until after hatching, giving birth to larvae (i.e. larviparous).

Flies are probably the most important of the groups of insects that affect people. Although some act as vectors of disease-causing organisms, most Diptera are harmless to people (Crosskey [ed.] 1979). Flies can be found almost everywhere, although many are specific to a particular habitat. Due to this specificity, the presence or absence of some flies has been used as a biological indicator of pollution, or to establish whether some areas are ancient and undisturbed by human activities. The fact that some adult flies or larvae can be expected to be present under certain conditions helps forensic entomologists to determine the time of death of murder victims, such evidence being used in criminal prosecutions (Erzinçioğlu 2000).

The life cycles of Diptera larvae vary. They may be found in water, decaying organic matter (such as carcasses, trees and sewage), in plants and sometimes on live animals, such as sheep. Some are free-living predators, some live on decaying matter and others are parasitic on other insects and other organisms.

Adult flies are usually free-living and, depending on the species, feed on a variety of foods including nectar, decaying organic matter and other fluid substances. Some flies predate on smaller insects, while others have developed blood-sucking habits (Davies 1988), this being mainly confined to the female (Imms 1957), although both sexes of tsetse flies (Glossinidae, genus *Glossina*) suck blood. Mouthparts are variable, though all are designed for sucking, or, in horse-flies (Tabanidae), for rasping or licking (Chinery 1973).

Flies are divided into three suborders, the Nematocera (e.g. mosquitoes, sand-flies, midges and gnats), the Brachycera (e.g. bee-flies, horse-flies, robber-flies), and the Cyclorrhapha (e.g. house-flies, fruit-flies, hover-flies and blow-flies).

The suborder Nematocera includes several species of medical importance, such as phlebotomine sandflies (Psychodidae), some of which transmit viruses. Others transmit dermal and visceral leishmaniasis (Lewis 1978), parasitic diseases that have caused considerable human suffering and mortality, dermal leishmaniasis causing disabling lesions on the skin and visceral leishmaniasis also known as *kala-azar* affecting the spleen, liver and lymph nodes. According to the World Health Organisation, 90 per cent of cutaneous



Robberflies (*Asilidae*) mating

leishmaniasis cases occur in Afghanistan, Brazil, Iran, Peru, Saudi Arabia and Syria. The genera from which the parasites have been isolated elsewhere in the world occur in the UAE, which is listed as a country where the disease is likely to occur, though actual cases seem to be very rare with very few records being available (e.g. el-Saaran and Harries 1979). The disease is known to occur in Oman (e.g. Elnour *et al.* 2001). Many *Phlebotomus* species bite mammals, and some *Sergentomyia* attack lizards or other cold-blooded animals (Lewis 1978).

Another nematoceran of medical importance is the mosquito, *Anopheles* species transmitting malaria. Among the 12 species of anopheline mosquitoes recorded in the UAE are *Anopheles culicifacies*, *A. dhali*, *A. paltrinierii*, *A. sergentii* and *A. stephensi* (Glick 1992). Malaria was formerly a serious health problem in the UAE with 2,436 cases recorded among UAE nationals in 1980, although at the end of 2000, the Ministry of Health declared the country to be free of locally-transmitted malaria. Two other mosquito genera are present (*Ochlerotatus* and *Culex*) and there are at least 16 recorded species of mosquitoes in Dubai Emirate (Balfour 2003). These can be a nuisance but are usually only found in the cooler months, population numbers declining with the arrival of summer and the evaporation of suitable breeding sites.

Blackflies also transmit disease. One species is recorded from Hatta (*Simulium (Wilhelmia) buettikeri*).

Not all Nematocera are associated with diseases. Adult chironomids, the non-biting midges, and many other families, are not harmful to man or livestock.

The size of adult Nematocera varies from just a few millimetres to several centimetres long. Some are so small that they are difficult to see and identify. However, the crane-flies are members of this suborder and although the species found in the UAE, *Styringomyia eberjeri*, is smaller than some of its European relatives, it is relatively large with a body 5.5 millimetres long and a wingspan of about 8 millimetres (Hancock 1997).

The Suborder Brachycera includes bee-flies, robber-flies, horse-flies and others.

Bee-flies (Bombyliidae) are common in the UAE, usually seen hovering low over the ground or just above the observer, their shadow often giving them away (Stubbs and Drake 2001). They appear to be totally still in mid-air, their wings beating so fast that they are often not visible and only a floating body can be seen. Some Bombyliidae have a long proboscis, used to suck nectar from the corollae of flowers during flight. In this way, their behaviour is similar to that of hummingbirds (Stubbs and Drake 2001). Bee-flies vary considerably

in size; one of the most spectacular members of the UAE fauna is *Exoprosopa megerlei*, a large species (wingspan approximately 3 centimetres) with dark wings.

Rather less conspicuous than bee-flies, although usually large, are members of the Asilidae (robber-flies), named for their hunting strategies. Robber-flies frequently sit quietly on sand or vegetation observing their environment closely. Their specially-adapted eyes curve round almost to the back of the head with small facets over most of the surface of the compound eye and large facets in some regions, enhancing their vision (Stubbs and Drake 2001). Any movement is closely monitored; the fly repositions itself until it spots a potential meal and then pounces with a deliberate capture-dart flight on the victim. Their sharp mouthparts render their victim helpless, first by piercing and then by injection of poisonous saliva that can kill invertebrates instantly (Adamovic 1963). Asilids usually do not attack people. In one recorded case, however, an observer was jabbed in the finger. A sharp pain was felt, but no swelling occurred (Stubbs and Drake 2001).

