

# TRIBULUS

Journal of the Emirates Natural History Group

VOLUME 29 / 2012



# Significant fern, lichen and bryophyte collections from the UAE and northern Oman, including five new records for the Arabian Peninsula

by Carl J. Rothfels, Ester Gaya, Lisa Pokorny, Paul Rothfels,  
Peter Rothfels and Gary R. Feulner

## Abstract

We present a list of ferns, lichens, mosses, and liverworts collected in the eastern UAE and northern Oman in January 2009. Of the seven fern species reported, *Cosentinia vellea* is confirmed for the UAE and *Asplenium ceterach* is reported for Oman for the second time. We briefly summarise the taxonomic and nomenclatural reasons for using the names *Asplenium ceterach*, *Cheilanthes acrostica*, and *Cosentinia vellea* for our collections, rather than the frequently used *Ceterach officinarum*, *Cheilanthes pteridioides*, and *Cheilanthes vellea*, respectively. Of the 12 lichen species reported, seven represent new records for Musandam, seven for Oman, and two for the Arabian Peninsula (*Caloplaca inconnexa* and *Caloplaca pusilla*). For the mosses, we report 13 species: seven new records for Musandam, nine for Oman, and three for Arabia (*Anoetangium handelii*, *Orthotrichum* cf. *cupulatum*, and *Syntrichia sinensis*). One of the liverworts is new for Oman (*Riccia crozalsii*). We include a brief description of the cryptogam flora of the UAE and northern Oman, the degree to which it is under-explored (five new records for Arabia in the course of extremely modest and relatively casual fieldwork by non-specialists), and avenues for future work.:

Included in this article are records of the following species

## FERNS:

*Adiantum capillus-veneris* L.  
*Asplenium ceterach* L.  
*Cheilanthes acrostica* (Balbis) Tod.  
*Cosentinia vellea* (Ait.) Tod.  
*Equisetum ramosissimum* Desf.  
*Onychium divaricatum* (Poir.) Alston  
*Pteris vittata* L.

## LICHENS:

*Aspicilia contorta* (Hoffm.) Kremp.  
*Caloplaca inconnexa* (Nyl.) Zahlbr.  
*Caloplaca pusilla* (A. Massal.) Zahlbr.  
*Collema* sp.  
*Collema tenax* s.l. (Sw.) Ach.  
*Diploschistes ocellatus* (Vill.) Norman  
*Gloeoheppia turgida* (Ach.) Gyeln.  
*Lichinella nigritella* (Lettau) P.P. Moreno & Egea  
*Psora decipiens* (Hedw.) Hoffm.  
*Squamarina lentigera* (Weber) Poelt  
*Toninia sedifolia* (Scop.) Timdal  
*Verrucaria* cf. *calciseda* DC.

A January 2009 family vacation to eastern UAE and northern Oman took a serendipitous turn when we (CJR, PRs) decided to see how many fern taxa we could find. This mission was not quite as improbable as it might appear—there are several clades of ferns that are noteworthy for having successfully colonised xeric habitats, including deserts of both the Old and New Worlds, particularly those in the family Pteridaceae (Schuettpelz *et al.* 2007). One of the larger Pteridaceae clades (the one that includes *Cheilanthes* and its relatives) is the focus of research by CJR's labmates at Duke University, North Carolina, which added some impetus to our quest. And, given that we were looking for ferns, it seemed only proper to look for mosses, liverworts and lichens as well.

The UAE and northern Oman boast a documented fern flora of nine species (Miller & Cope 1996; Jongbloed 2003). Some of these are hardy colonists but nonetheless require

## MOSESSES:

*Anoetangium handelii* Schiffn.  
*Barbula indica* (Hook.) Spreng.  
*Barbula* cf. *unguiculata* Hedw.  
*Bryum* cf. *nanoapiculatum* Ochi & Kurschner  
*Didymodon acutus* (Brid.) K. Saito  
*Fissidens arnoldii* R. Ruthe  
*Gyroweisia tenuis* (Hedw.) Schimp.  
*Orthotrichum* cf. *cupulatum* Hoffm. ex Brid.  
*Splachnobryum aquaticum* Müll. Hal.  
*Syntrichia inermis* (Brid.) Bruch.  
*Syntrichia pseudodesertorum* (Froehl.) Agnew & Vondr.  
*Syntrichia sinensis* (C. Müller) Ochyra  
*Timmiella barbuloides* (Brid.) Moenk.

## LIVERWORTS:

*Exormotheca pustulosa* Mitt.  
*Plagiochasma rupestre* (Forst.) Steph.  
*Riccia crenatodentata* Volk  
*Riccia crozalsii* Levier.

moderate levels of moisture, and thus are found principally around seeps and wadi pools (e.g., *Adiantum capillus-veneris*, *Equisetum ramosissimum*). Others are true xeric habitat specialists found in cracks in sheltered rock walls or under the lips of boulders (*Cheilanthes*, *Cosentinia*, *Asplenium ceterach*, etc.). Only one — *Ophioglossum polyphyllum* — is found in open sand habitats.

In comparison, relatively little is known about the lichen flora of much of the Arabian Peninsula. Studies are fragmentary and it is difficult to extrapolate to the Peninsula as a whole. Based on our literature search, we estimate that there are 267 reported species from the Peninsula and 247 from Socotra. Most species (~100) have been recorded from Saudi Arabia (Abuzinada & Hawksworth 1975; Abuzinada *et al.* 1986; Kürschner 1984; Bokhary *et al.* 1993). Thirty-eight lichen species have been reported from Kuwait by Brown (1998) and Schultz *et al.* (2000).



Fig 1. Wadi Tiwi, a study in contrast.

Lamb (1936) and Mandeel & Aptroot (2004) recorded some species from Bahrain, and Babikir & Kürschner (1992) from Qatar. About 73 species have been reported from mainland Yemen (Acharius 1810; Müller Argau 1893; Steiner 1907; Schultz 1998; Schultz 2004; Sipman 2002) and nearly 250 from the Socotra Archipelago (Steiner 1907; Mies 1994a, b; Mies 2001; Mies *et al.* 1994; Mies *et al.* 1995; Mies & Printzen 1997; Schultz *et al.* 1999; Schultz & Mies 2003; Mies & Schultz 2004; Schultz 2002, 2003, 2005). Lichen records from adjacent areas (Iran, Syria, Lebanon, Israel, Turkey, etc.) have been given by Steiner (1916, 1921), Szatala (1940, 1957), Galun (1970), Marton & Galun (1981), Insarov & Insarov (1995), and John (1996).

Even in the context of the Peninsula, our knowledge of the lichen flora of UAE and Oman is incomplete. To date, approximately 55 species have been recorded from Oman (Mandaville 1977; Krog 1983; Cope 1988; Ghazanfar & Rappenhoner 1994; Ghazanfar & Gallagher 1998; Kürschner & Ghazanfar 1998; Brown & *al.* 2002); comparable studies in the UAE are in their infancy (Brown & Sakkir 2004; Brown 2005). These numbers certainly under-represent the lichen richness present, as demonstrated in this paper: of 12 collections, seven are new species records for Oman and two for the Arabian Peninsula. Four of the 12 species are cyanobacterial lichens, which are particularly abundant in arid climates with scarce

vegetation, on soil crust in savannas, deserts or semi-deserts, where they play important ecological roles.

Kürschner (2000) reports 224 bryophyte species (one hornwort, 50 liverworts and 173 mosses) from the Arabian Peninsula and Socotra. Of these, Oman is represented with 16 liverworts and 41 mosses, and the UAE has seven liverworts and 14 mosses. It is, thus, not surprising that a great number of the bryophyte records presented here are new records for Oman (nine new mosses and one liverwort out of 17 species collected) and even for the Arabian Peninsula (three new mosses). The bryophyte flora of the Arabian Peninsula is composed of taxa with a mix of (Sub)cosmopolitan, Northern-Temperate, Xerotherm-Pangaeian, Circum-Tethyan, and Tropical distributions, aside from a number of local endemics (Kürschner 2008).

In general, we were surprised by the ease of finding ferns, given the limited time we had available to search and our lack of familiarity with the areas we visited. Having a search image for the appropriate microhabitats (generally sheltered pockets under boulders or around rock outcrops) was very helpful, as was getting to elevation. The drier hotter areas at low elevations were largely fern-free.

In contrast, we had difficulty finding lichens (especially rock lichens) and, to a lesser extent, bryophytes. These are groups with which we are less familiar, so might have not been as effective in our

searching. Nonetheless, even in glorious rocky habitats like those of Ru'us al-Jibal, rock lichens were scarce; comparable habitats in North America would have been covered with lichens.

Our collections of both lichens and bryophytes are likely to be strongly under-representative of the diversity present. We (CJR, PRs) did not know either group well enough to identify them in the field, and were hesitant to collect multiple samples that appeared superficially similar. Subsequently, however: a) most of our collections were determined to be of different species; b) mixed in with our liverwort collections were interesting mosses that we didn't notice in the field; and c) the things that we collected without even being sure that they were lichens in fact were, and interesting ones at that! Clearly, much awaits interested students of these groups.

We learned subsequently that one of the common techniques for collecting desert lichens and bryophytes is to bring water with you in the field, spray down promising looking spots, wait a few minutes for the lichens to rehydrate and the mosses to green-up, and then make your collections. Otherwise it is easy for even experts to overlook many of these taxa.

#### FERNS:

##### *Asplenium ceterach* L. *sensu* Miller & Cope (1996; as *Ceterach officinarum*). (Aspleniaceae).

###### - Sultanate of Oman; Musandam Peninsula.

Khasab to Jebel Harim Road, second major wadi above the Sayh plain. Elevation: 1400 m. Rare in crevices in NE-facing wadi wall cliff-face, with *Onychium divaricatum*, *Cheilanthes acrostica*, blue-green thalloid liverwort, mosses, etc. January 22, 2009. C.J. Rothfels #2755, with Paul Rothfels. Specimens to DUKE. Identified by C.J. Rothfels. For Miller and Cope (1996), in Arabia, this species was unknown north of southwestern Saudi Arabia. Since then, however, it has been discovered in Musandam (Jongbloed 2003); our's may be the second record for Oman. *Ceterach*, and virtually all other asplenioid segregate genera, have been shown by molecular phylogenetic analysis to be nested well within *Asplenium* itself (Schneider *et al.* 2004; Smith *et al.* 2006).

##### *Equisetum ramosissimum* Desf. *sensu* Miller & Cope (1996). (Equisetaceae).

###### - Sultanate of Oman; Sharqiyah Region.

Wadi Tiwi, approximately 3km up. Elevation: 30 m. Two dense patches seen, in our limited explorations. On flat sections of wet sand or shallow standing water, at the edge of the wadi pool, with *Bacopa*, Cyperaceae, etc. No fertile plants seen. Many of the sporophytes were simple, and tangled. Only the larger ones had lateral branches. January 29, 2009. C.J. Rothfels #2757, with Peter Rothfels, Paul Rothfels, M. Almack. Identified by C.J. Rothfels.

Horsetails, of which *E. ramosissimum* is the only representative in Arabia, are ferns (rather than "fern



Fig. 2. A tangled patch of *Equisetum ramosissimum*, mixed with other thin-leaved wetland plants, in a depression along Wadi Tiwi, Sultanate of Oman; Sharqiyah Region. C.J. Rothfels, January 29, 2008

allies", etc.), despite their odd appearance (Pryer *et al.* 2001). Miller and Cope (1996) show two isolated records for this species in the Hajar Mountains, presumably including Wadi Tiwi, where we found it; the next nearest Arabian records are in southern Yemen, against the Red Sea (Miller & Cope 1996). This may reflect its preference for relatively damp habitats; if so, it could yet be found in the Salalah area.

##### *Adiantum capillus-veneris* L. *sensu* Miller & Cope (1996). (Pteridaceae).

###### - Sultanate of Oman; Dhahirah Region; Wilayat Mahdhah.

South of Al Madam on Highway E44. Elevation: 400 m. Two patches ~15m apart. Each ~3m long, 20cm high, and densely packed with plants (living and dead leaves). Plants were on the vertical wadi wall, slightly overhung, right at the edge of the wet sand or standing water, with *Nerium oleander*, etc.



Fig. 3. *Adiantum capillus-veneris*, showing the small average plant size, and the mix of deeply and shallowly incised leaflets. Sultanate of Oman; Dhahirah Region; Wilayat Mahdhah. C.J. Rothfels, January 19, 2009.



Fig. 4. *Adiantum capillus-veneris* growing at the water's edge, under overhanging wadi wall. Note the small average plant size, and the mix of deeply and shallowly incised leaflets. Sultanate of Oman; Dhahirah Region; Wilayat Mahdhah. C.J. Rothfels, January 19, 2009.

The wadi was narrow, with steep walls, and at least semi-permanent clear flowing water and many toads. Plants seemed dimorphic—some leaves had deeply divided finger-like pinnae, others had more circular pinnae. January 19, 2009. C.J. Rothfels #2720, with Peter Rothfels, Paul Rothfels, M. Almack. Identified by C.J. Rothfels.



Fig. 5. Robust clumps of *Adiantum capillus-veneris*, on conglomerate wadi bank. United Arab Emirates; Ra's al-Khaimah Emirate. C.J. Rothfels, January 20, 2009.



Fig. 6. Robust clumps of *Adiantum capillus-veneris*, on conglomerate wadi bank. United Arab Emirates; Ra's al-Khaimah Emirate. C.J. Rothfels, January 20, 2009.

- **United Arab Emirates; Ra's al-Khaimah Emirate.** Diftah (southeast of Masafi). Up the wadi on the east side of Highway E89. Elevation: 350 m. aLocally common on steep, undercut, seepy conglomerate wadi bank in ophiolite bedrock. January 20, 2009. C.J. Rothfels #2721, with Paul Rothfels. Identified by C.J. Rothfels.

- **Sultanate of Oman; Sharqiyah Region.** Wadi Tiwi, approximately 3km up. Elevation: 30 m. Common in seeps and damp shaded spots along wadi, with *Pteris vittata* (CJR 2756, 2760), *Splachnobryum aquaticum* (CJR 2758), etc. This collection is from a large patch in shelter of boulders, on wet sand. The species seemed to be fairly morphologically uniform at this site—the more highly divided forms (see CJR 2720) were rare or absent. January 29, 2009. C.J. Rothfels #2759, with Peter Rothfels, Paul Rothfels, M. Almack. Identified by C.J. Rothfels.

*Adiantum capillus-veneris*, as it is most often treated, is one of the most widespread fern species in the world. Not only is it one of the two most common ferns in the UAE and Oman (with *Onychium divaricatum*), but it also occurs across Europe, and through much of North and South America, Africa, and the West Indies (Paris 1993). Whether or not all these populations should be treated within a single species is not yet determined. European plants examined thus far are diploid (two sets of chromosomes) whereas some North American populations are tetraploid (four sets), which suggests that multiple distinct lineages are present within the species (Manton 1950; Wagner 1963; Paris 1993).

We anticipated that the Arabian plants would be diploid, based on their proximity to the European populations. However, spore size data suggest otherwise. Twenty spores from a single sporangium

(64 spores per sporangium) of one plant yielded an average size of 45.3  $\mu\text{m}$ , with a standard deviation of 3.34  $\mu\text{m}$ , and five spores from another population had an average size of 39.8  $\pm$  2.88  $\mu\text{m}$ . These values fit the range of 40–50 microns cited for the tetraploid North American plants (Paris 1993), and suggest that the Arabian plants may also be tetraploid, which would be the first report of non-diploid *Adiantum capillus-veneris* outside of North America. Chromosome counts are necessary to confirm this hypothesis.

***Cheilanthes acrostica* (Balbis) Tod. sensu Jermy & Paul (1993). (Pteridaceae).**

**- Sultanate of Oman; Musandam Peninsula.**

Sahasa area, along the road from Khasab to Jebel Harim, between the Sayh plain and the pass.



Fig. 7. *Cheilanthes acrostica*, growing from crack roadside limestone rock face. Sultanate of Oman; Musandam Peninsula. Sahasa area, along the road from Khasab to Jebel Harim, between the Sayh plain and the pass. C.J. Rothfels, January 22, 2009.

Elevation: 1400 m. Locally common in sheltered cracks in E-facing roadcut wall. In hard, sharp, fractured, limestone, with mosses, *Onychium*, etc. This species was uncommon to common in the vicinity of the diesel generator area, but usually as smaller plants (see CJR 2753), and usually deep in crevices in north-facing rock faces. January 22, 2009. C.J. Rothfels #2735, with Paul Rothfels. Identified by C.J. Rothfels.

**- Sultanate of Oman; Musandam Peninsula.**

Sahasa area, along the road from Khasab to Jebel Harim, around the military complex just below the pass. Elevation: 1600 m. Uncommon, widespread, as scattered small individuals, in silt-packed crevices in W-facing limestone faces, with liverworts (CJR 2750, 2751), mosses, etc. *Cosentinia vellea* was also collected at this site (CJR 2749). January 22, 2009. C.J. Rothfels #2753, with Paul Rothfels. Identified by C.J. Rothfels.

This species, which belongs to the large “hemionitid” group of cheilanthoid ferns (see Windham *et al.* 2009), is part of the *C. pteridioides* complex.

There appear to be two main players of relevance to Arabian workers: a diploid with entire false indusia, and an allotetraploid with fringed false indusia (Vida *et al.* 1971, 1983). The diploid has long been referred to as *C. maderensis* Lowe, but the lectotype of *C. pteridioides* turns out to be that taxon, and the name *C. pteridioides* has priority (Nardi & Reichstein 1985). So the diploid has to be called *C. pteridioides*, leaving that name unavailable for the taxon to which it had historically been applied: the tetraploid. The tetraploid, then, gets the name *C. acrostica* (Balbis) Tod. A proposal to simplify the matter by throwing out the name *C. pteridioides* as ambiguous and confusing (Nardi & Reichstein 1986), which would leave the unambiguous name *C. maderensis* available for the diploid, was not accepted (Pichi Sermolli 1987). The



Fig. 8. *Cosentinia vellea*, wedged deeply in sheltered crack in limestone. Sultanate of Oman; Musandam Peninsula. Sahasa area, along the road from Khasab to Jebel Harim, around the military complex. C.J. Rothfels, January 22, 2009.

specimens here have fringed false indusia, and thus are the presumed tetraploid *C. acrostica*, although Arabian floras (e.g. Miller & Cope 1996; Jongbloed 2003) still use the name *C. pteridioides*. We know of no records of true *C. pteridioides* from Arabia. Some recent European publications (e.g., Jermy & Paul 1993) continue to use *C. maderensis*, in apparent contradiction to the Code of Nomenclature, but without explanation.