The bite of horse-flies (Tabanidae), in contrast, can not only be painful but can also cause swelling. *Tabanus rupinae* is found in oases and farms where it is a pest of livestock (Walker and Pittaway 1987).

The third major group of Diptera is the suborder Cyclorrhapha, which includes house-flies, fruit-flies, bluebottle flies, hover-flies and others. This suborder is divided into Aschiza and Schizophora. Members of the former lack a ptilinum which is used to escape from the puparium. The Schizophora further divide into Calypttratae, Acalypttratae and Pupipara.

Members of the Cyclorrhapha include the ubiquitous house-fly *Musca domestica*, important as potential spreaders of germs. They moisten their food with saliva containing digestive enzymes, then sucking up the broken-down food. Diseases can be spread when a house-fly has fed on decaying material and then moves on to food for human consumption (Walker and Pittaway 1987).

Another muscid frequently mistaken for a house-fly is the stable-fly *Stomoxys calcitrans* (Balfour 2003) where both sexes are able to 'bite'. They can be distinguished from *Musca domestica* by their long, forward-projecting proboscis.

Fruit-flies (Drosophilidae) are small flies, commonly found around fermenting, decaying fruit or fruit juice. Other well-known cyclorrhaphans are the bluebottles and greenbottles, members of the Calliphoridae. Some develop in carrion, faeces or the wounds of live animals, the latter making them important livestock pests. They are attracted by the volatile compounds given off by decaying flesh (Erzinçioğlu 2000) and are usually the first to discover dead animals, helping in the 'cleaning-up' of animal carcasses.

A spectacular member of the UAE Calliphoridae is the regal bluebottle *Chrysoma regalis*. The upper wing margin sports a black ridge and the eyes are usually bright orange which, together with the metallic-blue body, makes this fly a very impressive insect.

Many hover-flies (Syrphidae) are spectacular mimics. One such is *Eristalis taeniops*, strikingly similar to a honey-bee, as are other members of the Eristalinae around the world (e.g. Howarth and Edmunds 2000). Hover-flies are also the only Diptera to eat solid food (Gilbert 1986). Analysis of syrphid faeces can reveal their pollen diets and the identity of the source flower

(Golding, in prep.). Pollen is rich in protein, needed for the reproductive systems of both male and female syrphids to mature (Gilbert 1986).

A smaller member of the Cyclorrhapha in the UAE is *Dacus* (= *Leptoxyda*) *longistylus*, a brightly coloured orange and cream fly. The female has an impressive ovipositor (resembling a sting), with which it lays eggs in the fruit of Sodom's apple *Calotropis procera*, a plant upon which it is frequently seen (Walker and Pittaway 1987).

Many other cyclorrhaphan flies, known to be present in the UAE, await further study. Some, such as the families Agromyzidae, Chloropidae, Tethinidae and Ephydriidae, are small and have not yet been classified to genera and species level. Species of Agromyzidae, Chloropidae and Ephydriidae are known pests of cereals in other parts of the world (Alford 1999) and may be of economic importance in the UAE. Further Diptera of medical importance may also be present but are unrecorded to date. More work is likely to identify many additional species.

Just as Diptera may vary in size, their colouring, too, is very diverse and, in some cases, spectacular. Although the suborders Brachycera and Cyclorrhapha include small flies, many are large and some colourful. Some adult Diptera can be difficult to identify in flight, as they resemble and behave like bees and wasps (Hymenoptera), although, unlike the Hymenoptera, flies do not possess a sting. This mimicry of bees and wasps may deter predators.

Mimicking flies in the UAE can be found among the Syrphidae (hover-flies) and Bombyliidae (bee-flies). This kind of mimicry is known as 'Batesian Mimicry' after Henry Walter Bates, who noticed the similarity of South American butterflies belonging to different families and questioned its purpose (Bates 1862). In his studies, the butterfly that occurred most frequently proved to be poisonous while the far rarer mimics were edible. The author is currently studying mimics and their models in the UAE.

Brigitte Howarth

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## BUTTERFLIES AND MOTHS (ORDER LEPIDOPTERA)

This is one of the larger groups of UAE insects, the most colourful, and the best known. A simplistic division of the group is into two: the day-flying butterflies (Rhopalocera) (Larsen 1983; 1984) and the night-flying moths (Heterocera).

However, many moths, including some found in the Emirates, fly by day and elsewhere there are also some nocturnal butterflies. In fact, the butterflies are all found in just five families arranged in two superfamilies, but the moths belong to a

confusing array involving numerous families and superfamilies. A convenient way of dealing with moths has long been to split them into two artificial groups: Macro-heterocera and Micro-heterocera. In the UAE, the former corresponds to a series of families of mainly larger moths that are generally well known (Legrain and Wiltshire 1998) and the latter to the mainly unstudied groups of generally smaller moths (Pelham-Clinton 1977; Gillett 1997b).