***Cosentinia vellea* (Ait.) Tod. sensu Miller & Cope (1996; as *Cheilanthes vellea*). (Pteridaceae).**

**- United Arab Emirates; Ra's al-Khaimah**

**Emirate.** Diftah (southeast of Masafi). Up the wadi on the east side of Highway E89. Elevation: 400 m. Rare, local - five plants seen. On steep NW-facing jebel slope above steep-walled wadi. Plants were in pockets of silt in sheltered cracks among fractured ophiolite rocks, with scattered angiosperms, *Riccia crenatodentata* (CJR 2725) and *Timmiella barbulooides* (CJR 2727). January 20, 2009. C.J. Rothfels #2724, with Paul Rothfels. Identified by C.J. Rothfels.

**- Sultanate of Oman; Musandam Peninsula.**

Sahasa area, along the road from Khasab to Jebel Harim, around the military complex. Elevation: 1600 m. Local, in crevices in W-facing hard limestone face, with *Cheilanthes acrostica* (CJR 2753), etc. This species was locally more abundant than *C. acrostica*, although *C. acrostica* was much the more common species in the broader area. Plants were wedged deeply in crevices, and were very hard to collect. January 22, 2009. C.J. Rothfels #2749, with Paul Rothfels. Identified by C.J. Rothfels.

Contrary to its general appearance and its long history of treatment under *Cheilanthes* or *Notholaena*, this species is not closely related to *Notholaena* or any *Cheilanthes* group (Rothfels & al. 2008). Rather, it is closer to species of *Anogramma* and *Pteris* (Nakazato & Gastony 2003). Conversely, the superficially similar *Cheilanthes acrostica* is more closely related (evolutionarily) to *Adiantum* than it is to *Cosentinia*. The two *Cosentinia* collections above are from very different substrates (limestone vs. ophiolite) and elevations (1600m vs. 400m). There is only one species in the genus, however, with two subspecies (Pichi Sermolli 1985; Badré & Reichstein 1983) that differ in their ploidy levels. The nominate (tetraploid) subspecies can be distinguished from the diploid *Cosentinia vellea* Tod. subsp. *bivalens* (Reichstein) Rivas Mart. & Salvo (1984) by spore size: spores of the tetraploid range from (53-)57-66(-75)  $\mu\text{m}$ , whereas spores of the diploid are smaller: (42-)51-57(-60)  $\mu\text{m}$  (Badré & Reichstein 1983).

Our collections have spore sizes that overlap the boundary. From the UAE collection, we measured spores from four sporangia with the following average sizes and standard deviations: 52.5 $\pm$ 2.90  $\mu\text{m}$  (n=13 spores counted); 57.4 $\pm$ 1.96  $\mu\text{m}$  (n=24); 57.0 $\pm$ 2.59 $\mu\text{m}$  (n=18); 55.8 $\pm$ 2.90  $\mu\text{m}$  (n=22). Similarly, three sporangia from the Oman collection had the following spore sizes: 58.8 $\pm$ 2.26  $\mu\text{m}$  (n=8); 57.9 $\pm$ 2.01  $\mu\text{m}$  (n=14); 52.2  $\pm$ 1.95  $\mu\text{m}$  (n=6). The last sporangium has spores significantly smaller than the other two, and, interestingly, a mixture of spores from the UAE specimen (not taken from individual sporangia) had a bimodal size distribution, with some spores larger (~63  $\mu\text{m}$ ), darker, and more strongly and evenly tetragonal than the others (which were ~49  $\mu\text{m}$  in diameter, more transparent, and irregularly shaped). Perhaps those spores, and those of the third sporangium of the Oman plant, were incompletely formed, or suffered from an error at some stage of sporogenesis. Regardless of whether these smaller spores are included, however, our mean spore sizes span the boundary supposedly separating the diploid from the tetraploid taxon; chromosome counts will be necessary to conclusively determine the subspecies involved. All the sporangia we measured spores from had 32 spores per sporangium, a condition that typically indicates apomixis (asexuality), but apparently not so in *Cosentinia* (Badré & Reichstein 1983).

Miller and Cope (1996) show records of *Cosentinia* only from Oman (several from the Hajar mountains and one from the vicinity of Khasab). More recently, it has been found in the Hajar mountains and in the Musandam of the UAE (Feulner 2011).

***Onychium divaricatum* (Poir.) Alston sensu Miller & Cope (1996). (Pteridaceae).**

**- Sultanate of Oman; Musandam Peninsula.** On the road from Khasab to Jebel Harim, between Wadi Khasab and the Sayh plain. Elevation: 650 m. Fairly common, scattered individuals. In pockets of silt in crevices under boulders on north-facing limestone boulder slope, with *Morus* cf. *johannis*, *Timmiella barbulooides* (CJR 2731), *Bryum* cf. *nanoapiculatum* (CJR 2732), *Plagiochasma rupestre* (CJR 2733), etc. We saw this species frequently on the subsequent day, between 1200m and 1500m, but there it was mostly just fiddleheads (few fully expanded leaves). January 21, 2009. C.J. Rothfels #2730, with Paul Rothfels, M. Almack, Colin Rothfels. Identified by C.J. Rothfels.

*Onychium* was locally common in Musandam, in accord with the records of Miller and Cope (1996) and Jongbloed (2003), who record it as widespread in the Hajar Mountains as well. Otherwise on the Arabian Peninsula it is only found along the Red Sea in southern Yemen and western Saudi Arabia. It reappears on both sides of the peninsula, in northern Africa, and in Iran, and extends east into East Asia (Miller & Cope 1996).

***Pteris vittata* L. sensu Miller & Cope (1996). (Pteridaceae).**

**- Sultanate of Oman; Sharqiyah Region.** Wadi Tiwi, approximately 3km up. Elevation: 30 m. Common in seeps and sheltered spots (under rocks, etc.) along wadi, with *Adiantum capillus-veneris* (CJR 2759), *Splachnobryum*, etc. Most plants were largish, although a dwarf form occurred in exposed rock crevices. January 29, 2009. C.J. Rothfels #2756, #2760, with Peter Rothfels, Paul Rothfels, M. Almack. Identified by C.J. Rothfels.



Fig.9. *Pteris vittata* perched over the clear pools of Wadi Tiwi. Sultanate of Oman; Sharqiyah. Region C.J. Rothfels, January 22, 2009.

Our collection is in accord with Miller and Cope (1996), who show a smattering of records in northern Oman, a few from the Salalah area, and then a dense series of collections from southern Yemen and extreme southwestern Saudi Arabia. A single site is known from Musandam, at 'Ayn as-Sih, a large seep that is the only Musandam site for several other hygrophilous plant species as well (Feulner 2011). Originally African, this species is generally weedy, and is found far from its native range (e.g., Mickel & Smith 2004). It has attracted considerable attention as a hyperaccumulator of heavy metals, with potential applications for phytoremediation of contaminated sites (Chen *et al.* 2002).

## LICHENS:

### *Toninia sedifolia* (Scop.) Timdal (Catillariaceae).

#### - Sultanate of Oman; Musandam Peninsula.

Sahasa area, along the road from Khasab to Jebel Harim. Elevation: 1550 m. In sheltered cracks between limestone boulders and rocks on gentle NE-facing slope. With *Collema tenax* s.l. (CJR 2736), *Squamarina lentigera* (CJR 2737, 2738), *Collema* sp. (CJR 2742), *Didymodon acutus* (CJR 2741), scattered *Cheilanthes acrostica* (see CJR 2735), *Ephedra pachyclada*, grasses, misc. spiny angiosperms, etc. Could also be *T.opuntioides* (thin layer chromatography would be needed for confirmation). January 22, 2009. C.J. Rothfels #2739, with Paul Rothfels. Identified by E. Gaya.

First record for Oman. Otherwise, it is recorded from Yemen (Müller 1893, as *Thalloidima caeruleo-nigricans*; Sipman 2002), Kuwait (Brown 1998), and Jordan (El-Oqlah & Lahham 1985, as *Toninia coeruleonigricans*; El-Oqlah 1992). This is a widespread holarctic lichen, with a broad altitudinal and latitudinal range, found on soil and weathered typically calcareous rocks; it prefers well-lit horizontal surfaces in arid regions. *Toninia sedifolia* can be identified by the presence of whitish to bluish-grey (green-olive when hydrated) convex to swollen squamules, by the blackish apothecia without pruina (although sometimes with dense bluish-grey pruina), and by the flat to slightly convex disks. The spores are bicellular and fusiform. No diagnostic chemical reactions are known.

### *Collema* sp. (Collemataceae).

- Sultanate of Oman; Musandam Peninsula. Sahasa area, along the road from Khasab to Jebel Harim. Elevation: 1550 m. In sheltered cracks between limestone boulders and rocks on gentle NE-facing slope. With *Collema tenax* s.l. (CJR 2736), *Squamarina lentigera* (CJR 2737, 2738), *Toninia sedifolia* (CJR 2739), *Didymodon acutus* (CJR 2741), scattered *Cheilanthes acrostica* (see CJR 2735), *Ephedra pachyclada*, grasses, misc. spiny angiosperms, etc. Globose isidia, apothecia sunken in lobes. January 22, 2009. C.J. Rothfels #2742, with Paul Rothfels. Identified by E. Gaya.

No *Collema* species have been reported from Oman so far, and only one (*Collema coccophorum*) from the UAE (Brown & Sakkir 2004). Several species have been recorded for mainland Yemen and Socotra (Schultz 1998; Schultz & Mies 2003) as well as Saudi Arabia and Kuwait (Abuzinada *et al.* 1986; Kürschner 1984; Abokhatwa 1989; Frey 1989; Bokhary *et al.* 1993; Schultz *et al.* 2000). Unfortunately, this specimen, with globose isidia and apothecia sunken in lobes, is too small to identify to the species level.

### *Collema tenax* s.lat. (Sw.) Ach. (Collemataceae).

#### - Sultanate of Oman; Musandam Peninsula.

Sahasa area, along the road from Khasab to Jebel Harim. Elevation: 1555 m. In sheltered cracks between limestone boulders and rocks on gentle NE-facing slope. With *Squamarina lentigera* (CJR 2737, 2738), *Toninia sedifolia* (CJR 2739) *Collema* sp. (CJR 2742), *Didymodon acutus* (CJR 2741), scattered *Cheilanthes acrostica* (see CJR 2735), *Ephedra pachyclada*, grasses, misc. spiny angiosperms, etc. January 22, 2009. C.J. Rothfels #2736, with Paul Rothfels. Identified by E. Gaya.

First record for Oman. Reported from Yemen, Socotra (Schultz & Mies 2003), growing in a soil crust over calcareous rock, Jordan (El-Oqlah *et al.* 1986) as var. *ceranoides* (Borr.) Degel, and Saudi Arabia (Abuzinada *et al.* 1986; Bokhary *et al.* 1993). This cyanobacterial lichen is mainly terricolous, with a thick thallus and submural spores.

### *Gloeoheppia turgida* (Ach.) Gyeln. (Gloeoheppiaceae).

#### - United Arab Emirates; Ra's al-Khaimah

Emirate. Diftah (southeast of Masafi). Up the wadi on the east side of Highway E89. Elevation: 400 m. Uncommon, local? On steep NW-facing jebel slope above steep-walled wadi. In sheltered pockets of silt among fractured ophiolite rocks. Also collected here were *Riccia crenatodentata* (CJR 2725) and *Timmiella barbulooides* (CJR 2727). January 20, 2009. C.J. Rothfels #2728, with Paul Rothfels. Identified by E. Gaya.

This is a common species with a widespread occurrence throughout Arabia. It has been reported from mainland Oman by Brown *et al.* (2002), from Masirah island by Ghazanfar & Rappenhöner (1994) and Ghazanfar & Gallagher (1998), and from the UAE by Brown and Sakkir (2004) and Brown (2005). *Gloeoheppia turgida* grows mainly on calcareous soil and rock, also in shaded, sand-filled clefts between limestone boulders from coastal to mountainous regions in the Mediterranean, Macaronesian and Saharo-Arabian regions. Another *Gloeoheppia* species known from Oman is *Gloeoheppia erosa* (J. Steiner) Marton, recorded by Brown *et al.* (2002), and from the UAE by Brown and Sakkir (2004). *Gloeoheppia turgida* is one of the few species able to withstand the harsh, dry climate of the coastal plains of southern Yemen.



This is another cyanobacterial lichen, widespread and conspicuous, which can form large populations. Characteristic features of *G. turgida* are the inflated squamules with rounded margins and the smooth surface. The species is rather variable in habit. The squamules can be convex, concave or convoluted, erect and elongated or flat and  $\pm$  distinctly peltate, brown, olivaceous or blackish, matt, glossy or often covered by a bluish white pruina; the apothecia remain completely immersed or are secondarily raised above the thallus surface and then surrounded by a thalline margin. Old thalli can be pruinose and develop minute cracks, often with dark-brown or blackish,  $\pm$  urceolate apothecia.

***Lichinella nigrifella* (Lettau) P.P. Moreno & Egea (Lichinaceae).**

**- Sultanate of Oman; Musandam Peninsula.**

Sahasa area, along the road from Khasab to Jebel Harim, between Wadi Khasab and the Sayh plain. Elevation: 650 m. Locally common on vertical limestone face, by N-facing limestone boulder slope. *Onychium* (CJR 2730), *Morus* cf. *johannis*, liverwort (CJR 2733), *Timmiella barbulooides* (CJR 2731), *Bryum* cf. *nanoapiculatum* (CJR 2732), etc., in vicinity. January 21, 2009. C.J. Rothfels #2734, with Paul Rothfels, M. Almack, Colin Rothfels. Identified by E. Gaya.

Recorded from Oman by Brown *et al.* (2002), it is elsewhere known from Europe and North America. In the Arabian Peninsula, apart from Oman, it has been reported from Socotra by Schultz & Mies (2003), and Saudi Arabia by Abuzinada *et al.* (1986, as *Thyrea nigrifella*) and Bokhary *et al.* (1993, as *Thyrea nigrifella*). Other *Lichinella* species recorded from Oman are *L. cribellifera* (Nyl.) P. Moreno & Egea, *L. iodopulchra* (Crozals) P. Moreno & Egea, *L. sinaica* (Galun & Marton) P. Moreno & Egea, and *L. stipatula* Nyl. (Brown *et al.* 2002). *Lichinella nigrifella* is a cyanobacterial lichen characterised by a foliose-fruticose thallus with deeply branched, erect,  $\pm$  strap-like lobes usually densely covered by globose isidia; fruiting bodies are rarely formed. It has been reported growing on both calcareous and silicate rocks.

***Aspicilia contorta* (Hoffm.) Kremp. (Megasporaceae).**

**- Sultanate of Oman; Musandam Peninsula.**

West of the Sahasa area, off the road from Khasab to Jebel Harim. Elevation: 1700 m. On rock, in moist, shallow, north-facing "cave" in hard sharp limestone, on moderate rocky slope. With *Caloplaca pusilla*, *Caloplaca inconnexa*, *Aspicilia contorta* (CJR 2743, 2744, 2770), *Psora decipiens* (CJR 2748), *Syntrichia inermis* (CJR 2745,2747), and *Syntrichia sinensis* (CJR 2746). The site is apparently very close to the international border, and it may be that this record should equally be credited to the UAE (Ra's al-Khaimah emirate). January 22, 2009. C.J. Rothfels

#2770, with Paul Rothfels. Identified by E. Gaya.

This is a first record for Oman. *Aspicilia contorta* has also been found in Iran (Szatala 1957, as *A. viridescens*), Saudi Arabia (Abuzinada & Hawksworth 1974, as *Lecanora contorta*), Abuzinada *et al.* (1986), and in Kuwait (Brown 1998, as *Aspicilia contorta* (Hoffm.) Kremp. subsp. *hoffmanniana* S. Ekman & Fröberg). Another *Aspicilia* species that seems to be common in the Arabian Peninsula is *A. circummunita*. *Aspicilia contorta* is easily recognised by the scattered areoles, convex, grey and more or less pruinose, and by the sunken apothecia. It is typically found on limestone.

***Psora decipiens* (Hedw.) Hoffm. (Psoraceae).**

**- Sultanate of Oman; Musandam Peninsula.**

West of the Sahasa area, off the road from Khasab to Jebel Harim. Elevation: 1700 m. On pocket of soil, in moist, shallow, north-facing "cave" in hard sharp limestone, on moderate rocky slope. With *Caloplaca pusilla*, *Caloplaca inconnexa*, *Aspicilia contorta* (CJR 2743, 2744, 2770), *Syntrichia inermis* (CJR 2745,2747), and *Syntrichia sinensis* (CJR 2746). The site is apparently very close to the international border, and it may be that this record should equally be credited to the UAE (Ra's al-Khaimah emirate). January 22, 2009. C.J. Rothfels #2748, with Paul Rothfels. Identified by E. Gaya.

Recorded from Oman by Brown *et al.* (2002), Ghazanfar & Gallagher (1998) and Mandaville (1977), and from the UAE by Brown and Sakkir (2004), where it can be common (Brown 2005). Ghazanfar & Gallagher (1998) state that the species is common throughout the northern and southern mountains of Oman above 1500 m. According to Brown *et al.* (2002), this species is probably widespread in suitable high elevation locations throughout the Arabian Peninsula, as implied by the records from various countries. It has been recorded also from Jordan (El-Oqlah & Lahham 1985; El-Oqlah 1992), Kuwait (Brown 1998), Saudi Arabia (Abuzinada & Hawksworth 1974, as *Lecidea decipiens*; Abuzinada *et al.* 1986; Bokhary *et al.* 1993), and Yemen (Schultz 1998; Sipman 2002). This lichen can be easily spotted by the pinkish or reddish rounded squamules (specially conspicuous when wet), in general with white margins, with rounded divisions or crenulate, concave, flat to irregular, with a whitish lower surface, and black apothecia. It is typically found on thin soils in carbonate areas, often with *Fulgensia fulgens* and *Toninia sedifolia*.

***Squamarina lentigera* (Weber) Poelt (Stereocaulaceae).**

**- Sultanate of Oman; Musandam Peninsula.**

W of the Sahasa area, off the road from Khasab to Jebel Harim. Elevation: 1550 m. In sheltered cracks between limestone boulders and rocks on gentle NE-facing slope. With *Collema tenax* s.l. (CJR 2736), *Toninia sedifolia* (CJR 2739), *Collema* sp. (CJR 2742), *Didymodon acutus* (CJR 2741), scattered *Cheilanthes*



Fig.10. Two large individuals of *Squamarina lentigera*, surrounded by a mixed community of *Collema* (the black lichen), and mosses. Sultanate of Oman; Musandam Peninsula. Sahasa area, along the road from Khasab to Jebel Harim, between Sayh plain and pass. C.J. Rothfels, January 22, 2009.

*acrostica* (see CJR 2735), *Ephedra pachyclada*, grasses, misc. spiny angiosperms, etc. January 22, 2009. C.J. Rothfels #2737, 2738, with Paul Rothfels. Identified by E. Gaya.

Recorded from Oman, in the Musandam mountains, by Ghazanfar & Gallagher (1998). Also known from Kuwait (Brown 1998). This is a squamulose, soil-growing lichen, forming whitish rosettes, with pruinose lobules lifted at the margins, and light brown discoid apothecia. On limestone and chalky soils, sunny, with superficial crust. Common in areas of scarce rain in the Mediterranean region, occasionally on sandy or hard soils. Part of the terricolous communities of bright colours. Often found with *S. cartilaginea*, *Psora decipiens*, *Toninia sedifolia*, *Fulgensia* spp., and *Catapyrenium* spp.

***Caloplaca inconnexa* (Nyl.) Zahlbr. (Teloschistaceae).**

**- Sultanate of Oman; Musandam Peninsula.**

W of the Sahasa area, off the road from Khasab to Jebel Harim, on the Khasab side of the pass. Elevation: 1700 m. On rock, in moist, shallow, north-facing "cave" in hard sharp limestone, on moderate rocky slope. With *Caloplaca pusilla*, *Caloplaca inconnexa*, *Aspicilia contorta* (CJR 2743, 2744, 2770), *Psora decipiens* (CJR 2748), *Syntrichia inermis* (CJR 2745,2747), and *Syntrichia sinensis* (CJR 2746). The *Caloplaca inconnexa* is growing on the *Aspicilia*. The

site is apparently very close to the international border, and it may be that this record should equally be credited to the UAE (Ra's al-Khaimah emirate). January 22, 2009. C.J. Rothfels #2743, 2744 with Paul Rothfels. Identified by E. Gaya.

First record for Oman, and probably for the Arabian Peninsula. It was found growing on *Aspicilia*. *Caloplaca inconnexa* may be more common in the area than records indicate, due to mis-identification as *C. holocarpa* (Hoffm.) Wade, a species reported from all over the Peninsula, but with a complex taxonomy that has been recently clarified by Arup (2009).

***Caloplaca pusilla* (A. Massal.) Zahlbr. (Teloschistaceae).**

**- Sultanate of Oman; Musandam Peninsula.**

W of the Sahasa area, off the road from Khasab to Jebel Harim. Elevation: 1700 m. On rock, in moist, shallow, north-facing "cave" in hard sharp limestone, on moderate rocky slope. With *Caloplaca pusilla*, *Caloplaca inconnexa*, *Aspicilia contorta* (CJR 2743, 2744, 2770), *Psora decipiens* (CJR 2748), *Syntrichia inermis* (CJR 2745,2747), and *Syntrichia sinensis* (CJR 2746). The site is apparently very close to the international border, and it may be that this record should equally be credited to the UAE (Ra's al-Khaimah emirate). January 22, 2009. C.J. Rothfels #2743, 2744 with Paul Rothfels. Identified by E. Gaya.

This is a first record for Oman and the Arabian Peninsula. *Caloplaca pusilla* is a widely distributed species, probably cosmopolitan, known mainly from Europe, North Africa and North America. Coniophilous and ornithocoprophilous, this is a typical taxon from eutrophic microenvironments. Found at varying altitude and exposure, *C. pusilla* is a very common species and one of the most easily identifiable taxa of the *C. saxicola* group (Gaya 2009). With (relatively) large thalli, this species has a characteristic ochraceous-yellow (the form observed here) to salmon pigmentation, reacting K+ purple. Almost always pruinose, it can be whitish in the central part of the rosettes and suffer necrosis. Apothecia are dark, orange to red, and the spores are wide ellipsoid. *Caloplaca pusilla* is a taxon that has been, and still is, frequently confused with typical *C. saxicola*. There are records of the latter species from Jordan (El-Oqlah & Lahham 1985; El-Oqlah 1992).

***Diploschistes ocellatus* (Vill.) Norman (Thelotremataceae).**

- **Sultanate of Oman; Musandam Peninsula.** Sahasa area, on the road from Khasab to Jebel Harim, around the military complex. Elevation: 1600 m. Rare in silt-packed crevices in west-facing limestone faces, with *Cheilanthes acrostica* (CJR 2753), a big thalloid liverwort (CJR 2750), mosses, etc. January 22, 2009. C.J. Rothfels #2752, with Paul Rothfels. Identified by E. Gaya.

Recorded from Oman by Mandaville (1977) and Ghazanfar & Gallagher (1998), and from UAE by Brown (2005). Known also from Kuwait (Brown 1998), Saudi Arabia (Abuzinada *et al.* 1986; Bokhary *et al.* 1993), and Yemen (Schultz 1998; Sipman 2002), this species has a thick white thallus, which can cover large areas (extending 10-20 cm or more), and convex areoles, with big apothecia slightly sunken in the thallus. In the Mediterranean region it prefers sunny carbonate rocks and soil. It often occurs with *Toninia tumidula*.

***Verrucaria cf. calciseda* DC. (Verrucariaceae).**

- **Sultanate of Oman; Musandam Peninsula.** Along the road from Khasab to Jebel Harim, around the military complex. Elevation: 1600 m. Rare on west-facing limestone face. *Cheilanthes acrostica* (CJR 2753), mosses, *Cosentinia vellea* (CJR 2749), liverworts (CJR 2750, 2751), etc., were all in the vicinity. January 22, 2009. C.J. Rothfels #2754, with Paul Rothfels. Identified by E. Gaya.

This is the first record of *Verrucaria* for Oman. *Verrucaria calciseda* has been reported from mainland Yemen (Schultz 2004). This is an endolithic lichen that leaves only a white stain on the rock, with dot-like perithecia, eating away depressions in limestone substrate, giving the rock a pitted appearance. The specimen was found on exposed limestone rock. It is too small to confirm a species-level identification.

**MOSSES:**

***Bryum cf. nanoapiculatum* Ochi & Kurschner (Bryaceae).**

- **Sultanate of Oman; Musandam Peninsula.** Along the road from Khasab to Jebel Harim, between Wadi Khasab and the Sayh plain. Elevation: 650 m. In pockets of silt in crevices under boulders on north-facing limestone boulder slope, with *Onychium* (CJR 2730), *cf. Morus johannis*, liverwort (CJR 2733), *Timmiella barbulooides* (CJR 2731), etc. January 21, 2009. C.J. Rothfels #2732, with Paul Rothfels, M. Almack, Colin Rothfels. Identified by John Spence.

First record for Oman. *Bryum nanoapiculatum* was first described by Ochi and Kürschner (1998) from Yemen. It is, to date, known only from the Arabian Peninsula and, according to Kürschner (2008), belongs in a complex of more than 50 "desert bryophytes" restricted to the arid regions of SW Asia that have a "circum-Tethyan and xerotherm-Pangaeian" origin.

***Fissidens arnoldii* R.Ruthe sensu Heyn & Herrnstadt 2004. (Fissidentaceae).**

- **Sultanate of Oman; Musandam Peninsula.** Road from Khasab to Jebel Harim, around the military complex. Elevation: 1600 m. In silt-packed crevices in west-facing limestone faces, with *Cheilanthes acrostica* (CJR 2753), *Plagiochasma rupestre* (CJR 2750), *Anoetangium handelii* (CJR 2768), etc. This specimen was originally collected for the liverwort; P. Majestyk recognised and extracted the moss. C.J. Rothfels #2751, with Paul Rothfels. Identified by R. Pursell.

First record for the Musandam Peninsula, although not unexpected. "This species is found in Europe and various areas of the Middle East (see Heyn & Herrnstadt 2004). *Fissidens arnoldii* is often confused with the North American *F. obtusifolius* Wilson" (R. Pursell, *pers. comm.* 2009). In the Arabian Peninsula, this species is known from Kuwait, Saudi Arabia, Yemen and Oman (El-Oqlah 1988, Frey & Kürschner 1988, Kürschner 2000, Ros *et al.* 2001).

***Anoetangium handelii* Schiffn. (Pottiaceae).**

- **Sultanate of Oman; Musandam Peninsula.** Road from Khasab to Jebel Harim, around the military complex. Elevation: 1600 m. In silt-packed crevices in west-facing limestone faces, with *Cheilanthes acrostica* (CJR 2753), *Plagiochasma rupestre* (CJR 2750), *Fissidens arnoldii* (CJR 2751) etc. This specimen was originally collected for the liverwort; P. Majestyk recognised and extracted the moss, etc. January 22, 2009. C.J. Rothfels #2768, with Paul Rothfels. Identified by R. Zander.

First record for Oman and the Arabian Peninsula. This rare species is previously known from Turkish Kurdistan, where it was first described (Schiffner 1913), Israel and Palestine (Heyn & Herrnstadt 2004),

the Crimean Peninsula (Hill *et al.* 2006), Spain (Casas *et al.* 1976), and Colorado, USA (Zander & Weber 2005).

***Barbula cf. unguiculata* Hedw. (Pottiaceae).**

- **Sultanate of Oman; Sharqiyah Region.** Small wadi between Fins and Ash Shab. Elevation: 20 m. Hardpacked sand at base of steep dry wadi walls. This specimen was mixed in with *Exormotheca pustulosa* (CJR 2764); P. Majestyk recognised and extracted the moss. January 29, 2009. C.J. Rothfels #2765. Identified by R. Zander.

First record for Oman. *Barbula unguiculata* is a sub-cosmopolitan species (Smith 2004) known from N Africa, i.e. the Nile Delta (El-Saadawi *et al.* 1986), and SW Asia, i.e., Turkey (Heyn & Herrnstadt 2004).

***Barbula indica* (Hook.) Spreng. (Pottiaceae).**

- **Sultanate of Oman; Sharqiyah Region.** Wadi Tiwi, approximately 3km up. Elevation: 30 m. Sheltered hard-packed north-facing earthen bank, by wadi pool. *Orthotrichum cf. cupulatum*, *Gyroweisia tenuis*, and *Barbula indica* co-occur at this site (CJR 2761-2763). January 29, 2009. C.J. Rothfels #2763, with Peter Rothfels, Paul Rothfels, M. Almack. Identified by R. Zander.

First record for Oman. Broadly distributed across new and old world tropics (Kürschner 2008). Previously recorded in Saudi Arabia, Yemen and Socotra (Kürschner 2000).

***Didymodon acutus* (Brid.) K. Saito (Pottiaceae).**

- **Sultanate of Oman; Musandam Peninsula.**

W of Sahaha area, off the road from Khasab to Jebel Harim. Elevation: 1550 m. In sheltered cracks between limestone boulders and rocks on gentle NE-facing slope. With *Collema tenax* s.l. (CJR 2736), *Squamarina lentigera* (CJR 2737, 2738), *Toninia sedifolia* (CJR 2739) *Collema* sp. (CJR 2742), scattered *Cheilanthes acrostica* (see CJR 2735), *Ephedra pachyclada*, grasses, misc. spiny angiosperms, etc. January 22, 2009. C.J. Rothfels #2741, with Paul Rothfels. Identified by R. Zander (under the synonym *Didymodon rigidulus* var. *gracilis* (Hook. & Grev.) Zander).

First record for Oman. *Didymodon acutus* is a xerophyte previously known from the Fartak Mountains in Yemen (Kürschner 2008).

***Gyroweisia tenuis* (Hedw.) Schimp. (Pottiaceae).**

- **Sultanate of Oman; Sharqiyah Region.** Wadi Tiwi, approximately 3km up. Elevation: 30 m. Sheltered hard-packed N-facing earthen bank, by wadi pool. *Orthotrichum cf. cupulatum*, *Gyroweisia tenuis*, and *Barbula indica* co-occur at this site (CJR 2761-2763). January 29, 2009. C.J. Rothfels #2762, with Peter Rothfels, Paul Rothfels, M. Almack. Identified by R. Zander.

First record for Oman. This is a temperate species found in Europe north to Scandinavia, Turkey, Syria, Iran, China, Tunisia, and N America (Smith 2004). In the Arabian Peninsula, it is known from Saudi Arabia (Frey & Kürschner 1988).

***Orthotrichum cf. cupulatum* Hoffm. ex Brid. (Pottiaceae).**

- **Sultanate of Oman; Sharqiyah Region.** Wadi Tiwi, approximately 3km up. Elevation: 30 m. Sheltered hard-packed N-facing earthen bank, by wadi pool. *Orthotrichum cf. cupulatum*, *Gyroweisia tenuis*, and *Barbula indica* co-occur at this site (CJR 2761-2763). January 29, 2009. C.J. Rothfels #2761, with Peter Rothfels, Paul Rothfels, M. Almack. Identified by R. Zander.

First record for Oman and the Arabian Peninsula. This taxon is a Eurosiberian Temperate moss known from Europe, Macaronesia, N Africa, W and N Asia, N America, Australia, and New Zealand, as well as SW Asia (Iraq, Syria, and Turkey; Smith 2004). Most probably this is *O. cupulatum* var. *bistratosum*.

***Syntrichia sinensis* (C. Müller) Ochyra (Pottiaceae).**

- **Sultanate of Oman; Musandam Peninsula.**

West of the Sahasa area, off the road from Khasab to Jebel Harim, on the Khasab side of the pass. Elevation: 1700 m. On pocket of soil, in moist, shallow, north-facing "cave" in hard sharp limestone, on moderate rocky slope. With *Caloplaca pusilla*, *Caloplaca inconnexa*, *Aspicilia contorta* (CJR 2743, 2744, 2770), *Psora decipiens* (CJR 2748), and *Syntrichia inermis* (CJR 2745, 2747). The site is apparently very close to the international border, and it may be that this record should equally be credited to the UAE (Ra's al-Khaimah emirate). C.J. Rothfels #2746, with Paul Rothfels. Identified by R. Zander (as *Syntrichia alpina* (B.S.G.) Jur., an invalid name).

First record for Oman and the Arabian Peninsula. This taxon, placed in *Syntrichia* by Ochyra (1992), is rare in Europe and more common in Asia.

***Syntrichia pseudodesertorum* (Froehl.) Agnew & Vondr. (Pottiaceae).**

- **Sultanate of Oman; Musandam Peninsula.**

W of the Sahasa area, off the road from Khasab to Jebel Harim. Elevation: 1550 m. In sheltered cracks between limestone boulders and rocks on gentle NE-facing slope. With *Collema tenax* s.l. (CJR 2736), *Squamarina lentigera* (CJR 2737, 2738), *Toninia sedifolia* (CJR 2739), *Collema* sp. (CJR 2742), *Didymodon acutus* (CJR 2741), scattered *Cheilanthes acrostica* (see CJR 2735), *Ephedra pachyclada*, grasses, misc. spiny angiosperms, etc. January 22, 2009. C.J. Rothfels #2740, with Paul Rothfels. Identified by R. Zander.

First record for Oman. There is nomenclatural confusion around the name "*Syntrichia pseudodesertorum*." Some treat it as a synonym of *Syntrichia caninervis* Mitten var. *pseudodesertorum* (Vondr.) M.T. Gallego (Gallego *et al.* 2002), while to others it is a synonym of *S. pseudohandelii* (Fröhlich) Agnew & Vondracek (Zander 1993). In SW Asia, the former species is known from Iran, Afghanistan and Turkey; the latter from Iraq. They all belong to the larger *Syntrichia caninervis* complex. *Syntrichia caninervis*, *sensu stricto*, is recorded from northern Saudi Arabia, but not from Oman.

***Timmiella barbuloides* (Brid.) Moenk. (Pottiaceae).**

- **United Arab Emirates; Ra's al-Khaimah Emirate.** Diftah (southeast of Masafi). Up the wadi on the east side of Highway E89. Elevation: 400 m. Uncommon, local? On steep NW-facing jebel slope above steep-walled wadi. In sheltered pockets of silt among fractured ophiolite rocks. Also collected here were *Riccia crenatodentata* (CJR 2726) and *Gloeoheppia turgida* (CJR 2728). January 20, 2009. C.J. Rothfels #2727, with Paul Rothfels. Identified by R. Zander.

- **Sultanate of Oman; Musandam Peninsula.** Along the road from Khasab to Jebel Harim, between Wadi Khasab and the Sayh plain. Elevation: 650 m. Uncommon? In pockets of silt in crevices under boulders on north-facing limestone boulder slope, with *Onychium* (CJR 2730), cf *Morus johannis*, *Plagiochasma rupestre* (CJR 2733), *Bryum* cf. *nanoapiculatum* (CJR 2732), etc. January 21, 2009. C.J. Rothfels #2731, with Paul Rothfels, M. Almack, Colin Rothfels. Identified by R. Zander.

Frey & Kürschner (1988) and Kürschner (2000) report this species both from the UAE and Oman, including records from Musandam.

***Syntrichia inermis* (Brid.) Bruch. (Pottiaceae).**

- **Sultanate of Oman; Musandam Peninsula.**

W of the Sahasa area, off the road from Khasab to Jebel Harim. Elevation: 1700 m. In pocket of soil, in moist, shallow, N-facing "cave" in hard sharp limestone, on moderate rocky slope. With *Caloplaca pusilla*, *Caloplaca inconnexa*, *Aspicilia contorta* (CJR 2743, 2744, 2770), *Psora decipiens* (CJR 2748), and *Syntrichia sinensis* (CJR 2746). The site is apparently very close to the international border, and it may be that this record should equally be credited to the UAE (Ra's al-Khaimah emirate). January 22, 2009. C.J. Rothfels #2745, 2747, with Paul Rothfels. Identified by R. Zander (as *Tortula inermis* (Brid.) Mont.).

First record for the Musandam Peninsula. This species is known from Saudi Arabia, Iraq, Kazakhstan, and Egypt, and may also occur in southwestern USA. It has previously been found in Oman (Frey & Kürschner 1988).

***Splachnobryum aquaticum* Müll. Hal. (Splachnobryaceae).**

- **Sultanate of Oman; Sharqiyah Region.** Wadi Tiwi, approximately 3km up. Elevation: 30 m. Formed dense pillows on south-facing rocks around a small trickle leading down to the wadi pool. Close to the water's edge, with *Pteris vittata*, *Adiantum capillus-veneris*, and a squishy white deposit. Carbonate bedrock. Mosses were common, but local, at this general location. January 29, 2009. C.J. Rothfels #2758, with Peter Rothfels, Paul Rothfels, M. Almack. Identified by P. Majestyk.