Almost 50 species of butterfly are now known to occur in the UAE, including representatives of all five families: Papilionidae (swallowtails), Pieridae (whites and yellows), Lycaenidae (hairstreaks, coppers and blues), Nymphalidae (danais, nymphs and satyrs) and Hesperidae (skippers). Many are sporadic in their occurrence and many are true migrants that arrive in the country in periods following rain when the vegetation is at its lushest and their own populations are high. The largest UAE species are the lime butterfly *Papilio demoleus* and the related swallowtail *P. machaon muetingi*, a distinct subspecific form of a butterfly common across the Palaearctic and Nearctic regions of the world. The lime butterfly is thought to be an introduction from West Asia as its foodplants, *Citrus* spp., do not occur naturally in Arabia, but the swallowtail is an endemic butterfly usually found under oasis conditions. Another large butterfly is the plain tiger *Danaus chrysippus* whose bright chestnut wings are usually, but not always, marked with black and white (Gillett 1998a). The larval foodplants are the poisonous milkweeds Asclepidaceae. The diadem *Hypolimnas misippus*, from the same family, has differently coloured sexes, the male is black with three purple-fringed white spots, but the female is a near-perfect copy of the poisonous plain tiger. This mimicry helps to protect the non-poisonous diadem female from predators. The lycaenids include many forms, some only recently recognised as occurring in the UAE. These include the small copper *Lycaena phlaeas*, brown playboy *Deudorix antal*, Somali cupid *Euchrysops lois*, African cupid *E. osiris* (Gillett 1997a) and the leopard *Apharitis acamas hyparargos* (Gillett 1999c). An interesting recent discovery is a tiny American butterfly, the Western pygmy blue *Brephidium exile*, first noticed in Al Ain in April 1998 (Gillett 1999b) and subsequently recorded all over the region, including Das



LEFT: Blue pansy *Precis orithya*

BELOW: Lime butterfly *Papilio demoleus*

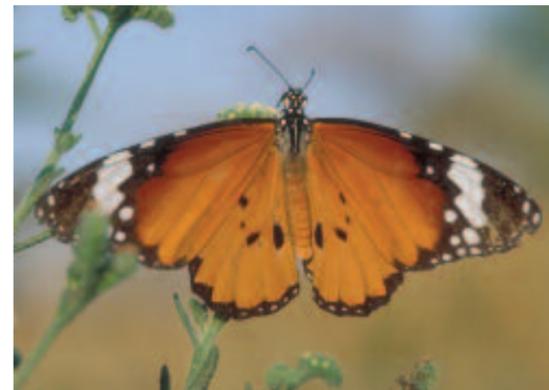
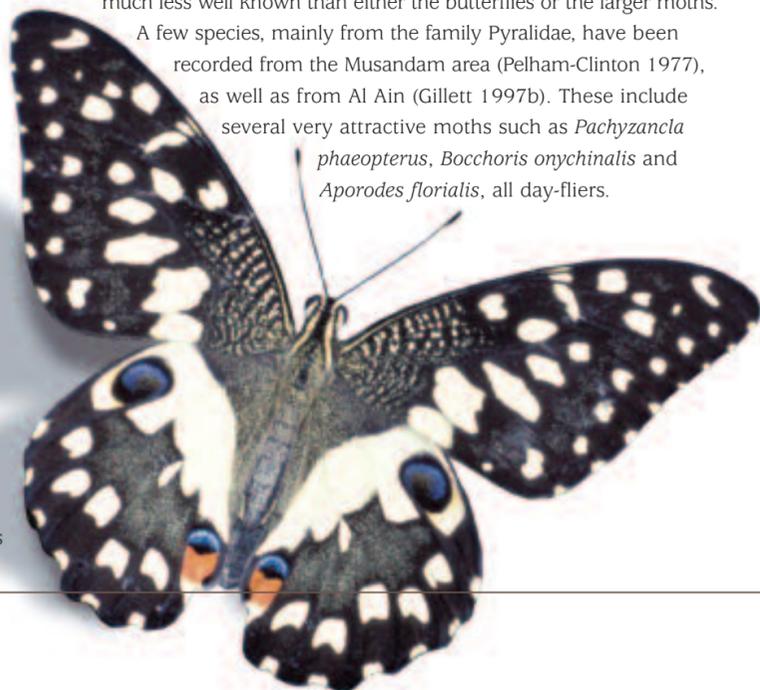
OPPOSITE CLOCKWISE FROM TOP LEFT: Plain tiger *Danaus chrysippus*, larva of deathhead hawkmoth, deathhead hawkmoth *Acherontia styx*, giant skipper *Coeliades anchises jucunda*, oleander hawkmoth *Daphnis neri*, diadem *Hypolimnas misippus*

and Marawah islands (Gillett 2003). It probably arrived with plants imported for landscaping and is associated with

*Sesuvium verrucosum*, which is widely planted, but is not a known larval host plant. The discovery of the giant skipper *Coeliades anchises jucunda* on Jebel Hafit is also interesting, although the presence of the larval foodplant, *Acridocarpus orientalis*, on the mountain suggested that the butterfly might be present (Gillett 1998d).

Moths belonging to the families Cossidae (carpenter moths), Metarbelidae, Psychidae (bagworms), Lasiocampidae (eggars), Geometridae (earth-measurers), Sphingidae (hawkmoths), Notodontidae (prominents), Lymantriidae (tussocks), Nolidae, Arctidae (tiger moths) and Noctuidae (owlet moths) have been extensively collected by Legrain. Over 200 species have been recorded from the UAE and adjacent areas of Oman (Legrain and Wiltshire 1998), with a few more added by Gillett (1998a; 1998b). Largest of these are the hawkmoths with seven species known from the UAE, including the spectacularly beautiful oleander hawkmoth *Daphnis nerii* and the Eastern deathhead hawkmoth *Acherontia styx*. Another hawkmoth from Yemen, *Cephonodes hylas virescens*, a known migrant and pest of coffee bushes, surprisingly appeared in the UAE in the wetter years of the mid-1990s. There are probably several hundred species of micro-moth in the UAE, but these are much less well known than either the butterflies or the larger moths.