In Kürschner (2000) this species is given as *Splachnobryum procerrium*, but *S. aquaticum* is the currently accepted name. It is previously known from both the UAE and Oman. It is also known from Somalia and South Asia (Arts 2001).



Fig.11. Pillows of *Splachnobryum aquaticum* hanging off the rock walls around the Wadi Tiwi channel, with lots of carbonate mineral crusts. Sultanate of Oman; Sharqiyah Region. C.J. Rothfels, January 29, 2009.



Fig.12. Close-up of *Splachnobryum aquaticum* at Wadi Tiwi. Sultanate of Oman; Sharqiyah Region. C.J. Rothfels, January 29, 2009.

## LIVERWORTS:

### *Plagiochasma rupestre* (Forst.) Steph. (Aytoniaceae).

- **Sultanate of Oman; Musandam Peninsula.** On the road from Khasab to Jebel Harim, between Wadi Khasab and the Sayh plain. Elevation: 650 m. Uncommon? In pockets of silt in crevices under boulders on north-facing limestone boulder slope, with *Onychium* (CJR 2730), cf. *Morus johannis*, *Timmiella barbulooides* (CJR 2731), *Bryum* cf. *nanoapiculatum* (CJR 2732), etc. January 21, 2009. C.J. Rothfels #2733, with Paul Rothfels, M. Almack, Colin Rothfels. Identified by D. Long.

- **Sultanate of Oman; Musandam Peninsula.** Road from Khasab to Jebel Harim, around the military complex. Elevation: 1600 m. Common in silt-packed crevices in W-facing limestone faces, with *Cheilanthes acrostica* (CJR 2753), mosses, etc. January 22, 2009. C.J. Rothfels #2750, with Paul Rothfels. Identified by D. Long.

According to Kürschner (2008) this taxon is a typical example of the Xerotherm-Pangaeian element commonly found in the Arabian peninsula. It has been recorded in Socotra (Kürschner 2003), Saudi Arabia, Yemen and Oman (Kürschner 2000). Previous records from Oman include the Musandam peninsula.

### *Exormotheca pustulosa* Mitt. (Exormothecaceae).

- **Sultanate of Oman; Sharqiyah Region.** Small wadi between Fins and Ash Shab. Elevation: 20 m. Hardpacked sand at base of steep dry wadi walls. January 29, 2009. C.J. Rothfels #2764. Identified by D. Long.

This is another Xerotherm-Pangaeian element common in the Arabian Peninsula (Kürschner 2008). It is known from Socotra (Kürschner 2003), Saudi Arabia, Yemen, UAE, and Oman (Kürschner 2000). In Oman it was previously known from the Batinah region and from Musandam but not from Sharqiyah.

### *Riccia crenatodentata* Volk (Ricciaceae).

- **United Arab Emirates; Ra's al-Khaimah Emirate.** Diftah (southeast of Masafi). Up the wadi on the east side of Highway E89. Elevation: 400 m. Rare, local? On steep NW-facing jebel slope above steep-walled wadi. In sheltered pockets of silt among fractured ophiolite rocks. Also collected here was *Timmiella barbulooides* (CJR 2727), and *Gloeoheppia turgida* (CJR 2728). January 20, 2009. C.J. Rothfels #2725, with Paul Rothfels. Identified by D. Long.

Endemic to SW Asia (Kürschner 2008). In the Arabian peninsula, it is known from Saudi Arabia, Oman and UAE (Kürschner 2000). Previous records of this taxon in the UAE are from south of the Musandam peninsula, in the area between Diftah and Musandam (Kürschner & Böer 1999).

### *Riccia crozalsii* Levier (Ricciaceae).

- **Sultanate of Oman; Sharqiyah Region.** Small wadi between Fins and Ash Shab. Elevation: 20 m. Hardpacked sand at base of steep dry wadi walls. See CJR 2766 — *Exormotheca pustulosa*. January 29, 2009. C.J. Rothfels #2766. Identified by D. Long.

First record for Oman. Within the Arabian Peninsula, this taxon of circum-Mediterranean origin has only been recorded in Yemen (Al-Gifri & Kürschner 1996).



Fig.13. Paul Rothfels enjoying some much deserved rest in the company of *Pteris vittata*, *Adiantum capillus-veneris* and *Splachnobryum aquaticum*, at Wadi Tiwi. Sultanate of Oman; Dhahirah Region; Wilayat Mahdhah.



Fig.14. Returning from some *Adiantum* hunting, Sultanate of Oman; Dhahirah Region; Wilayat Mahdhah.



Fig.15. Wadi with standing water (and *Adiantum* along its edges), Sultanate of Oman; Dhahirah Region; Wilayat Mahdhah.



Fig.16. Musandam - an inhospitable environment for ferns and mosses. C.J Rothfels, January 22, 2009.

## References:

- Abokhatwa, A. N. 1989. A contribution to the lichens of Saudi Arabia and the role of lichen acids. *Proc. Wildlife Cons. Dev. Saudi Arabia* 3: 201–208.
- Abuzinada, A. H., and D. L. Hawksworth. 1974. A contribution to the lichens of Saudi Arabia. *Bull. Fac. Sci. Riyadh Univ.* 6: 224–233.
- , —, and H. A. Bokhary. 1986. The lichens of Saudi Arabia, with a key to the species reported. *Arab Gulf J. Scient. Res. Sp. Pub.* 2: 1–54.
- Al-Gifri, A.N. & H. Kürschner. 1996. First records of bryophytes from the Hadramout and Abyan Governorate, Southern Yemen. *Studies in Arabian bryophytes* 20. *Nova Hedwigia* 62: 137-146.
- Arts, T. 2001. A Revision of the Splachnobryaceae (Musci). *Lindbergia* 26: 77–96.
- Arup, U. 2009. The *Caloplaca holocarpa* group in the Nordic countries, except Iceland. *Lichenologist* 41: 111–130.
- Badré, F., and T. Reichstein. 1983. The two cytotypes of *Notholaena lanuginosa* (Sinopteridaceae, Pteridophyta). *Willdenowia* 13: 361–367.
- Bokhary, H. A., Parvez, S. and A. H. Abuzinada. 1993. Lichens from high altitude areas of Saudi Arabia. *Nova Hedwigia* 56: 491–496.
- Brown, G. 1998. Notes on the lichen flora of Kuwait. *Nova Hedwigia* 67: 267–273.
- . 2005. Lichens. In: P. Hellyer and S. Aspinall, eds: **The Emirates - A Natural History**. Trident Press Ltd.
- , and S. Sakkir. 2004. Flora and vegetation of Jebel Hafit. In: S. Aspinall and P. Hellyer, eds: **Jebel Hafit - A Natural History**. Abu Dhabi: Emirates Natural History Group.
- , M. Schultz and M. D. Robinson. 2002. Saxicolous and terricolous lichens from the foothills of northern Oman. *Nova Hedwigia* 75: 177–188.
- Bruggeman-Nannenga, M. A. 1987. An annotated list of *Fissidens* species from the Yemen Arab Republic and Sultanate of Oman, with *F. laxetexturatus* nov. spec. *Studies in Arabian bryophytes* 7. *Nova Hedwigia* 45: 113–117.
- Casas, C., E. Fuertes & J. Varo. 1976. Aportaciones al conocimiento de la flora briologica española. Notula III: musgos y hepáticas de los alrededores de Titaguas. *Anal. Inst. Bot. Cavanilles* 33: 139–152.
- Chen, T., C. Wei, Z. Huang, O. Huang, Q. Lu, and Z. Fan. 2002. Arsenic hyperaccumulator *Pteris vittata* L. and its arsenic accumulation. *Chinese Science Bulletin* 47: 902–905.
- El-Oqlah, A. A. 1992. The lichen flora of Jordan. A catalogue of species and ecological notes. *Dirasat* 19B: 109–121.
- , W. Frey & H. Kürschner. 1988. The Bryophyte Flora of Trans-Jordan. A Catalogue of Species and Floristic Elements. *Willdenowia* 18: 253–279.
- , D. L. Hawksworth and J. N. Lahham. 1986. Additions to the lichen flora of Jordan. *Candollea* 41: 69–73.
- , and J. N. Lahham. 1985. Lichens from the northern part of Jordan. *Nova Hedwigia* 42: 201–205.
- El-Saadawi, W. E., A. A. Badawi, & M. S. Refai. 1986. Mosses of the Nile Delta. *Lindbergia* 12: 106–110.
- Feulner, G. R. 2011. The flora of the Ru'us al-Jibal – the mountains of the Musandam Peninsula: An annotated checklist and selected observations. *Tribulus* 19: 4–153
- Frey, W. 1989. The bryophytes of Saudi Arabia and the importance of their conservation (Studies in Arabian Bryophytes 9). *Proc. Wildlife Cons. Dev. Saudi Arabia* 3: 209–219.
- , and H. Kürschner. 1988. Bryophytes of the Arabian Peninsula and Socotra. Floristics, phytogeography and definition of the Xerothermic Pangaeian element. *Studies in Arabian bryophytes* 12. *Nova Hedwigia* 46: 37–120.
- Gallego, M. T., M. J. Cano, R. M. Ros & J. Guerra. 2002. New Taxonomic Data on a Circum-Tethyan Group of *Syntrichia* (Pottiaceae, Bryophyta): the *S. caninervis* Complex. *Systematic Botany* 27: 643–653.
- Gaya, E. 2009. Taxonomical revision of the *Caloplaca saxicola* group (Teloschistaceae, lichen-forming Ascomycota). *Bibl. Lichenol.* 101: 1–191.
- Ghazanfar, S. A., and M. Gallagher. 1998. Remarkable lichens from the Sultanate of Oman. *Nova Hedwigia* 67: 519–528.
- , and D. Rappenhöner. 1994. Vegetation and Flora of the islands of Masirah and Shagaf, Sultanate of Oman. *Arab Gulf J. Scient. Res.* 12: 509–524.
- Heyn, C. C., and I. Herrnstadt (eds.). 2004. **The**



***Bryophyte Flora of Israel and Adjacent Regions.***

Israel Academy of Sciences and Humanities, Jerusalem. Backhuys Publishers B.V., Leiden.

Hill, M. O., N. Bell, M. A. Bruggeman-Nannenga, M. Brugués, M. J. Cano, J. Enroth, K. I. Flatberg, J.-P. Frahm, M. T. Gallego, R. Garilleti, J. Guerra, L. Hedenäs, D. T. Holyoak, J. Hyvönen, M. S. Ignatov, F. Lara, V. Mazimpaka, J. Muñoz, & L. Söderström. 2006. An annotated checklist of the mosses of Europe and Macaronesia. *Journal of Bryology* 28: 198–267.

Jermy, A. C., and A. M. Paul. 1993. *Cheilanthes*. In ***Flora Europaea*** (T. G. Tutin, N. A. Burges, A. O. Chater, J. R. Edmondson, V. H. Heywood, D. M. Moore, D. H. Valentine, S. M. Walter, and D. A. Webb, eds.). Cambridge University Press, Cambridge.

Jongbloed, M. 2003. ***The Comprehensive Guide to the Wild Flowers of the United Arab Emirates.*** Environmental Research and Wildlife Development Agency, Abu Dhabi, 576 pp.

Kürschner, H. 1984. Epiphytic communities of the Asir Mountains (SW Saudi Arabia) Studies in Arabian Bryophytes 2. *Nova Hedwigia* 39: 177–198.

—. 2000. Bryophyte flora of the Arabian Peninsula and Socotra. In *Bryophytorum Bibliotheca* 55 (Ed., Grandstein, R.), J. Cramer Pub., Germany, Berlin, Stuttgart, 131 pp.

—. 2003. Nineteen new records to the bryophyte flora of Socotra Island. Additions to the Bryophyte Flora of the Arabian Peninsula and Socotra 5. *Willdenowia* 33: 445–458.

—. 2008. Biogeography of South-West Asian bryophytes – with special emphasis on the tropical element. *Turk. J. Bot.* 32: 433–446.

—, and B. Böer. 1999a. New records of bryophytes from the southern Musandam Peninsula and Jebel Hafit (United Arab Emirates). *Nova Hedwigia* 68: 409–419.

—, —. 1999b. New records of mosses in the southern Musandam and the UAE (Jebel Hafit and Hajar Mountains). *Tribulus* 9.2: 5–9.

—, and A. Erda. 2005. Bryophytes of Turkey: An annotated reference list of the species with synonyms from the recent literature and an annotated list of Turkish bryological literature. *Turk. J. Bot.* 29: 95–154.

Mandaville, J. P., Jr. 1977. Plants. In: ***The Scientific Results of The Oman Flora and Fauna Survey 1975.*** A Journal of Oman Studies Special Report. Ministry of Information and Culture, Sultanate of Oman, pp. 229–259.

Manton, I. 1950. ***Problems of Cytology and Evolution in the Pteridophyta.*** London.

Mickel, J. T., and A. R. Smith. 2004. ***The Pteridophytes of Mexico.*** The New York Botanical Garden Press, New York.

Miller, A. G., and T. A. Cope. 1996. ***Flora of the Arabian Peninsula and Socotra:*** Volume 1. Edinburgh: Edinburgh University Press.

Müller Argau, J. 1893. Lichenes arabici a cl. Dr Schweinfurth in Arabia Yemensis lecti. *Bull. Herb. Boissier* 1: 213–258.

Nakazato, T., and G. J. Gastony. 2003. Molecular phylogenetics of *Anogramma* species and related genera (Pteridaceae: Taenitidoideae). *Systematic Botany* 28: 490–502.

Nardi, E., and T. Reichstein. 1985. Nomenclatural notes on *Cheilanthes pteridioides* (Reichard) C. Chr. (Sinopteridaceae). *Webbia* 39: 135–139.

—, —. 1986. (807) Proposal to reject *Polypodium pteridioides* Reichard and all combinations based on it (Sinopteridaceae: Pteridophyta). *Taxon* 35: 172–174.

Ochi, H. & H. Kürschner. 1988. *Bryum nanoapiculatum* (Bryaceae, Musci), a species new to the moss flora of the Arabian Peninsula. XIII: Studies in Arabian bryophytes. *Nova Hedwigia* 47: 359–361.

Ochyra R. (1992) New combinations in *Syntrichia* and *Warnstorfia* (Musci). *Frag. Flor. Geobot.* 37: 211–214.

Paris, C. A. 1993. *Adiantum*. Pages 125–130 in ***Flora of North America*** (Flora of North America Editorial Committee, ed.) Oxford University Press, New York.

Pichi Sermolli, R. 1985. The fern genus *Cosentinia* Todaro. *Webbia* 39: 179–189.

—. 1987. Report 12 of the Committee for Pteridophyta. *Taxon* 36: 740–41.

Pryer, K. M., H. Schneider, A. R. Smith, R. Cranfill, P. G. Wolf, J. S. Hunt, and S. D. Sipes. 2001. Horsetails and ferns are a monophyletic group and the closest living relatives to seed plants. *Nature* 409: 618–622.

Rivas-Martinez, S., and Á. E. Salvo. 1984. Sobre el género *Cosentinia* en la Península Ibérica. *Anales del Jardín Botánico de Madrid* 41: 196.

Ros, R. M., J. A. Jiménez, M. J. Cano, R. A. Pursell, M. A. Bruggeman-Nannenga, and G. M. Dirkse. 2001. *Fissidens sublimbatus*, New to Morocco and the Canary Islands. *The Bryologist* 104: 468–470.

- Rothfels, C. J., M. D. Windham, A. L. Grusz, G. J. Gastony, and K. M. Pryer. 2008. Toward a monophyletic *Notholaena* (Pteridaceae): Resolving patterns of evolutionary convergence in xeric-adapted ferns. *Taxon* 57: 712–724.
- Schiffner, V. 1913. Bryophyta aus Mesopotamien und Kurdistan, Syrien, Rhodos, Mytilini und Prinkipo. Gesammelt von Dr. Heinrich Frh. v. Handel-Mazzetti (Wissenschaftliche Ergebnisse der Expedition nach Mesopotamien, 1910). *Annalen des Naturhistorischen Museums in Wien* 27: 472–504.
- Schneider, H., S. Russell, C. Cox, F. Bakker, S. Henderson, F. Rumsey, J. Barrett, M. Gibby, and J. Vogel. 2004. Chloroplast phylogeny of asplenoid ferns based on *rbcL* and *trnL-F* spacer sequences (Polypodiidae, Aspleniaceae) and its implications for biogeography. *Systematic Botany* 29: 260–274.
- Schuettpelz, E., H. Schneider, L. Huiet, M. D. Windham, and K. M. Pryer. 2007. A molecular phylogeny of the fern family Pteridaceae: Assessing overall relationships and the affinities of previously unsampled genera. *Molecular Phylogenetics and Evolution* 44: 1172–1185.
- Schultz, M. 1998. Studies on lichens from Southern Yemen (Arabian Peninsula). *Lichenologist* 30: 293–297.
- . 2004. *Pterygiopsis pulchra*, a remarkable new species of the Lichinaceae from south-eastern Yemen. *Bibl. Lichenol.* 88: 555–560.
- , G. Brown, and B. Büdel. 2000. Cyanophilous lichens from Kuwait. *Nova Hedwigia* 70: 193–216.
- , and B. Mies. 2003. The saxicolous and terricolous, cyanobacterial lichens of Socotra (Yemen, Indian Ocean). *Nova Hedwigia* 77: 73–97.
- Smith, A. R., K. M. Pryer, E. Schuettpelz, P. Korall, H. Schneider, and P. G. Wolf. 2006. A classification for extant ferns. *Taxon* 55: 705–731.
- Smith, A. J. E. 2004. *The Moss Flora of Britain and Ireland*. 2<sup>nd</sup> Ed. Cambridge University Press. Cambridge, UK.
- Sipman, H. J. M. 2002. Lichens of mainland Yemen. *Willdenowia* 32: 127–135.
- Szatala, Ö. 1957. Prodomus einer Flechtenflora des Irans. *Ann. Hist.-Natur. Mus. Nation. Hungarici*, series nova 8: 101–154.
- Uyar, G., and B. Çetin. 2004. A new checklist of the mosses of Turkey. *Journal of Bryology* 26: 203–220.
- Vida, G., C. N. Page, T. Walker and T. Reichstein. 1971. Cytologie der Far-Gattung *Cheilanthes* in Europa und auf den Canarischen Inseln. *Bauhinia* 4: 223–253.
- , A. Major, and T. Reichstein. 1983. Relations and evolution in *Cheilanthes* (Sinopteridaceae, Pteridophyta) in Macaronesia and Mediterranean area, deduced from genome analysis of their hybrids. *Acta Bot. Malacit.* 8: 101–126.
- Wagner, W. H. Jr. 1963. A biosystematic survey of United States ferns—A preliminary abstract. *American Fern Journal* 53: 1–16.
- Windham, M. D., L. Huiet, E. Schuettpelz, A. L. Grusz, C. J. Rothfels, and J. Beck. 2009. Using plastid and nuclear DNA sequences to redraw generic boundaries and demystify species complexes in cheilanthoid ferns. *American Fern Journal* 99: 68–72.
- Zander, R. H. 1993. Genera of the Pottiaceae: Mosses of harsh environments. *Bull. Buffalo Soc. Nat. Sci.* 32. vi + 378 pp.
- , and W.A. Weber. 2005. *Anoetangium handelii* (Bryopsida, Pottiaceae) in the New World. *The Bryologist* 108: 47–49.

**Carl Rothfels**

(to whom all correspondence should be addressed)  
 Department of Biology  
 Duke University  
 Box 90338  
 Durham NC 27708  
 U.S.A.  
 email: [crothfels@yahoo.ca](mailto:crothfels@yahoo.ca)

**Paul Rothfels**

**Ester Gaya**

**Lisa Pokomy**

**Peter Rothfels**

**Gary Feulner**

P.O. Box 9229  
 Dubai, UAE  
 email: [grfeulner@gmail.com](mailto:grfeulner@gmail.com)

# Stable isotope sclerochronology of Pleistocene shells of the 'Giant Clam' *Tridacna* from Abu Dhabi

by Stephen Lokier, Ayesha Eid Al-Suwaidi and Thomas Steuber



Fig. 1. Well-preserved *Tridacna* specimen exhibiting good taphonomic preservation.

## Introduction

Shells of the 'Giant Clam' *Tridacna* were recently identified during dredging activity from the shallow subtidal zone (up to 10 m deep) off the coastline of Abu Dhabi, on the southern shore of the Arabian Gulf. The shells exhibit a good state of preservation with little evidence of post-mortem degradation or diagenesis (Fig. 1). No extant species of *Tridacna* have been documented from the Arabian Gulf or identified from archaeological investigations of United Arab Emirates shell-middens (P. Hellyer, *pers. comm.*). The absence of an archaeological record implies that *Tridacna* has been absent from the Arabian Gulf since the Neolithic period (c. 8,000 BC). Radiocarbon dating of four separate shells gave an age of >50,000 years. Consequently, these molluscs predate the last glacial maximum and date from a previous flooding episode in the Arabian Gulf, most likely the last interglacial eustatic sea level high at 120 ka. This age is currently being confirmed via the application of U/Th radiometric dating.

## Geographic setting

The Arabian Gulf is an enclosed epeiric sea connected to the world oceans via the relatively narrow Strait of Hormuz. Water depths are shallow with an average depth of 35 m and rarely exceed 100 m. During periods of glaciation, declining eustatic sea levels result in exposure of the shallow basin floor with a consequent shift to aeolian sedimentary systems - typically in the form of dune-field development (Glennie, 1998). Interglacial episodes, such as the Holocene flooding event, have resulted in inundation of the basin and the re-establishment of marine conditions (Lambeck, 1996). Today, the floor of much of the Arabian Gulf is dominated by fine muddy carbonate sediments and hard-grounds.

The low-angle ramp geometry of the southern shoreline of the Arabian Gulf provides an ideal setting for the study of Holocene and Recent sea level change. Today this coastline is characterised by the transition from a supratidal *sabkha* passing offshore, through a broad carbonate-evaporite intertidal setting

with complex depositional facies geometries, into a subtidal carbonate depositional environment (Evans *et al.*, 1969). Much of the Abu Dhabi coastline is isolated from open marine conditions by a number of peninsulas and offshore shoals and islands that are associated with the approximately east-west trending Great Pearl Bank.

Seasonal temperature variations can be extreme; summer temperatures will often exceed 50°C, yet temperatures may regularly fall below 10°C at night during the winter months. These air temperatures are reflected in the water temperatures and salinities offshore of Abu Dhabi. A surface water temperature of 34°C was recorded during June 2010 whilst 21°C was recorded during February 2011.

The shoreline of the United Arab Emirates is currently undergoing massive infrastructure development on an unprecedented scale, with huge dredging and island building projects completely changing the dynamics of the coastline beyond recognition. It was during one of these dredging operations that the specimens analysed were exposed and identified.

### Calculated Palaeotemperatures

Oxygen and carbon isotopic compositions were studied in sclerochronological transects of two aragonite shells sourced from the same location just to the west of Abu Dhabi Island. Thus far, specimens have only been identified in this area (R. Hornby, *pers.com.*). The isotopic composition is compared with modern skeletal aragonite to constrain salinity and temperature of Pleistocene seawater of the Arabian Gulf, and annual variations of these parameters. Preservation of original skeletal aragonite was confirmed via petrographic thin-section observations and X-ray diffraction. Thick sections were prepared from two specimens of *Tridacna*. Powder samples were milled from the thick sections parallel to growth bands using a hand-held micro-drill with a 0.8 mm diameter tungsten drill bit. Between 10 and 23 samples were obtained within each growth band; this figure was dependant on the band's thickness. Specimen EPB02 had 3 clearly defined growth bands from which a total of 57 samples were obtained. The second specimen, EPB06, had 14 increments of which the innermost 6 (a total of 75 samples) have been sampled and analysed to date (*Fig. 2*). The thickness of growth bands in both shells lay in the range of 5 -7 mm. All samples were analysed for  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$ , analytical precision is  $\pm 0.1\text{‰}$  2 S.D.

Palaeotemperatures were calculated following Goodwin *et al.* (2003) using the equation:

$$20.6 - 4.34 [\delta^{18}\text{O aragonite} - (\delta^{18}\text{O water} - 0.2)]$$



Fig. 2. Thick-section of sample EPB06 showing the sampling transect, the first 6 sampled growth bands are numbered. Note the clearly-defined growth increments and well-preserved nature of the original aragonite skeleton.

A value of +3 ‰ was applied for  $\delta^{18}\text{O}_{\text{water}}$  in accordance with the relationships observed from analysis of Recent water samples taken from offshore Abu Dhabi.

The calculated palaeotemperatures for shell EPB02 exhibit a seasonal temperature range between 20-28°C while specimen EPB06 yielded a slightly lower temperature range of 18-27°C (*Fig. 3*). The latter specimen also displays a trend of increasing temperature over the sampled interval, with a range of 18-23°C in the first two growth bands increasing to 20-27°C in the final two sampled bands. In both shells the cyclicity of the palaeotemperatures was clearly demarcated by the shell's growth bands.

The temperatures derived for both specimens are significantly lower than the temperatures seen offshore of Abu Dhabi today (21-34°C). This implies that, either the  $\delta^{18}\text{O}$  of Pleistocene sea water was higher, or that temperatures were, in fact, cooler during the previous interglacial.

Sampling of the remaining eight growth bands in specimen EPB06 has been completed and analysis is currently under way. The compilation of this data-set with a radiometric age, determined from U/Th dating of the shells, will allow us to establish temporally-constrained seasonal palaeotemperatures for the previous interglacial during which these *Tridacna* were growing.

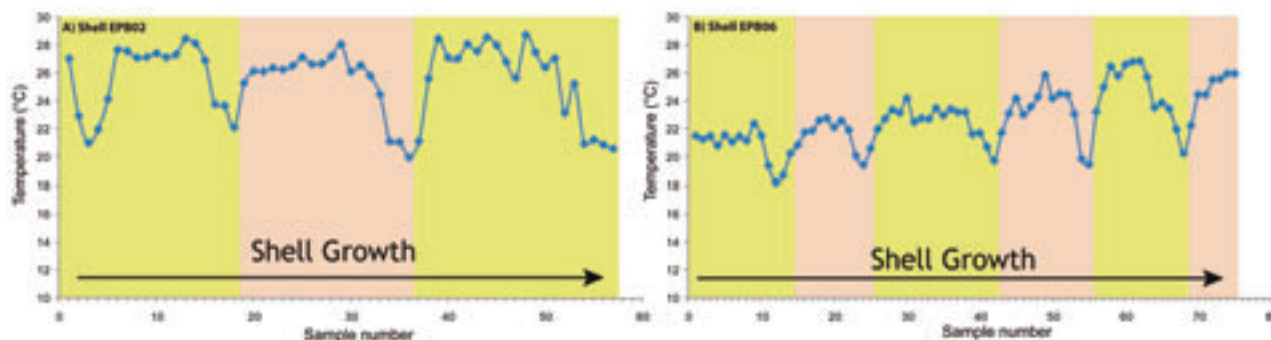


Fig. 3. Calculated palaeotemperatures results for the two *Tridacna* samples analysed during this study. The yellow and buff backgrounds denote the 3 growth bands in specimen EPB02 (A) and 6 sampled bands in EPB06 (B). In both frames the oldest shell material lies to the left and the youngest material to the right.

## Acknowledgements

The authors wish to thank Peter Hellyer for initially bringing these samples to our attention and Maarten Verhage for establishing the sample provenance.

## References

Evans, G., Schmidt, V., Bush, P. and Nelson, H. (1969) Stratigraphy and geologic history of the *sabkha*, Abu Dhabi, Persian Gulf. *Sedimentology*, 145-159.145-159

Glennie, K.W. (1998) The desert of southeast Arabia, A product of Quaternary climatic change. In: ***Quaternary Deserts and Climatic Change*** (Ed. G. Alsharhan, Whittle and Kendall), pp. 279-291. Balkema, Rotterdam.

Goodwin, D.H., Schone, B.R. and Dettman, D.L. (2003) Resolution and Fidelity of Oxygen Isotopes as Paleotemperature Proxies in Bivalve Mollusk Shells: Models and Observations. *PALAIOS*, 18, 110-125.110-125

Lambeck, K. (1996) Shoreline reconstructions for the Persian Gulf since the last glacial maximum. *Earth and Planetary Science Letters*, 142, 43-57.43-57

**Stephen Lokier**

(to whom all correspondence should be addressed)

The Petroleum Institute

P.O. Box 2533

Abu Dhabi, UAE

email: [slokier@pi.ac.ae](mailto:slokier@pi.ac.ae)

**Ayesha Eid Al-Suwaidi**

ADCO,

PO Box 270,

Abu Dhabi, UAE

e-mail: [a.alsuwaidi@adco.ae](mailto:a.alsuwaidi@adco.ae)

**Thomas Steuber**

Petroleum Institute,

PO Box 2533,

Abu Dhabi, UAE

e-mail: [tsteuber@pi.ac.ae](mailto:tsteuber@pi.ac.ae)

# Coastal wetlands in Ra's al-Khaimah, United Arab Emirates: an update on their status, biodiversity, values and protection

by Robert E. Llewellyn-Smith

## Introduction

An overview and description of 24 wetland systems in the United Arab Emirates (UAE) is given in a Directory of Wetlands of the Middle East (Scott, 1995), and includes four coastal wetlands in the Emirate of Ra's al-Khaimah (RAK). Many of these sites have been recommended for protection, along with formal inclusion in a national network of protected areas (Aspinall, 1996). However, since these publications, the rapid economic development in the UAE, especially between 2003 to 2008, has changed the physical and biological nature of many of the wetlands described.

Four coastal wetlands exist in the Emirate of Ra's al-Khaimah: Khor Muzahmi (300 ha), Khor Ra's al-Khaimah (410 ha), Khor Julfar (227 ha) and Khor Hulaylah (also known locally as Khor al-Rams) (676 ha). These areas have high scenic value, are individual in character, and are important for their biodiversity. Khor Muzahmi includes an area designated for reserve status, while the other three wetlands are without formal protection. All sites face various pressures and challenges to their ecology, caused largely by rapid economic development. In combination, the total wetland area is 1,500 ha, representing a highly valuable natural resource for fisheries, biodiversity, climate change mitigation, and with high recreation, ecotourism, education and research potential. Further studies and protection measures are recommended.

This report seeks to update existing information on these four wetlands and highlight their importance, thereby offering renewed justification for the conservation and careful management of these critical areas. It also aims to provide a source of information to be used in any future State of the Environment reports for RAK's marine and coastal region. Such reports, piloted by Abu Dhabi Emirate (EAD, 2005), are proposed for replication in other Emirates as a resource to support habitat conservation and help in policy-making.

Wetlands are defined by the international Convention on Wetlands as "... areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters" (RAMSAR, 2009). Wetlands deliver a wide range of ecosystem services that contribute to

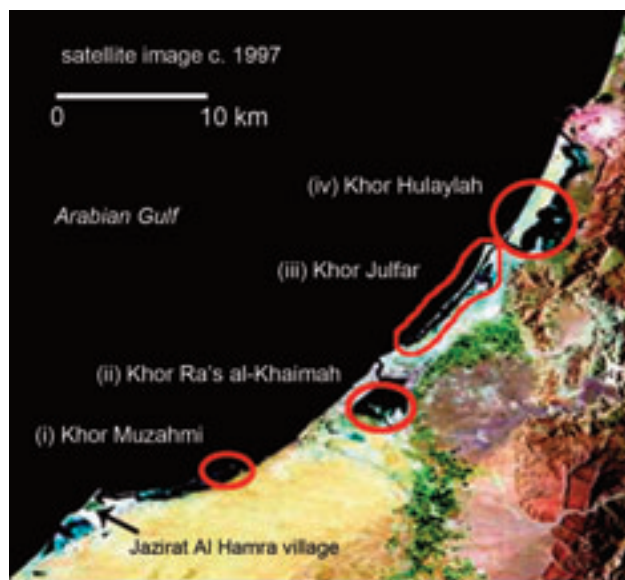


Fig. 1. Coastal wetlands of Ra's al-Khaimah.

human well-being, such as fish and fibre, water supply, water purification, climate regulation, flood regulation, coastal protection, recreational opportunities and tourism (MEA, 2005).

The Regional Organisation for the Protection of the Marine Environment (ROPME) has identified physical alteration of the Arabian Gulf coastline for real estate, industry, hotels and port facilities as a major threat to the marine environment, with wetland ecosystems particularly affected (ROPME, 2005). Worldwide, the degradation and loss of wetlands is more rapid than that of other ecosystems, attributed mainly to growing human populations coupled with economic activity (MEA, 2005).

Wetlands in the UAE occur along a coast that is generally shallow and gently shelving, with numerous natural islands dominating the coastline of Abu Dhabi.

Ra's al-Khaimah (RAK) is the northernmost of the seven Emirates comprising the UAE. Its coastline stretches along the Arabian Gulf coast for 63 km, in the south bordering Umm al-Qaiwain Emirate, and in the north bordering Oman's Musandam territory.

The total coastline of the UAE is about 700 km long (excluding islands). Although RAK's portion makes up only 9% of the total coastline, its four wetlands, named above, are highly interesting and significant (Fig. 1).

### i) Khor Muzahmi (Al Jazeera Khor or Khor Qurm) (25°43'N, 55°51'E)

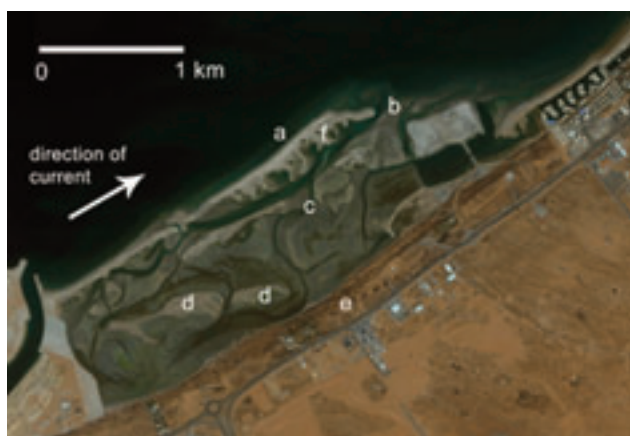


Fig. 2. Satellite image (2009) of Khor Muzahmi

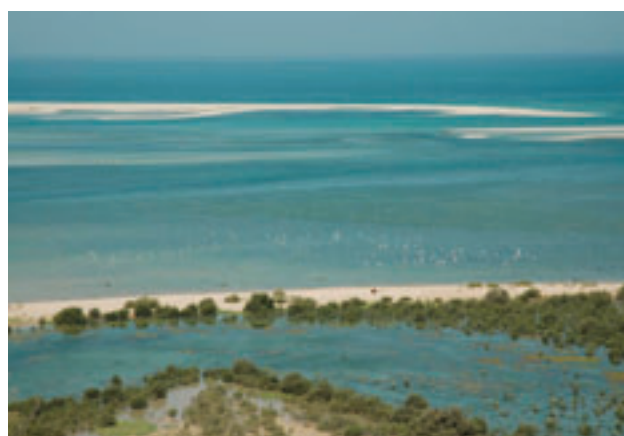


Fig.3. View northwards over Khor Muzahmi (2010).  
(Photograph: R. Llewellyn-Smith).

#### Location and features

Locally known as Khor Muzahmi, this wetland is located north of the town of Jazirat al-Hamra (Fig. 1) and about 14 km south of Ra's al-Khaimah city. It is the remnant of a series of shallow lagoons, bar and spit complexes, and intertidal mudflats that once extended over a distance of about 14 km, separated roughly in the middle by Jazirat al-Hamra old town (Goudie *et al.* 2000). Coastal development, firstly by a new harbour in 1996, and secondly by extensive reclamation for the real estate and hotel industry starting in 2004, has reduced it in size to approximately 300 ha.

The remaining portion of Khor Muzahmi retains a number of key features. These include an outer sandbar (Fig.2,a); the main opening to the sea (Fig.2,b); large areas of intertidal mudflats and a mosaic of shallow channels (Fig.2,c); several sand islands fringed with mangroves (Fig.2,d), and dunes

over 20 m in height (Fig.2,e) on the landward side overlooking the wetland. Adjacent to the wetland, to the north east, is a man-made island (Fig.2,g), surrounded by deeper dredged water. A causeway provides a connection to the mainland, although a bridge allows tidal flow between the wetland and the beach belonging to the Cove Rotana hotel development (Fig.2 h).

The sandbar stretches for 2.8 km, sheltering the inner wetland from the open sea. It provides an excellent example of the process of longshore drift in action, with the aerial image showing a clear depositional sequence of curved headlands (Fig.2,f). A comparison of GPS coordinates taken in 2008 and 2009 with aerial and satellite images revealed that the sand bar had extended a surprising 670 m between 23 December 2004 and 26 May 2009 (Table 1), representing a rate of about 170 m per year.