A few species, mainly from the family Pyralidae, have been recorded from the Musandam area (Pelham-Clinton 1977), as well as from Al Ain (Gillett 1997b). These include several very attractive moths such as *Pachyzancla phaeopterus*, *Bocchoris onychinalis* and *Aporodes floralis*, all day-fliers.



## ANTS, BEES AND WASPS (ORDER HYMENOPTERA)



LEFT: A caterpillar-hunting wasp, *Delta diminuatipenne*  
 OPPOSITE TOP: Desert runner ant *Cataglyphis niger*  
 OPPOSITE BELOW: Beetle wasp, *Scolia* sp.

This is the third largest insect order with over 100,000 known species, arranged in two suborders, Symphyta and Apocrita. The first is a small group, containing the sawflies and gall wasps, not yet recorded from the Emirates. The vast majority of hymenopterans are classified as Apocrita and include relatively well-known insects such as ants, bees and wasps (series Aculeata), as well as many parasitic forms such as the ichneumons (series Parasitica). The hymenopterous fauna of the Emirates is poorly known, but many new species have been described from specimens collected in the country in the 1980s, thanks largely to the activities of C.G. (Giles) Roche (1981) and Ian Hamer (1982; 1983; 1985; 1986a; 1986b; 1988). All of the best known groups in the Emirates belong to the Aculeata and are included in eight superfamilies.

Chrysoidea has a single family of interest, Chrysididae, containing the vividly metallic coloured ruby-tailed or cuckoo wasps (Linsenmaier 1994). These solitary wasps lay single eggs in the brood chamber of other species of Hymenoptera. On hatching, the larva devours its host and pupates. The adult insects have two protective devices to ward off attack by host species, one being an extremely hard cuticle, which prevents the sting of other species from penetrating the body, and the second an ability to roll up into a compact ball. Six genera and a dozen species are known from the Emirates, one of the commonest being the emerald cuckoo wasp *Stilbum cyanurum*.

Tiphioidea contains the family Mutillidae or velvet ants. There are no published records for the Emirates, but at least two species are common in sandy areas. The female is wingless and resembles a pubescent ant. The males are quite different, possess wings and fly readily to lights.

The Pompiloidea includes the spider-hunting wasps of the family Pompilidae. These are very agile, often found in oases where they hunt and immobilise spiders by stinging. The prey is used to stock a burrow with food for the larva. Most species have orange, yellow or smoky colouration on their wings. *Mygnumia dorsalis* is common in the Al Ain area.

The true ants belong to a single family, the Formicidae (superfamily Formicoidea). Ants are very common in the Emirates, but are surprisingly poorly recorded (Tigar and Collingwood 1993). Over 275 species are known from Arabia (Tigar 1996), but only 15 were then known from the Emirates. Subsequently another 15 species of introduced ants were added in 1997 (Collingwood *et al.* 1997). The most obvious species is the desert runner ant *Cataglyphis niger*. Active even at midday, this species characteristically folds its abdomen over its thorax to avoid contact with the baking ground. Colonies of this ant in the Al Ain area may have either dark brown or yellow individuals. The Samsun ant *Pachycondyla sennaarensis* is a primitive stinging ant, widespread and aggressive. There have been cases of human fatalities in the Al Ain Medical District due to hypersensitivity to its venom (Dib *et al.* 1992).

The Scoliidae contains a single family of beetle-hunting wasps Scoliidae with two common species in the Emirates, *Scolia erythrocephala* and *Campsomeriella thoracica*. Males and females are sexually dimorphic. Both sexes often frequent flowers such as *Reseda*, but only the female locates and stings the larvae of large scarabaeid beetles such as *Pentodon*, *Phylognathus* and *Oryctes* for use as larval food.

Vespoidea includes three families, all found in the Emirates. The Massaridae includes several species of flower wasps (Richards 1984a), the Eumenidae, the potter wasps such as *Delta campaniforme*, which hunt caterpillars and the Vespidae, with three species of true social wasps, including the inquisitive Oriental hornet, *Vespa orientalis* (Richards 1984b).

The Sphecoidea includes only a single family, the hunting wasps Sphecidae, but it is the most species-rich and well-studied group in the Emirates (Guichard 1986; 1988a; 1988b; 1989a; 1988b; 1990; 1994a; 1994b). Some of these wasps, such as *Prionyx niveatus*, are large and can sting and immobilise powerful orthopterans including the desert locust. Others are smaller and more graceful insects such as the slim sand wasp *Parasammophila turanica*.

The bees belong to the superfamily Apoidea, which is split into eight separate families. Social bees, such as the Asiatic honeybee *Apis florea*, belong to the family Apidae and leaf-cutter bees to the Megachilidae. Other solitary bees in the Emirates include the very common Canary carpenter bee *Xylocopa aestuans* (Xylocopidae) and the black- and white-striped *Paracrocisa sinaitica* (Anthophoridae).

Most of the diverse Hymenoptera of the Emirates are beneficial to humans either as pollinators, as pest control agents or, in the case of the social bees, as providers of honey and wax.



## BEETLES (ORDER COLEOPTERA)

The Coleoptera is by far the largest order of insects, with well over 350,000 scientifically described species (currently about one-fifth of all recorded organisms). There are learned estimates of several million others yet to be catalogued. However, beetles are mainly tropical insects and in more temperate regions, both the Diptera and the Hymenoptera are often more species-rich. In the Emirates, the three orders are probably similar in overall numbers of species, with perhaps as many as a thousand taxa in each.

Beetles are surprisingly diverse and occupy all habitats from the intertidal zone of marine coastlines to the edge of permanent snowfields whilst also including all types of freshwater habitat. This diversity, together with an ability to utilise all types of organic material as food, plus the protection offered by a pair of hardened forewings (elytra), is responsible for their success (Evans and Bellamy 2000). In the insect fauna of the Emirates, beetles are a prominent group, including numerous large and relatively well-known insects such as the domino beetle *Anthaxia duodecimguttata*, the rhinoceros beetle *Oryctes agamemnon arabicus*, the darkling beetle *Prionothea coronata ovalis* (Gillett 1995d), the longhorn *Anthracoecentrus arabicus* and many others. As with other regions, in the Emirates, spectacular beetles are far outnumbered by much smaller and often little-known species.

A relatively conservative classification of the world Coleoptera (Lawrence and Newton Jr 1995) elaborates over 160 families, with many more subfamilies, all arranged in four suborders. Two of these suborders are both family- and species-poor and have not yet been found in the Emirates. The other two are much richer in species with many forms present in the region.

Of the two, the suborder Adephaga is the smaller, with representatives of just five families known from the Emirates. Most species are carnivorous, both as larvae and adults. From the Cicindelidae (tiger beetles) (Wiesner 1993; 1996; Gillett 1995b; Cassola and Rihane 1996) about a dozen species are present, mostly coastal, like the unique crab-eating *Hypaetha schmidti* (Cassola and Schneider 1997), but some are found in the mountains or in inland *sabkha*, including the large metallic-green *Megacephala euphratica*. The tiger beetles are often classified as a subfamily or supertribe of the family Carabidae or ground beetles. Typical ground beetles in the



Domino beetle

Emirates include the beautiful black and white domino beetle and the black and orange bombardier beetle, *Pheropsophus africanus*. The larva of the latter is an obligatory parasitoid of mole crickets, but the adults frequent fresh carrion. The three other families are all associated with freshwater environments and include the crawling water beetles (Halipidae), the diving beetles (Dytiscidae) and the whirligig beetles (Gyrinidae) (Brancucci 1984).

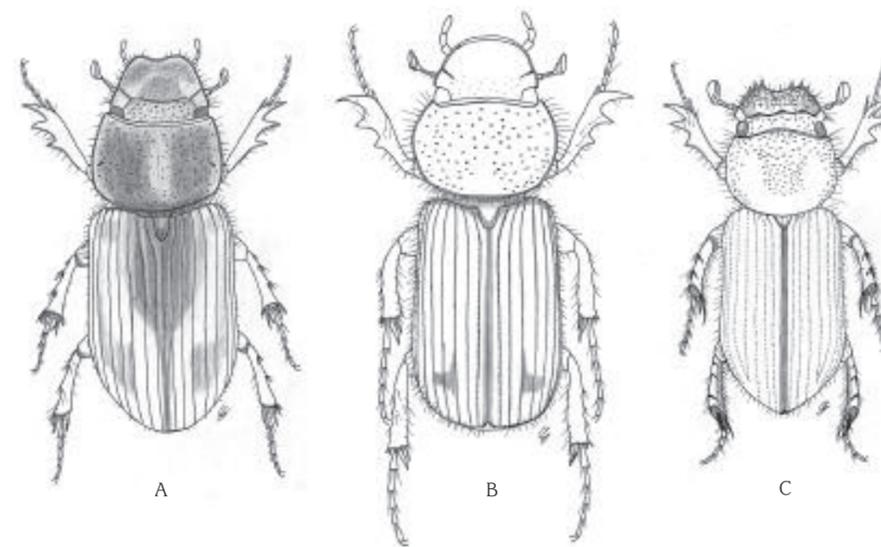
The other suborder, Polyphaga, includes a vast number of species with herbivorous and omnivorous, as well as carnivorous, tendencies. The families represented in the Emirates are too numerous to be discussed here. However, some of the more familiar groups include the scarab beetles of the superfamily Scarabaeoidea (Zunino 1979, 1981; Scholtz 1980; Paulian 1980;

Enrödi 1980; Kuijten 1980; Pittino 1984; Sabatinelli and Pontuale 1998), the darkling beetles, Tenebrionidae (Kaszab 1981; 1982; Johnson 1989; Schawaller 1990), the poisonous oil or blister beetles, Meloidae (Kaszab 1983; Schneider 1991), the ladybirds Coccinellidae (Fürsch 1979) and two families of purely phytophagous beetles, the longhorns (Cerambycidae) (Holzschuh and Téocchi 1991; Holzschuh 1993) and the weevils (Curculionidae). Representatives of many more families are included in the checklist.

The scarabs are one of the most numerous groups of beetles and are grouped in several families, of which the most important in the Emirates is Scarabaeidae (Gillett 1995a), which includes both dung feeders and herbivores. The dung beetles or true scarabs are exemplified by the ball-rolling species; *Scarabaeus bannuensis* in the desert and *Gymnopleurus elegans* in the mountains. Others, such as the smaller *Onthophagus* spp. and *Chironitis osiridis*, remove dung into tunnels beneath animal or human faeces, whilst others, such as *Aphodius arabicus* and *Didactylia arabica*, feed and breed directly in dung pellets. The rarest dung beetle identified in the Emirates is *Apsteiniella naviauxi*, from Hili near Al Ain (Gillett 1995c); previously known only from two other specimens from Saudi Arabia and Iraq.