**Table 1. Khor Muzahmi sand bar elongation.**

Date	Coordinates of north east end of sand bar		Increase in meters from position on 23rd December 2004
	Latitude	Longitude	
23rd December 2004	25° 44'06.73"N (Google Earth)	55° 52'01.55"E (Google Earth)	
12th October 2008	25° 44'.15.56"N (GPS)	55° 52'18.70"E (GPS)	550 m
26th May 2009	25° 44'16.85"N (GPS)	55° 52'22.91"E (GPS)	670 m (a gain of 120 m since position on 12th October 2008)

This is a much higher rate than the 40 m per year estimated by Goudie *et al.* (2000) in a measurement of the Julfar spit migration, 16 km further north, and reconstructed using cartographic data from 1822 to 1958. This is likely due to the rapid physical change in the coastline immediately to the south, created by dredging of the Jazirat al-Hamra harbour (2000), creation of Marjan Island (2005), Dana Island (2008) and wetland reclamation for the Mina Al Arab development (2004). These works have affected currents and reduced the availability of sand for the process of longshore drift and sandbar formation.

Further extension of the sandbar at this rate will substantially reduce the opening to the sea, although two breaches occurring in early 2009 have made additional openings, facilitating tidal exchange. These breaches appear to be widening, reflecting the dynamic nature of coastal erosion and deposition, influenced by the developments mentioned earlier.

### Marine life

The sandbar is used by nesting turtles. A nesting attempt recorded by the author on 21st May, 2009 showed a track width of 48cm with a faintly staggered pattern of flipper marks suggesting Hawksbill turtle *Eretmochelys imbricata*. The blue swimming crab *Portunus pelagicus*, the mud crab *Macrophthalmus depressus* and fiddler crabs *Uca* sp. appear numerous. The swimming crab *Thalassidroma crenata* is present, and can be added to the list provided by Hornby (1997). However, this species was not observed by the author in RAK's other three wetlands. The main channels support sea grass, mainly *Halodule uninervis*, although small patches of *Halophila ovalis* were observed. The gastropod *Cerithidea cingulata* occurs in large numbers on the mudflats, and is a feature common to all of RAK's wetlands, and typical of the UAE's intertidal lagoon environments (Feulner & Hornby, 2006).

### Birds

The sheltered landward side of the sandbar provides feeding and roosting areas for gulls, terns and plovers. This area and the shallow waters (< 2m) of the inner wetland support a population of Greater Flamingo *Phoenicopterus roseus* throughout the year.

Counts of flamingos by the author between June 2009 and May 2010 showed a steady increase in number from around 100 in mid-June to 250 by the beginning of August. This was followed by a rapid increase to over 500 (reaching 600) between 10th August and 16th September with many juvenile birds, followed by a steep drop back to around 200 at the start of October, rising again to around 350 in November and December before showing a gradual decline to 107 on the last count of 25 May, 2010.

The rapid increase in August and September may be due to the arrival of flamingos from colonies further north, possibly Iran, Turkey and Central Asian countries, reflecting the start of an autumn migration.

The steep drop in late September may reflect a dispersal to local wetlands and others further along the Gulf coast. Breeding by Greater Flamingo has not been proved at any of RAK's wetlands, but a one-off, large breeding event in an intertidal area near Abu Dhabi in 2009 means that the possibility of future breeding in RAK cannot be ruled out. The population of Socotra Cormorant *Phalacrocorax nigrogularis*, monitored during this period, showed tens of thousands roosting on the sandbar between 15 June and 19 August 2009, followed by a decline to small groups of under 20 or absent altogether. By mid-April, numbers were again in the tens of thousands. One recent estimate (June 2011) of Socotra Cormorant working their way down the outer sand bar numbered about 75,000 (*pers. comm.* R. Hornby). Crab plovers *Dromas ardeola* are a regular autumn, winter and spring visitor. Regular sightings are made of Osprey *Pandion haliaetus*, as well as at Khor Julfar and Khor Hulaylah.

Prior to 2004, the wetland was extensive and covered approximately 700 ha. In this condition, the wetland was listed as an Important Bird Area by the international conservation organisation Birdlife International (Evans, 1994). A detailed list of birds is provided in 'A Directory of Wetlands of the Middle East' (Scott, 1995), which states that over 90 species were recorded here. The site was considered internationally important as it regularly supported 1% of the regional wintering population of Terek Sandpipers *Xenus cinereus*, and nationally important as 5% of the estimated national population of the following species was present at the site: Grey Heron *Ardea cinerea*, Western Reef Heron *Egretta gularis*, Kentish Plover *Charadrius alexandrinus*, Grey Plover *Pluvialis squatarola*, Bar-tailed Godwit *Limosa limosa*, Curlew *Numenius arquata*, Greenshank *Tringa nebularia*, Slender-billed Gull *Larus genei* (Hellyer & Aspinall, 2005).

Considering the size reduction of this wetland from 700 ha to 300 ha in 2004, further assessments are now required to ascertain international and national importance for the species mentioned previously.

### Vegetation

Mangrove cover is limited to approximately 1.2 ha, mainly on two islands within the wetland and along the mainland shoreline, although cover has increased since 2003, with aerial photos then showing an approximate coverage area of 0.14 ha. Camels had been feeding on the mangroves but were prohibited in early 2009. Mangrove bushes are now showing clear signs of regeneration. Other vegetation includes salt tolerant halophytes namely *Arthrocnemum macrostachyum* and *Zygophyllum qatarense*, the grass *Halopyrum mucronatum*, and the desert hyacinth *Cistanche tubulosa*. The invasive mesquite tree *Prosopis juliflora*, is present on the mangrove islands (Fig. 2, d) and high sand dunes.



The high sand dunes support scrub vegetation and numerous mature ghaf trees *Prosopis cineraria*, which provide suitable habitat for a range of migrant and resident birds as described by Richardson & Aspinall (1998). The high sand dunes provide excellent views over the wetland and out to sea (Fig.3).

### Ownership and habitat management issues

About 70% of Khor Muzahmi is now protected by the real estate company developing the adjoining former wetland to the south, and known as the Mina Al Arab Environmental Reserve. The company fenced the landward side along the base of the dunes in early 2009. The remaining 30% at the northern end is under the control of local Government and private ownership.

Existing pressures include fishing with nets, littering, and damage to dune vegetation through off-road driving. Future challenges will lie in ensuring that the private dune developments do not encroach on the wetland, as it is a relatively small site. Any further habitat loss will reduce the ecological integrity of the wetland. Furthermore, these private developments should be encouraged to keep the scrub vegetation, and *ghaf* woodland with its deep rooting systems, to help anchor the steep dune slopes and maintain habitat for associated fauna. This dune habitat should be conserved and considered integral to the wetland ecosystem.

The neighbouring hotel and real estate developments will need to ensure their activities adjacent to the wetland are compatible with its sensitive ecology. Khor Muzahmi's values and potential benefits to society are summarised in Tables 2 and 3.

### ii) Khor Ra's al-Khaimah (25°46'N, 55°57'E)



Fig. 4. Aerial image (2009) of Khor Ra's al-Khaimah.

### Location and features

Khor Ra's al-Khaimah lies in the heart of the city. It was once part of the Julfar lagoon complex (wetland (iii) in this paper) as shown by early maps of the coastline and later air photography. Goudie *et al.* (2000) suggest that the Khor was fed by a major ephemeral river discharging through the Wadi al-Bih whose catchment lies in the Musandam mountains. Recent satellite images show a modern feeder channel that runs south east past the golf club, and sandwiched between sand dunes and the alluvial fan deposits of Wadi Naqab.

Separation from the Julfar complex occurred with storm breaches of the outer barrier beach in the late 1950s, followed in the 1980s by construction and dredging of a fishing harbour and port, along with further land reclamation (Fig. 4,a & b) (Goudie *et al.* 2000). Subsequent further modification included a west-east road through the mangroves (Fig. 4,c); a golf course at its southern end established in 2004 (Fig. 4,d); corniche widening in 2007 (Fig. 4,f); and infill for commercial and residential towers in 2008 (Fig. 4,e).

Despite these changes, the wetland is of high scenic importance, with its wide expanse of green mangroves. It covers an area of 390 ha (area south of the bridge Fig.4, h), with a further 23 ha of mangroves and water channels that are part of the adjoining golf course south of the west-east road.

It contains substantially more mangrove cover than Khor Muzahmi, with an area of 230 ha, which includes both dense mature stands, with new seedlings and young stands also present. These mangroves have developed in the last 30 years, as a black and white aerial photo taken in the mid-1970s, held by RAK Department of Antiquities and Museums, show the wetland to be made up of open mudflats and devoid of any mangrove cover.

The prominent sand island, Nad Abu Tabl (Fig. 4,g), provides a contrasting sand dune habitat within the mangrove wetland, and is home to Blue-cheeked Bee-eaters *Merops superciliosus*, and Red Fox, *Vulpes vulpes*. Thick layers of shell fragments in the dune profile provide evidence of ancient exploitation of the shell fish resources.

### Marine life

Khor Ra's al-Khaimah provided a sighting, in 1996 of the large mangrove crab, *Scylla serrata*. It was large, at about 2 kg in weight, having just been caught by an expatriate Filipino (*pers comm.* R. Hornby). Further confirmation of this species in the khor is provided in an article by Hogarth & Beech (2001). Visits during 2008 and 2009 by the author failed to reveal new sightings of *S. serrata* or its burrows, although the dense mangrove cover may ensure its continued presence. Continued collection by Asian crab hunters is likely to have affected population numbers, an activity dating back some years in this khor (Feulner, 2002). Other crab species identified include the violet



Fig. 5. View northeast over Khor Ra's al-Khaimah (2009. (Photograph: Y.Thakur).

crab *Eurycarcinus orientalis*, mud crab *Metopograpsus messor* and fiddler crabs *Uca* sp.

The mangrove-lined channels contain patches of sea grass *H. uninervis*, and are important as fish nurseries, with many fish fry species and larger fish present. Common species identified include Red spot Emperor *Lethrinus lentjan*, Banded Terapon *Terapon jarbua*, Killifish *Aphanius dispar*, and Sea bream *Rhabdosargus* sp.

### Birds

Many fish-eating birds take advantage of the abundant fish resources, including the Common Kingfisher *Alcedo atthis* and different species of heron including Western Reef Heron *E. gularis*, Striated Heron *Butorides striatus*, Grey Heron *A. cinerea*, Great Egret *Egretta alba* and Little Egret *Egretta garzetta*. Curlew *Numenius arquata* and Whimbrel *Numenius phaeopus* appear especially numerous. Marsh Harriers *Circus aeruginosus* are seen during the winter and spring months hunting over the mangroves. Mallard *Anas platyrhynchos* are common in the winter months. Greater Flamingo *P. roseus* are sometimes present although usually as individuals or small groups of less than 15.

### Ownership and habitat management issues

Khor Ra's al-Khaimah is owned by the Government of Ra's al-Khaimah. To protect this habitat, formal designation and management of the wetland as a nature reserve is recommended. This would allow for the necessary enforcement of protection measures, monitoring, water sample testing and clean-ups, along with the planning and oversight of recreation and education activities. Any further reclamation and reduction in size will reduce the ecological value and functioning of the wetland which is already vulnerable to pollution sources, being surrounded by the city.

The wetland is ideally suited to recreation and education activities, with potential for a wetland educational centre, along with nature trails, using boardwalks and carefully sited bird hides. The secluded channels offer scope for exploration by kayak. In combination with rowing and water skiing near the corniche, the wetland is an immensely valuable recreational resource in an increasingly busy and expanding city.

### (iii) Khor Julfar (25°50'N, 55°59'E)

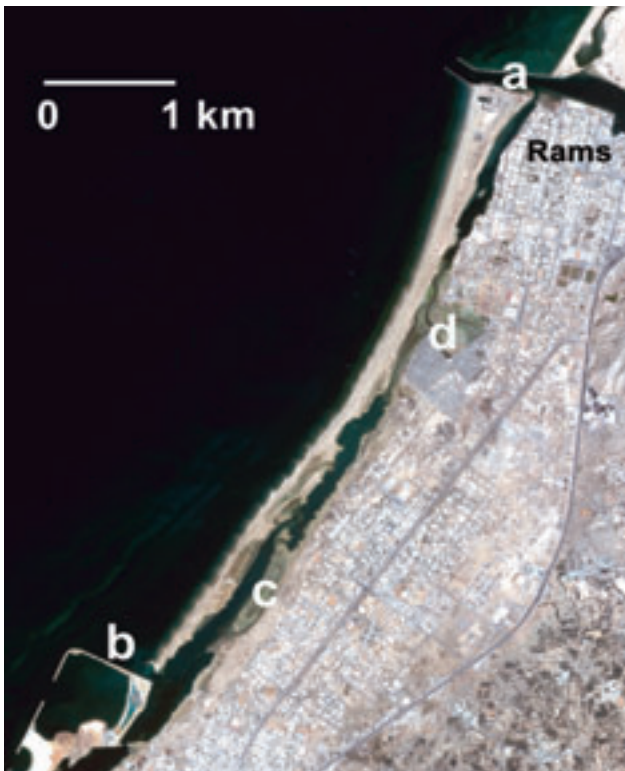


Fig. 6. Satellite image (2009) of Khor Julfar.

#### Location and features

Khor Julfar extends north of Ra's al-Khaimah city for 6 km to the town of Rams, where it connects with the fourth wetland, Khor Hulaylah, and outlet to the sea at Rams harbour (Fig. 6,a). At its southern end, it opens to the sea through a man-made opening in the outer sandbar (Fig. 6,b). Its name is taken from the site of the ancient trading city of Julfar (Fig. 6,c), where archaeological investigations have provided evidence of extensive maritime trade with Asia, including China, between the 8th/9th and 17th centuries (Hansman, 1985, King, 1990, 1991, 1992).

The lagoon does not exceed 4 m depth, except at the northern end where dredging in the past is suspected. It is protected from the sea by a prominent sandbar, approximately 200 m wide. The total area of sand bar and inner lagoon is approximately 410 ha, while the inner lagoon is approximately 227 ha.

#### Marine life

As in Khor Ra's al-Khaimah, the common fish found here include *Lethrinus lentjan*, *Terapon jarbua* and *Aphanius dispar*. The lagoon's sheltered location, connection with the Hulaylah wetland and regular presence of fish-eating herons are indicators of its importance as a nursery and refuge habitat for various juvenile fish species. This habitat also supports an abundance of filter-feeder and invertebrate faunal species (a variety of small gastropods and crustaceans, bivalves and sponges). Sea grass

(*Halodule uninervis* and *Halophila ovalis*) is relatively widespread, particularly in the southern stretch. Turtle tracks and nesting attempts have been observed on the outer sandbar. Khor Julfar is the type locality for *Bulla arabica*, a newly-recognised species of bubble shell, distinguished from *Bulla ampulla* found in the Indian Ocean to the south. (Feulner, 2007; Malaquias & Reid, 2008).

#### Birds

Birdlife includes typical shorebirds found at the other wetland sites, with one survey recording 52 species although no one species was found to be present in internationally important numbers. Greater Flamingo, *P. roseus*, are often present but usually in small groups and low numbers (<15) and favour a shallow bay at Fig.6,d. Regular sightings of Osprey have been made and terns, plovers and herons are all common.

#### Vegetation

The sandbar is occupied by common coastal vegetation species, with *Zygophyllum qatarense* as the dominant plant followed by *Suaeda vermiculata*, dune grass *Halopyrum mucronatum*, and *Arthrocnemum macrostachyum* along the sheltered lagoon shoreline. Mangrove is present in isolated small patches, mostly at the southern end, with a total approximate area of 0.7 ha. Vegetation is similar on the mainland side of the lagoon, although notable additions are the Egyptian fig marigold *Mesembryanthemum nodiflorum*, whose distribution is rare on mainland UAE, and in a bay on the eastern side of the lagoon (Fig.6,d) a species of sea lavender *Limonium carnosum* (also considered rare in the UAE), and a grass *Panicum antidotale*, which has a localised distribution along the Arabian Gulf Coast.

#### Ownership and habitat management issues

Ownership of Khor Julfar is with the Government of Ra's al-Khaimah. The outer sandbar suffers from rubbish left by visitors and brought in by the tide, along with fishing debris from fishermen who land their catch on the outer sandbar. This no doubt attracts the Red Fox, *V. vulpes*, which has been sighted on occasion. The mainland side is subject to grazing and progressive infilling for new housing, with associated dumps of building waste and garbage.

Protection is recommended for the whole lagoon, and as it connects with the Hulaylah wetland to the north, it should be regarded as one ecological system. The already protected and fenced Julfar historical site fits naturally into this wetland complex, and provides protection for a 1.6 km stretch of beach containing mudflats and some mangroves. This area offers high potential for boat-based recreation (e.g. bird watching, kayaking) and heritage tourism if plans by the RAK Department of Antiquities and Museums to develop the Julfar historical site come to fruition.



Fig.7. Khor Julfar looking northwards (2010). (Photograph: R. Llewellyn-Smith).

**(iv) Khor Hulaylah (Khor al-Rams)  
(25°50'N, 55°59'E)**

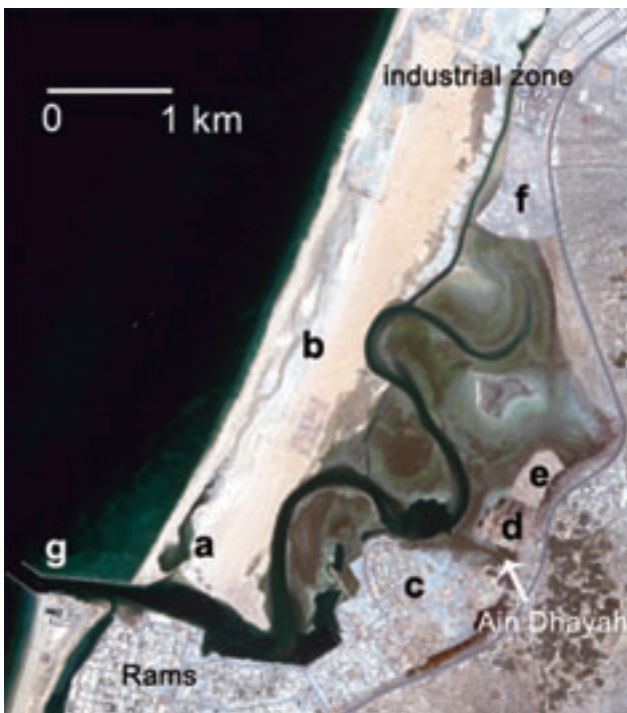


Fig. 8. Satellite image (2009) of Khor Hulaylah.