The phytophagous species or chafers are very varied, but include several pests that feed on roots as larvae, including *Pentodon algerinum dispar*, the widespread chafer *Autoserica insanabilis*, probably introduced, and *Stalagmosoma cynanchi*, allied to the European rose chafer (Gillett and Gillett 1997).

The darkling beetles, Tenebrionidae, include numerous large and small species in the Emirates. They are mainly nocturnal scavengers, such as the very common beetles *Trachyderma philistina* in towns and *Mesostena puncticollis* and *Pimelia arabica emiri* on the



Small scarab dung beetles from the UAE: A. *Aphodius arabicus* (length, 4 millimetres); B. *Didactylia arabica* (4 millimetres); C. *Apsteiniella naviauxi* (3.5 millimetres)

desert fringes. A few are diurnal plant feeders such as *Adesmia stoekleini rasalkhaymana*, first described from the Northern Emirates.

A group of particularly colourful beetles includes the oil beetles Meloidae, many being red or yellow and marked with black stripes or spots. These bright colour schemes advertise the fact that the beetles are poisonous to lizards, birds and humans because they contain the deadly toxin cantharidin (Gillett 1994). In the larval stage, many species are parasites on grasshopper egg pods or in the nests of Hymenoptera, whilst as adults they feed on flowers and leaves. They have been noted



Once considered rare, the rhinoceros beetle *Oryctes agamemnon arabicus* is now common in the gardens of many towns in the Emirates.

as pests outside the region. The species found in the Emirates are very sporadic in occurrence and are only usually found in spring after significant rainfall, when they congregate to feed on ephemeral plants. Common UAE examples include the yellow and black *Croscherichia richteri*, the red and black *Mylabris bipunctata*, the chestnut coloured *Cylindrothorax suturellus* and the metallic-green *Diaphorocera hemprichi*. The largest is the 3-centimetre-long, black and cream *Mylabris maculiventris* found at Al Ain (Gillett and Gillett 1996), an African species previously only recorded in south-east Arabia from Muscat, Oman.

Ladybirds are also poisonous beetles and their red and black spotted markings also serve as warnings. Most species are relatively small and are predators of aphids. As such, they are considered as beneficial insects and include beetles also found in Europe, such as the seven-spot ladybird *Coccinella septempunctata* and eleven-spot ladybird *C. undecimpunctata*. An exception is the larger, orange and black *Henosepilachna elaterii*, which is a plant-eater and considered in some neighbouring regions to be an agricultural pest on Cucurbitaceae.

Like other phytophagous groups, the longhorn beetles are less well represented in desert lands than in greener temperate or tropical regions. In the Emirates, this family contains the country's largest (length, 4.5–7.5 centimetres) beetle, *Anthracoecentrus arabicus*. The world's largest beetle is a related species, *Titanus giganteus*, from Brazil.



A typical poisonous oil beetle, *Mylabris bipunctata*

## BEETLES (ORDER COLEOPTERA)

Other longhorns known from the Emirates include the desert species *Apomecyna lameeri* and *Jebusaea hammerschmidtii*, a pest of date palms (Talhouk 1979).

The weevils are the largest grouping of beetles, usually small, but like the order as a whole, very diverse. A few species are cosmopolitan, including *Sitophilus oryzae* and *S. granarius* and have become pests of stored products such as rice and other grains. Most weevils, however, are inoffensive feeders on native plants, like *Ammocleonus aschabadensis*. An exception is the red palm weevil *Rhynchophorus ferrugineus*; originally introduced in infested palms *Phoenix dactylifera* from mainland Asia in the 1980s, it is now an increasingly significant pest of date palms in the UAE.

The beetles of the Emirates represent one of the most interesting elements of the country's fauna, including many forms beautifully fitted to the desert and mountain environments of the country. From mankind's standpoint, they are mostly innocuous, but immensely important ecologically, whilst a very few are real or potential pests of both stored products and food plants, such as the date palm.

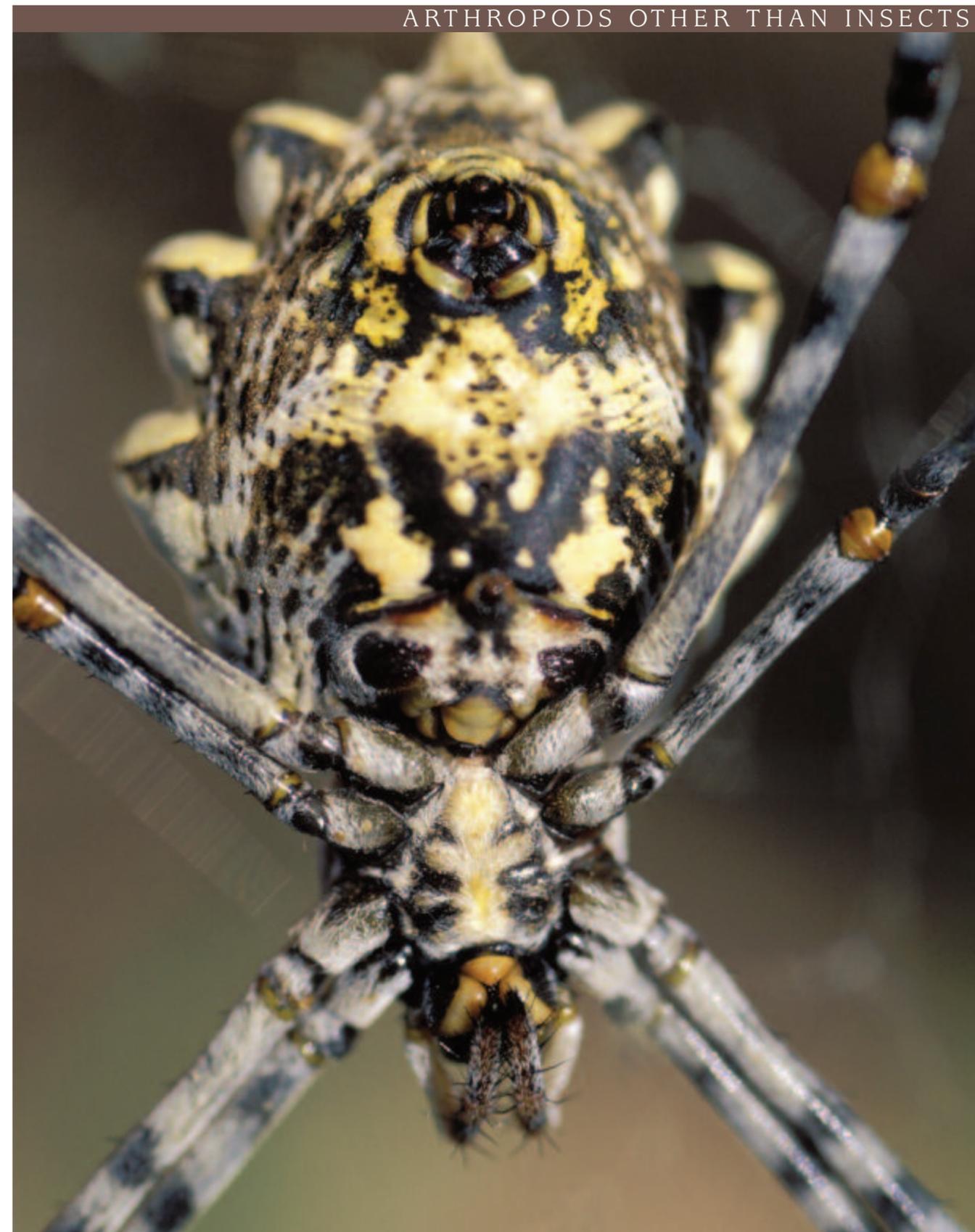


The longhorn beetle *Jebusaea hammerschmidtii* can be a pest of date palms.



The red palm weevil is a major pest among date farmers and has destroyed huge numbers of date palms.

## ARTHROPODS OTHER THAN INSECTS



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ABOVE: *The velvet mite only appears above ground after rains.*  
 LEFT: *Scorpion Androctonus crassicauda*  
 BELOW: *Apistobuthus pterygocercus*  
 OPPOSITE: *Scorpion Latrodectus sp. trapped in the web of Orthochirus.*

Scorpions are relatively common arthropods in the Emirates in sand desert, gravel plains, mountain and oasis. The scorpion fauna of Arabia (Vachon 1979) and of Oman (Lowe 1993) have been reviewed. Some scorpions enter buildings, such as, in Al Ain, the highly venomous fat-tailed scorpion *Androctonus crassicauda*. This species belongs to the family Buthidae in which all of the most venomous scorpions are included. Others in the Emirates include *Vachoniolus globimanus*, *Buthotus jayakari* (Feulner 1998) and *Parabuthus liosoma*. Scorpions of other families also occur, including *Nebo omanicus* (Diplocentridae) found in oases.

True spiders of many families are found in the Emirates, although little attempt has thus far been made to catalogue them. They are found in houses, on the banks of mountain streams, on all types of vegetation and under stones and debris and in burrows in mountain terrain, gravel steppe and sand dunes. Families represented include Gnaphosidae (ground spiders), Thomisidae (crab spiders), Salticidae (jumping spiders), Lycosidae (wolf spiders), Theridiidae (comb-footed spiders) and Argiopidae (orb-web spiders). At least two medically important spiders occur. One is an undetermined brown spider, possibly a wolf spider, whose bite has caused necrotic lesions in the Al Ain region (F.K. Dar, pers. comm.). The other is a subspecies of the widely distributed *Latrodectus mactans*, which has neurotoxic venom.

The pseudoscorpions of Oman and Saudi Arabia have been studied (Mahnert 1991) and similar arachnids are present in the Emirates, but are not yet identified, although probably referable to the genus *Minniza*. They are found mainly in mountain and gravel plain areas under stones.

Related to both scorpions and true spiders, several species of camel spiders (Solpugida) commonly occur in the Emirates, but little is known about them scientifically. One of the commonest belongs to the genus *Galeodes* and is sexually dimorphic, with the slimmer male having much longer legs than the female.

Mites and ticks are probably much better represented in the Emirates than records suggest. This is an important group, including vectors of human diseases such as Crimea-Congo haemorrhagic fever. One species occurring commonly in the Emirates



ARTHROPODS OTHER THAN INSECTS



ABOVE: *Jumping spider*  
 LEFT: Of the various species of scorpions that occur in the UAE, the small yellow *Buthacus yotvatensis nigroaculeatus* is the most poisonous.  
 BELOW: *Wolf spider*



and Dubai and on the Al Madam Plain, and are probably widespread in sandy areas elsewhere.