**Location and features**

The fourth wetland is a creek and marshland with extensive intertidal mudflats and mangroves (*Fig.9*), known locally as Khor Hulaylah, or Khor al-Rams. It joins with Khor Julfar at the town of Rams, close to the harbour and exit to the sea (*Fig.8*) and winds its way northwards, originally joining the sea again at Khor Khwayr. The building of an industrial complex and harbour since 2000, has now blocked this northern exit to the sea, with a sizeable portion of northern wetland area reclaimed for industrial use.

Nonetheless, the area of remaining wetland is 676 ha (as at August 2009), of which 167 ha is comprised of mangroves and 17 ha of intertidal mudflats.

The island of Hulaylah (*Fig.8,b*) forms a protective barrier on the seaward side of the creek. It is an ancient feature, as evidenced by an extensive distribution of archaeological sites over its surface, some dating back to the eighth century AD (Kennet, 1994). It is relatively wide and high, reaching an altitude of 14 m at its highest point and composed largely of fine calcareous quartz sand (Goudie *et al.* 2000). A smaller shallow water body, locally called Khor Ghantra (*Fig. 8, a*) occupies low ground along the foreshore.

A unique feature of this wetland is the occurrence of a series of brackish pools, influenced by the seepage of fresh water, just west of the main road at Dhayah (Llewellyn Smith, 2011). The geology maps for the area (Ellison *et al.* 2006) show that the pools are situated along the interface between the alluvial fan deposits (brought down by the wadis emerging from the Dhayah and Rahaba mountain front) and the marine deposits of Khor Hulaylah. The most prominent of the brackish pools is Ain Dhayah (Fig.8) where fresh water input has supported the growth of particularly dense and high mangroves (up to 6 m).

### Biodiversity

Preliminary studies to assess biodiversity in 2006 and 2007 revealed 26 species of plants and 122 species of animals (excluding birds). A study of UAE bird records combined with local observations reveal 197 different species for the Hulaylah area, around 43% of the total number of bird species recorded for the UAE. Further investigation into insects and marine life (especially sponges and fish) which have been little studied will increase the number of species.

### Marine life

Green turtles *C. mydas* are regularly sighted inside the khor, where extensive sea grass beds provide potential feeding areas. Turtle nesting and egg laying have been recorded on Jazirat Hulaylah beach. The winding channel contains a variety of sponges, false corals (*Zoanthus* sp.) and the pearl oyster *Pinctada radiata*. Adding further diversity are corals *Siderastraea savignyana*, *Platygyra daedalea*, *Favites flexuosa*, *Favia fava* and *Porites* sp. growing on the limestone boulders making up the outer harbour breakwater (Fig. 8,g), along with various species of reef fish. Dead shells of the Potamidid gastropod *Terebralia palustris* are common in this khor. They provide testimony to a once thriving live population and a major food source for prehistoric inhabitants as evidenced by their presence at archaeological sites on Hulaylah Island and just inland at Dhayah. Feulner (2000) suggests their early abundance may be linked to a period of more normal salinity in the Arabian Gulf, under a less arid climate, with the nearby mountains inducing precipitation and channeling it to the coast. The mangrove crab *Scylla serrata* is present. The uppermost intertidal gastropods *Potamides conicus* and the air-breathing *Melampus castaneus* are also present.

### Birds

This wetland is strategically important as it provides the first stopover feeding and resting area along the Gulf coast for migrating birds crossing southwards from Asia over the Straits of Hormuz and has the most extensive mudflats of any of the RAK wetlands. It supports a population of up to 600 Greater Flamingo *P. roseus* throughout the year. Other common birds include Western Reef Heron *E. gularis*, Grey Heron *A.*



Fig. 9. View northwards over Khor Hulaylah. (Photograph: R. Llewellyn-Smith).

*cinerea*, Striated Heron *B. striatus*, Ringed Plover *Charadrius hiaticula*, Greater Sand Plover *Charadrius leschenaultii*, Kentish Plover *Charadrius alexandrinus*, Greenshank *Tringa nebularia*, Socotra Cormorant *P. nigrogularis*, Black-necked Grebe *Podiceps nigricollis*, Black-winged Stilt *Himantopus himantopus* and Common Kingfisher *A. atthis*. Marsh Harriers *C. aeruginosus* can often be seen hunting low over the mangroves. Occasional winter sightings are also made of Great Spotted Eagle *Aquila clanga*. Crab Plovers *Dromas ardeola* are common in autumn and winter months. Spoonbills *Platalea alba* have been observed at the smaller Khor Gantra (Fig.8,a), a species not usually evident at the other three wetlands. Clamorous Reed Warbler *Acrocephalus stentoreus* and Moorhen *Gallinula chloropus* favour the mangroves and brackish pools on the east side of the khor.

### Vegetation

The reed grass *Phragmites australis* and sedge *Cyperus laevigatus* indicate the presence of brackish water pools on the eastern side of the khor. Extensive areas of sea rush *Juncus rigidus*, are present on the salt marsh, while on the drier saline ground, *Cressa cretica*, *Alhagi graecorum* and tamarisk species are common. This saltmarsh vegetation community is unique to this wetland and is not seen at Khor Julfar, Khor Ra's al-Khaimah or Khor Muzahmi, or indeed in the rest of the country.

### Ownership and habitat management issues

Khor Hulaylah is owned by the Government of Ra's al-Khaimah. Of the four wetlands, it is considered the most species diverse on account of its greater variety of habitat types. Unfortunately, the wetland lies in a narrow land corridor between the sea and mountains (approx. 6 km wide) that limits the land available for new housing and other developments. Consequently, expansion of Rams town has led to the reclamation of areas (Fig.8,c,d) in the late 1990s, along with the loss of mangroves and mudflats between 2007-2009 (Fig. 8,e & f).

In 2009, Khor Hulaylah was marked for no development on land use plans by the RAK

Municipality's Town Planning and Survey Administration. To consolidate this situation, protective legislation, governance, active conservation management and coordination between local institutions and other stakeholders is urgently recommended.

The mangroves and sea rushes, *J. rigidus*, on the eastern side of Khor Hulaylah have been extensively grazed by camels and have suffered obvious damage. A count over two days in 2007 revealed 92 and 88 camels respectively entering the area to feed. Studies coordinated by the author in 2006 showed the damage to mangroves caused by camels is through leaf defoliation, chewing of stems, trampling of seedlings and compaction of mud. Of 67 plants surveyed along a trial 100 m transect, 53% were either dead or severely grazed. Encouragingly, 16 % of plants were new healthy seedlings, suggesting that recovery would happen if camels were excluded. Hogarth (1999) records similar damage caused by camels and other livestock on mangroves in the Indus Delta, Pakistan. Camel grazing on this eastern side is reported to have stopped after 2010, although goats continue to feed on *J. rigidus*.

Other pressures include overgrazing on Hulaylah Island by camels and goats, and damage to wildlife through discarded fishing nets and rubbish. Crabs and the clam bivalve *Marcia flammea* are much collected for food. Future challenges will involve preventing any further loss of habitat through reclamation for development.

Of the four wetlands, Khor Hulaylah has the strongest cultural connection with local residents. Each bend and headland in the winding khor has a local name, and several interviewed residents revealed much local knowledge on fish and bird species. The fishing community generally keeps fishing outside the khor, in recognition of the importance of the wetland as a fish nursery and spawning area.

### Values

The ecosystem services provided to Ra's al-Khaimah by these wetland sites along with other values are significant and varied (Table 2 & 3). Their conservation and 'wise use' as advocated by the Convention on Wetlands of International Importance (Ramsar Convention) could play a key part in sustainable development programmes for the Emirate and contribute to human well-being.

### Recommendations for protection and further study

Three of the wetlands, Khor Ra's al-Khaimah, Khor Julfar and Khor Hulaylah, have no official protection status and their continued survival is at risk without this in place. Information on all sites is sufficient to call for their immediate protection and according

designation on land use plans, followed by careful habitat management to maintain their ecological effectiveness and to ensure the sustainable release of benefits to society (Table 2). An accepted method, adopted worldwide and increasingly in the UAE, is to create formal protected areas (nature reserves), managed using site-specific management plans and integrated into wider coastal zone management plans. As a starting point, preparation of a wetlands 'Master Plan' for Ra's al-Khaimah would provide a planning and management overview of all four sites in combination, helping to maximise benefits and minimise site degradation. For example, kayaking greatly disturbs feeding and roosting birds at Khor Muzahmi due to its open nature, and is better suited to the more enclosed mangrove channels at Khor Ra's al-Khaimah.

All four sites would probably qualify as Wetlands of International Importance (Ramsar sites), and their designation through the Wetlands Convention, which the UAE joined in 2008, would help boost their profile and importance.

Protection will re-emphasise the UAE's commitment to the Convention on Biological Diversity, the regional Convention on Conservation of Wildlife and its Natural Habitats in the Gulf Cooperation Countries, and the Convention on Migratory Species. In addition, given the increasing concerns of global climate change and growing evidence of the contribution of wetlands to regulating climate (MEA, 2005; Dudley *et al.* 2010), conserving these wetland ecosystems can provide a contribution to a UAE climate change mitigation strategy.

Future more systematic studies will help refine protection measures. Areas requiring further study are bird surveys at different seasons (especially during autumn and spring migrations), fisheries studies to determine species diversity and seasonal variation, water and sediment quality, insect studies, and sub-tidal marine ecology. A turtle study, particularly during the nesting season, is needed to assess the importance of Khor Muzahmi, Khor Julfar and Khor Hulaylah to these endangered animals. Work is needed to restore degraded areas, particularly the mangroves at Khor Hulaylah that have been overgrazed by camels.

A national level assessment of the status of UAE's wetlands is recommended to help focus attention back on these critical areas and provide decision makers with the latest information on status, biodiversity and pressures. The assessment would be made more powerful if combined with an effort to demonstrate the economic value of their direct and indirect services.

Approximately 1,500 ha of productive wetlands still remain in Ra's al-Khaimah, representing a sizeable and immensely valuable natural resource. These rich and diverse habitats should be maintained for present and future generations.

**Table 2. Ecosystem services provided by Ra's al-Khaimah's wetlands.**

Service categories	Specific services	Examples	Khor Muzahmi (300 ha)	Khor Ra's al-Khaimah (410 ha)	Khor Julfar (227 ha)	Khor Hulaylah (676 ha)
Provisioning	Food	Contribution to local fisheries by providing fish nursery & spawning grounds	✓	✓	✓	✓
Regulating	Climate regulation	Production of oxygen and carbon sequestration in mangroves, as well as carbon incorporated into mollusc and tubeworm (polychaete) shells and also directly as calcium carbonate in formation of oolitic sand and beach rock – all	✓ Mangrove area 1.2 ha.	✓ Mangrove area 230 ha	✓ Mangrove area 0.7 ha	✓ Mangrove area 167 ha
	Water purification	Mangroves role in retention & removal of excess nutrients & pollutants	✓	✓	✓	✓
	Erosion regulation	Retention of soils & sediments	✓	✓	✓	✓
Cultural	Recreation & tourism	Potential for recreational activities - birdwatching, kayaking etc.	✓	✓	✓	✓
	Aesthetic, landscape & heritage value	People find beauty, inspiration and relaxation	✓ Scenic view from high dunes overlooking wetland	✓ Scenic view from corniche, & surrounding high rise developments	✓ Scenic view from shoreline	✓ Dramatic mountain backdrop; traditional fishing harbour & strong cultural connection
	Education	Opportunities for raising awareness, education, training, research	✓ High dunes overlooking wetland would suit education viewpoint.	✓ Education potential in the heart of the city, easily accessible to local schools & visitors	✓ Combination with heritage tourism potential at Julfar historical site	✓ Related to coastal wetlands, salt marsh, traditional fishing history and local pearl project
Supporting	Nutrient recycling	Storage, recycling, processing of nutrients e.g. role of crabs in processing detritus	✓	✓	✓	✓
	Pollination	Habitat for pollinators	✓	✓	✓	✓

(adapted from MEA, 2005)

**Table 3. Wetlands of Ra's al-Khaimah: other properties & values.**

Value	Khor Muzahmi (300 ha)	Khor Ra's al-Khaimah (410 ha)	Khor Julfar (227 ha)	Khor Hulaylah (676 ha)
Stopover feeding & resting site for migrating birds	✓	✓	✓	✓
Notable biodiversity	✓ *Greater Flamingo; *Crab Plover; **Turtle nesting site on outer sand bar; Tens of thousands of Socotra Cormorant roosting on outer sand bar between April- August.	✓ *Greater Flamingo; Confirmed presence of Mangrove crab <i>Scylla serrata</i> ; Sea snail (darkly speckled through transparent shell) and tiny orange version, both <i>Haminoea</i> sp.	✓ *Greater Flamingo; **Turtle nesting; <i>Bulla arabica</i> (type locality); Rare plants <i>Mesembryanthemum nodiflorum</i> and <i>Limonium carnosum</i> ; Sea grass beds; Sea snail (darkly speckled through transparent shell) of <i>Haminoea</i> sp.	✓ *Greater Flamingo; *Crab Plover; diverse marine sponges; large areas of sea grass; corals & reef fish on outer breakwater; **turtle nesting on Hulaylah Island; Mangrove crab <i>Scylla serrata</i> ; pearl oyster <i>Pinctada radiata</i>
Archaeology value	-	✓ Shell middens & pottery sherds on the sand island of Nad Abu Tabl provide evidence of past occupation	✓ Ancient port of Julfar is an integral part of the lagoon on the south east bank.	✓ Settlement structures, shell middens, pottery sherds and ceramic fragments are evidence of 1,400 years of settlement history
Geodiversity / geomorphology/ hydrological diversity	✓ Dynamic outer sand bar; high sand dunes an ancient geological feature with prominent depositional layers evident; sandstone pavement on two islands	✓ Prominent sand dune of Nad Abu Tabl forming the most northerly extension of RAK's sand desert.	✓ Sand bar and lagoon system	✓ Protective barrier island; sandstone pavement & cliffs; salt marsh habitat; brackish springs/seepages
<p>* these are 'flagship species' which have great symbolic and awareness raising value  ** Green turtle is listed as Endangered, and Hawksbill Turtle as Critically Endangered in the IUCN Red List of Threatened Species.</p>				

## Acknowledgements

The Government of Ra's al-Khaimah is acknowledged for supporting this work. The author is thankful to Mustafa Khalifa for his assistance in the field and to the following for their habitat observations and help with species identification at Khor Hulaylah during 2006 and 2007: Simon Aspinall, Richard Hornby, Gary Feulner, Ron Loughland, Ayoob Hassan al Ghafari and Hannah and Jens Eriksen. Christian Velde, Imke Moellering and Hilal Ahmed of the RAK Department of Antiquities and Museums are gratefully acknowledged for archaeological information related to Hulaylah island, Khor Julfar, and Nad Abu Tabl at Khor Ra's al-Khaimah. The author is grateful to Dr Basheer Ali, Gary Feulner and Richard Hornby for their valuable comments on early drafts of this paper.



## References

- Aspinall, S.A. (1996). Time for a protected area network in the UAE. *Tribulus* 6.1. 5-9.
- Dudley, N., Stolton S., Belokurov A., Krueger L., Lopoukhine N., Mackinnon M., Sandwith T., and Sekhran N. (eds.) (2010). Natural Solutions: Protected areas helping people cope with climate change. - IUCN, WCPA, TNC, UNDP, WCS, The World Bank and WWF, Gland, Switzerland, Washington DC and New York, USA.
- EAD (2007). Marine and Coastal Environment Sector Paper. Environment Agency Abu Dhabi, United Arab Emirates.
- Ellison, R.A., Woods, M.A., Pickett, E.A., and Arkley, S.L.B. (2006). Geology of the Al Rams Area 1:50,000 map sheet, 50-1, United Arab Emirates. - Keyworth, Nottingham: British Geological Survey.
- Evans, M.I. (ed.) (1994). **Important Bird Areas of the Middle East**. - Birdlife Conservation Series No. 2. Birdlife International, Cambridge, UK.
- Feulner, G.R. (2000). The large mangrove mud creeper *Terebralia palustris* (Linnaeus, 1767) in non-mangrove environments in southeastern Arabia. *Tribulus* 10.2: 15-27.
- Feulner, G.R. (2002). The mangrove crab *Scylla serrata* in the UAE. *Tribulus* 12.1: 29.
- Feulner, G.R. and Hornby, R.J. (2006). Intertidal molluscs in UAE Lagoons. *Tribulus* 16:2:17-23.
- Feulner, G.R. (2007). UAE specimens clarify marine gastropod taxonomy. *Tribulus* 17:103.
- Goudie, A.S., Parker A.G., and Farraj A. Al. (2000). Coastal change in Ras Al Khaimah (United Arab Emirates): a Cartographic analysis. - *The Geographical Journal*, Vol. 166, No.1, March 200, pp.14-25.
- Hansman, J. (1985). Julfar, An Arabian Port. Its Settlement and Far Eastern Ceramic Trade from the 14th 18th Centuries. - Royal Asiatic Society Prize Publication Fund, Vol. xxii.
- Hellyer, P. and Aspinall, S. (eds.) (2005). **The Emirates - A Natural History**. Trident Press, 428 pp.
- Hogarth, P., and Beech M. (2001). A first modern record of the mangrove crab, *Scylla serrata*, in the UAE and south-eastern Arabian Gulf. *Tribulus*. 11.2: 30.
- Hogarth, P.J. (1999). **The Biology of Mangroves. The Biology of Habitats**. Oxford, New York: Oxford University Press. 228 pp.
- Hornby, R.J. (1997). A survey of the habitats, invertebrate fauna and environmental sensitivity of the mainland coast of the UAE, with information on status and distribution of crustaceans. *Tribulus* 7.2:11-17.
- Jongbloed, M., Feulner, G.R., Böer, B and Western, A.R. (2003). **The Comprehensive Guide to the Wild Flowers of the United Arab Emirates**. Environmental Research and Wildlife Development Agency, Abu Dhabi, UAE.
- Kennet, D. (1994). Jazirat al-Hulaylah - early Julfar. *Journal of the Royal Asiatic Society, Series 3,4,2* pp. 163-212.
- King, G.R.D. (1990). Excavations of the British team at Julfar, Ra's al-Khaimah, United Arab Emirates: Interim Report on the first season (1989). *Proceedings of the Seminar for Arabian Studies* 20. 79-93.
- King, G.R.D. (1991). Excavations of the British team at Julfar, Ra's al-Khaimah, United Arab Emirates: Interim Report on the second season (1990). *Proceedings of the Seminar for Arabian Studies* 21. 123-134.
- King, G.R.D. (1992). Excavations of the British team at Julfar, Ra's al-Khaimah, United Arab Emirates: Interim Report on the third season. *Proceedings of the Seminar for Arabian Studies* 22. 47-54.
- Llewellyn-Smith, R. E. (2011). Fresh water input to Khor Hulaylah: an unusual feature of Ra's al-Khaimah's wetlands. *Tribulus* 19:154-157.
- Malaquias, M., and Reid, D.G. (2008). Systematic revision of the living species of Bullidae (Mollusca: Gastropoda: Cephalaspidea) with a molecular phylogenetic analysis. *Zoological Journal of the Linnean Society*, 153, 453-543.
- MILLENNIUM ECOSYSTEM ASSESSMENT(MEA) (2005). Ecosystems and Human Well-Being: Wetlands and Water Synthesis. World Resources Institute, Washington, DC.
- RAMSAR (2009). Strategic framework for the list of wetlands of international importance. Edition 2009. Ramsar Secretariat, Gland, Switzerland.
- Richardson, C. and Aspinall, S.(1998). **The Shell Bird Watching Guide to the United Arab Emirates**. Hobby Publications, Liverpool, UK and Dubai, UAE.
- ROPME (2005). Summary of the State of the Marine Environment Report - 2003. ROPME/GC-12/001. Regional Organization for the Protection of the Marine Environment, Kuwait, 31pp.
- Scott, D.A. (ed.) (1995). **A Directory of Wetlands in the Middle East**. Gland, Switzerland. IUCN and Slimbridge, UK.