Non-marine crustaceans in the Emirates include a single species each of tadpole shrimp (*Triops* sp.) and clam shrimp (*Eulimnadia* sp.) (Hornby 1999; and this volume), both found in ephemeral ponds formed after winter rains, and a number of woodlice (Taita and Ferrara 1991). The latter are found in gardens, oases, gravel steppes, mountain areas and shorelines under stones where there is some moisture. Only a very few species have thus far been determined for the UAE, including *Littorophiloscia strouhali* and *Somalodillo paeinsulae*.

The centipedes of Arabia include species from the orders Geophilomorpha, Scutigermorpha and Scolopendromorpha (Lewis 1986), but only members of the last-named are known from the Emirates. The largest is *Scolopendra valida*, but smaller members of this genus also occur. They are found beneath stones or dead bark in parks and gardens as well as open country.

TOP LEFT: *Camel spider* Solifugid galeodes  
 TOP RIGHT: A centipede of the order *Scolopendromorpha*  
 LEFT: *Argiope*, the orb or signature spider, packaging its prey. The zig-zag anchoring chords (bottom right corner of photograph) may serve to draw the attention of a potential victim away from the web which captures it.  
 BELOW: *Spider* *Latrodectus* sp.

is the camel tick *Hyalomma dromedarii*, a persistent arthropod that homes in on potential hosts through ground vibrations. Ticks collected from both wild and domestic animals in the Emirates include *Rhipicephalus sanguineus* and *R. turanicus* (Cunningham and Thompson 2000). Others are occasionally found on scarab beetles, but their identity is as yet not determined. An interesting animal in this group, though rarely seen, is the giant velvet bug, *Dinotrombium* species, which appears in sandy areas after rain to feed on termites (Tigar 1996). They have been found in the desert between Abu Dhabi



## ARTHROPODS OTHER THAN INSECTS

ABOVE: *Phrynicus jakari*BELOW: *Dew-laden web of an orb-web spider*

## CLAM SHRIMPS

CLAM SHRIMPS (PHYLUM ARTHROPODA, superclass Crustacea, class Branchiopoda, superorder Conchostraca, order Spinicaudata) are a little-studied group of crustaceans found in ephemeral freshwater pools. Typically associated with hot arid conditions, they are widely distributed across the drier parts of North America, southern and eastern Europe, Arabia and the Indian subcontinent. Although known from Oman and Saudi Arabia (Thiery 1996), their discovery in 1999 in a pool on the west flank of Jebel Hafit, south of Al Ain, was a first record for the UAE (Hornby 1999).

Like other crustaceans, clam shrimps have many paired abdominal appendages and paired antennae, but they are unique in that the body is protected by a modified carapace consisting of two symmetrical dorsally-hinged valves, composed of chitin and fairly transparent, but otherwise resembling the shell of a bivalve mollusc, with concentric growth rings. The carapace is up to 1 centimetre long and is held partly open while the animals swim, working their appendages in a succession of waves to drive water through the mouthparts which filter out microscopic items of food.

Relatively short-lived, they appear after rain in pools which typically only retain water for a few weeks or, at the most, a few months. For most of the year they survive as hard-shelled cysts in dried sediments. It is believed that hatching is triggered not just by the presence of water but also by attainment of a threshold level of water pressure. The cysts hatch when there is sufficient water to enable the animals to complete their life-cycle. Growth is rapid, with the animals appearing only a week after rain has replenished the pool. The concentric rings may represent daily growth. The animals feed for a few days; then the females produce a mass of eggs which are fertilised by the males and deposited in the bottom of the pool. These may remain viable and dormant for several years. In addition to the hard-shelled cysts, clam shrimps also produce soft-shelled eggs under appropriate conditions. These hatch very quickly to produce a new generation before the pool dries up.

Since 1999, clam shrimps have also been found in other pools on Jebel Hafit, and also near Hatta, as well as in Wadi Sarfanah and Wadi al-Ramthah and on Jebel Qatar, these three locations all being in Oman. They seem to have a discontinuous distribution in

a limited area from Jebel Hafit to Hatta, along the western foothills of the Hajar Mountains.

A key part of the evolutionary strategy of clam shrimps, and other members of the Branchiopoda, including 'tadpole shrimps' and 'fairy shrimps', is that of predator avoidance. Fairly large, not secretive, and having no defence apart from their 'shells,' they would be easy prey for fish, toads, herons and water beetles. However, they are so short-lived that predators do not learn to associate the habitat with food, while they also survive in pools which are too isolated or too ephemeral to support fish, which are present in most wadis of the Hajar Mountains in the UAE and adjacent Oman (Feulner 1998a). Pools that are deep enough to hold water for most of the year usually do support fish. If, however, a pool is not connected to the main wadi flow or only

exists for a month or two each year, it may well be free of fish, which are unable to undergo any period of prolonged dormancy. In such spots, clam shrimps may be able complete their life-cycle before tadpoles and dragonfly larvae pose a threat.

Clam shrimps are temporal opportunists. When the time is right, eggs hatch, growth is rapid and genetic material is exchanged before reversion to the normal state of dormancy. Spatially, however, clam shrimps are not opportunists, unable to leave their little pool or move upstream, as fish and toads do. Wind-borne dispersal of cysts is possible, as is accidental dispersal by birds, but this is, at best, unreliable. The present distribution of clam shrimps is probably a relic of a formerly more extensive range, under more favourable climatic conditions. Perhaps they became secondarily adapted to ephemeral pools as a means of predator-avoidance, and this restricted them to a wide scatter of suitable places. This adaptation had little effect on their morphology however, as fossil clam shrimps, not too different from those of today, are known from the Devonian period, 350 million years ago.

Richard Hornby