**Robert Llewellyn-Smith,**  
32, Pinewoods,  
Church Aston, Newport Shropshire  
TF10 9 LN, UK  
email: Rllewellynsmith@yahoo.co.uk

# Assessing the need for shark management initiatives in the United Arab Emirates

by Rima W. Jabado



Collecting data from a Grey reef shark (*Carcharhinus amblyrhynchos*) at the Jubail Fish Market in Sharjah.

## Introduction

Around the world, shark populations are being affected both directly and indirectly by anthropogenic activities (Camhi *et al.*, 1998; Stevens *et al.*, 2000). Worldwide, some shark populations have declined by 90% in the past fifty years and the United Nations estimates that up to 73 million sharks are still being killed every year (NMFS, 2005; Lack & Sant, 2006). The K-selected life history strategies of most sharks, which include longevity, slow growth, late maturity, long gestation, low reproductive rates and low natural mortality, results in a slow intrinsic rate of population increase and makes their recovery potential very low (Manire & Gruber, 1990; Camhi *et al.*, 1998; Stevens *et al.*, 2000; Otway *et al.*, 2004; Shark Advisory Group & Lack, 2004; NMFS, 2005). As a consequence, many populations are now depleted and some species are considered threatened or critically endangered. Since they are keystone species, a decline in shark populations can have tremendous consequences on ecosystems (Stevens *et al.*, 2000; Robbins *et al.*,

2006; White & Kyne, 2010) as well as unpredictable effects on the abundance of commercially important fish stocks (Stevens *et al.*, 2000; Watts, 2003; Watts & Wu, 2005).

In 1999, in response to the global decline in shark populations, the United Nations Food and Agricultural Organisation (FAO) Committee on Fisheries developed an International Plan of Action for the Conservation and Management of Sharks (IPOA) within the context and framework of the Code of Conduct for Responsible Fisheries (CCRF) (FAO, 1999). The aim of this plan of action was to identify the measures needed to promote sustainable shark management across states with shark fisheries. It also called upon signatory nations to produce a Shark Assessment Report as well as develop and implement national plans of actions by 2001 (Fowler, 2005). While the United Arab Emirates (UAE) has been a signatory to the CCRF since 1999, there is still little information available on the status of the national shark fishery.

The lack of detailed quantitative information on the location and activities of the artisanal fishery, the species composition of landings and trade as well as the basic life history information of targeted species hampers any attempts at managing the shark fishery.

Anecdotal information as well as preliminary data collected from fishermen suggest that shark landings in the UAE have increased in the past 10 to 15 years, which raises concerns about potential stock depletions in the near future unless appropriate and scientifically based management actions are implemented. Furthermore, the UAE currently ranks amongst the fifth largest fin exporting countries in the world (Fowler *et al.*, 2005; Hareide *et al.*, 2007; WildAid, 2007). It therefore plays a crucial role in the international fin trade and serves as an export hub for the Arabian and eastern African region. It is, therefore, increasingly important to quantify and characterise this trade in order to gain a better understanding of exploitation rates and to accurately assess populations.

Even though sharks have long been documented in the Arabian Gulf (Blegvad & Loppenthin, 1944; Basson *et al.*, 1977), currently the only published records of sharks in this body of water are based on market observations (Tourenq *et al.*, 2007; Moore *et al.*, 2010), demersal fisheries surveys in Iran, Qatar and Kuwait (Sivasubramaniam, 1981; Sivasubramaniam & Ibrahim, 1982; Bishop, 2003; Valinassab *et al.*, 2006; FAO, 2009a) and extrapolations from species recorded in the Indian Ocean (Carpenter *et al.*, 1997). These efforts yielded important faunistic lists and species catalogues which provided information on species distribution and their incidence in fisheries. Although they are all limited observations, they possess a relative value because they remain the only measures of abundance levels of sharks in the region. There remains, however, a general lack of knowledge of how many species of sharks are found in the region, which are the main species in the catches, what the real sizes of the catches are and the amount of fishing effort from the fishermen in the region. Indeed, there are no studies or data about the definition of the stock of any elasmobranchs (all species of sharks and rays) in the region.

This study arose from the need to establish an overview and baseline data of the present status of sharks in the UAE and will lay foundations for any future national management plans. It will also serve as the first assessment of sharks in the UAE investigating the fishery; species composition, relative abundance and distribution; feeding ecology; and contributions to the international fin trade.

### **Project objectives and methods used**

The aim of each component of the project are detailed below with a short description of the method used.

1. *To gain a comprehensive understanding of the*

*shark fishery in the UAE by investigating the artisanal fishery and documenting gear characteristics, catch locations, seasonality of catch, changes in catch levels, fishery targets and perceptions of fishermen.*

Interviews with fishermen were conducted in June, July and September 2010. A semi-structured questionnaire was carefully designed to increase knowledge of the interactions between fishermen and sharks. All questionnaires were translated into Arabic and interviews were conducted with individual fishermen at landing sites and fishermen's cooperatives across the UAE. Data collected included personal information, type of fishing vessel and gear characteristics, shark species composition, catch seasonality and locations, perceptions of change in shark stocks, uses of sharks, the conservation value of sharks and the involvement of each fisherman in government decisions related to fisheries. The semi-structured nature of the interviews allowed fishermen to expand on the open-ended questions and provide an in-depth account of their experience with sharks and the fishery in the region.

2. *To develop a list of confirmed shark species occurring along the Arabian Gulf coast of the UAE while providing an overview of the abundance, patterns of distribution and biology of these species.*

Market and landing site surveys have been undertaken since October 2010 to assess the status of commercially important shark stocks and determine the volume, species composition, size composition and sex ratios of sharks landed. These include the sites with the largest concentration of sharks, located in Abu Dhabi, Dubai, Sharjah and Ra's al-Khaimah. Landing sites are visited twice a month and each visit is between three to four hours, depending on the quantities of sharks landed. All shark landings are identified to species level, measured to the nearest millimetre (total length), sexed, maturity assessed (for males) and genetic samples collected.

3. *To assess the status of commercially important shark stocks through a fishery independent survey.*

A longlining programme was initiated in February 2011 to allow for comparison of data from market specimens with sharks caught while fishing in Arabian Gulf waters. Demersal longlines are set in Dubai and Abu Dhabi on a rotation basis in order for each area to be sampled seasonally. A line (800 metres in length) consisting of up to 80 gangions of 2.5 m length with circle hooks. Data collected from all sharks includes species identification, measurements, sex, tissue samples and each specimen is tagged with conventional dart tags before being released.

4. *To determine the dietary composition of two commercially important species: the milk shark, *Rhizoprionodon acutus*, and the slit-eye shark, *Loxodon macrorhinus*.*



Large number of thresher sharks (*Alopias* sp.) at the Deira Fish Market in Dubai. These specimens were caught in Oman and transported on trucks to the UAE to be auctioned for their fins.

Preliminary data showed that two of the main species targeted by the commercial fishery are the milk-shark and the slit-eye shark. There are concerns that fishing is over-exploiting stocks of these species and it is crucial, therefore, to collect data on their life-history, population status and diet. An analysis of the stomach contents allows the identification of important food resources and investigation of ontogenetic changes in their diets. A random subsample of the observed landings was obtained for dissection and collection of additional biological information. All specimens were measured to the nearest millimetre (total length) and sexed. The stomach contents were removed and identified to the lowest possible taxon and weighed to the nearest 0.1g on an electronic balance.

5. *To quantify and characterise the trade in shark fins originating from the UAE, gain a better understanding of exploitation rates and accurately assess directed fisheries and their impact on a range of shark species.*

Genetic methods are being utilised to target an approximately 650 bp region of the mitochondrial cytochrome c oxidase I (COI) gene. During market and landing site surveys, data on the origin of the sharks is recorded while tissue samples from fresh or dried fins are collected and preserved in 95% ethanol and frozen at  $-20^{\circ}$ . The long-term data collected will allow the evaluation of differences in catch origins, volumes and species compositions. Due to limited time and funding, it will not be possible to analyse all samples collected in the field. A random sample of tissue collected from various shark fins originating from different parts of the region will be chosen. This will allow the detection of

potential illicit trade, the management of over-exploitation of harvested species as well as the formulation of conservation strategies for individual species that are of conservation concern.

## Conclusion

This research project is the first assessment of sharks in the UAE. Results will serve as a reference to managers, fisheries scientists and other stakeholders to prioritise future research as well as to lay foundations for the development and implementation of national management plans for the protection and conservation of sharks as well as regulations on the exploitation of these stocks. It is expected that this project will be completed by January 2013 at which time all results and data will be disseminated to the scientific community and government officials.

## Acknowledgements

The author would like to thank all the volunteers that have been involved in this project as well as the fishermen and workers at various market sites who have allowed the data to be collected. Also thank you to the United Arab Emirates University, the Emirates Natural History Group and the Emirates Marine Environmental Group for funding various parts of the project.

This research is undertaken as part of a PhD project at the United Arab Emirates University under the supervision of Dr. Saif M. Al Ghais, Prof. Waleed Hamza and Dr. Aaron C. Henderson.



In Abu Dhabi, sharks are landed by the fishermen early in the morning and laid out for the auction to take place.

## References

- Basson, P. W., Burchard, I. E., Hardy, J. T., & Price, A. R. G. (1977). **Biotores of the Western Arabian Gulf**. (p. 284). Dhahran, Saudi Arabia: ARAMCO, 284 pp.
- Bishop, J. M. (2003). History and current checklist of Kuwait's ichthyofauna. *Journal of Arid Environments*, 54, 237-256.
- Blegvad, H., & Loppenthin, B. (1944). **Fishes of the Iranian Gulf**. Copenhagen, Denmark: Einer Munksgaard.
- Camhi, M., Fowler, S. L., Musick, J. A., Brautigam, A., & Fordham, S. V. (1998). **Sharks and their relatives: Ecology and conservation**. IUCN/SSC Shark Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.
- Carpenter, K. E., Krupp, F., Jones, D. A., & Zajonz, U. (1997). **Living marine resources of Kuwait, Eastern Saudi Arabia, Bahrain, Qatar and the United Arab Emirates**. Rome: FAO.
- FAO (1999). *International Plan of Action for reducing incidental catch of seabirds in longline fisheries. International Plan of Action for the conservation and management of sharks. International Plan of Action for the management of fishing capacity*. (p. 26). Rome, Italy: Food and Agriculture Organisation of the United Nations, 26 pp.
- Fowler, S. (2005). The international and national frameworks for conservation and management of sharks: recommendations for Ecuador. *Contribution to Ecuador's draft National Plan of Action for the Conservation and Management of Sharks*. Quito, Ecuador: IUCN.
- Hareide, N. R., Carlson, J., Clarke, M., Clarke, S., Ellis, J., Fordham, S., Fowler, S., Pinho, M., Raymakers, C., Serena, F., Seret, B., & Polti, S. (2007). **European shark fisheries: a preliminary investigation into fisheries conversion factors, trade products, markets and management measures**. European Elasmobranch Association.

- Lack, M., & Sant, G. (2006). *World shark catch, production and trade 1990-2003*. TRAFFIC Oceania, Department of Environment and Heritage, Australia.
- Manire, C. A., & Gruber, S. H. (1990). Many sharks may be headed toward extinction. *Conservation Biology*, 4(1), 10-11.
- Moore, A. B. M., White, W. T., & Pierce, R. (2010a). Additions to the shark fauna of the Persian (Arabian) Gulf (Carcharhiniformes: Hemigaleidae and Carcharhinidae). *Zoology in the Middle East*, 50, 83-88.
- National Marine Fisheries Service (2005). *Report to Congress pursuant to the Shark Finning Prohibition Act of 2000* (Public Law 106-557). U.S. Department of Commerce, National Oceanic and Atmospheric Administration.
- Otway, N. M., Bradshaw, C. J. A., & Harcourt, R. G. (2004). Estimating the rate of quasi-extinction of the Australian grey nurse shark (*Carcharias taurus*) population using deterministic age- and stage-classified models. *Biological Conservation*, 119, 341-350.
- Robbins, W. D., Hisano, M., Connolly, S. R., & Choat, H. J. (2006). Ongoing collapse of coral-reef shark populations. *Current Biology*, 16, 2314-2319.
- Shark Advisory Group, & Lack, M. (2004). **National Plan of Action for the Conservation and Management of sharks**. Australian Government Department of Agriculture, Fisheries and Forestry.
- Sivasubramaniam, K. (1981). A report on the demersal resources of the Gulf and Gulf of Oman. In U. N. D. P. Food and Agriculture Organisation of the United Nations (Ed.), *Regional Fishery Survey and Development Project: Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates* (p. 139). Rome: FAO, 139 pp.
- Stevens, J. D., Bonfil, R., Dulvy, N. K., & Walker, P. A. (2000). The effects of fishing on sharks, rays, and chimaeras (Chondrichthyans), and the implications for marine ecosystems. *ICES Journal of Marine Science*, 57, 476-494.
- Tourenq, C., Shuriqi, M. K., Foster, G., Foster, K., Chellapermal, C., Lebon, S., & Rei, D. (2007). A note on elasmobranches (sharks and rays) of UAE and Musandam, Oman, with special mention of Bowmouth Guitarfish or Shark Ray (*Rhina ancylostoma*). *Tribulus*, 17, 63-69.
- Valinassab, T., Daryanabard, R., Dehghani, R., & Pierce, G. J. (2006). Abundance of demersal fish resources in the Persian Gulf and Oman Sea. *Journal of the Marine Biological Association of the UK*, 86(06), 1455-1462.
- White, W. T., & Kyne, P. M. (2010). The status of chondrichthyan conservation in the Indo-Australasian region. *Journal of Fish Biology*, 76, 2090-2117.
- Watts, S. (2003). *Shark finning: Unrecorded wastage at a global scale*. WildAid, Co-Habitat report.
- Watts, S., & Wu, V. (2005). *At rock bottom: sharks of the eastern tropical Pacific*. WildAid.
- WildAid (2007). *The end of the line? Global threats to sharks*. WildAid.

**Rima Jabado**  
 GulfElasmo Project  
 PO Box 29588,  
 Dubai, U.A.E.  
 e-mail: [rjabado@uaeu.ac.ae](mailto:rjabado@uaeu.ac.ae)

# A 17th C. Portuguese description and map of Dibba in south-east Arabia<sup>1</sup>

by Dr Geoffrey King



Plate 1: De Resende's illustration of Dibba facing westward from the sea

Dibba is a growing town on the coast of the Musandam Peninsula, shared between the United Arab Emirates and the Sultanate of Oman and on whose border it lies. Its fortresses were once its principal features but they have long since vanished. Yet in the 17<sup>th</sup> century, Dibba's defences were second only to those of Suhâr among the fortresses of the northern Bâtina coast of Oman and of what was later to become the United Arab Emirates. We know of the fortresses of Dibba in some detail because, in 1632, King Philip IV of Spain (who was also Philip III of Portugal and much else besides through his Hapsburg inheritance) ordered the mapping of all of the fortresses within his Portuguese dominions in east Africa, Arabia and the Far East. Collectively, this vast area was known as the *Estado da India Oriental* with its capital at Goa in India.

Until the coming of the Portuguese to south-east Arabia, the maps of this region were rare and included the Peutinger Table, based on a 1<sup>st</sup> century BC source, the Ptolemy maps of ca 120 AD compiled at Alexandria in Egypt, the world map of al-Idrîsî compiled in Sicily in the mid-12<sup>th</sup> century, and the map that was produced as a result of Chinese expeditions

sent into the western Indian Ocean in the early 15<sup>th</sup> century.

With the establishment of Portuguese dominion in south-east Arabia and the Gulf in the early 16<sup>th</sup> century, the level of recording of the area in terms of mapping became increasingly precise. Thus, a map of 1561 by Giacomo de Gastaldi made at Venice and depending on Portuguese information about the Oman Peninsula shows places not mentioned in earlier records. These include "*C. Mashandam*" (Musandam) and "*Corfan*" (Khawr Fakkân)<sup>2</sup>. An Atlas by Lázaro Luis drawn at Lisbon in 1563 also gives new information, recording a series of Portuguese fortresses in south-east Arabia that include Julfâr (in Ra's al-Khaimah), Khasab and Kumzâr (both in Musandam) and Dibba. An anonymous illustrated manuscript, entitled the *Livro de Lizuarte de Abreu* and dated to ca 1564, shows the mountains of the Oman Peninsula with a deep *khawr* which is an accurate rendering of the area's landscape. These illustrations all reflect contemporary knowledge of the places and the landscape of south-east Arabia in the mid-16<sup>th</sup> century and arise from the Portuguese explorations of preceding decades.

<sup>1</sup> An earlier version of this paper was presented at a conference in Al Ain, organised by the Zayed Centre for History and Heritage on 7<sup>th</sup> April, 2005. The research on which it is based was made possible by a grant generously provided by the British Academy to visit libraries in Portugal and in Holland.

<sup>2</sup> G.R. Tibbetts, *Arabia in Early Maps*, Falcon-Oleander, Cambridge (1978), p. 45-46. The Chinese map prepared before 1433 for the Ming admiral Zheng He uses Chinese names or Chinese transliterations of the local place-names used in SE Arabia.

However, a far more precise level of mapping was compiled in 1632 for King Philip IV as a result of an order he sent to his administrators in Goa, asking his officials there to record the location of the towns and fortresses of Portuguese India, the *Estado da Índia Oriental*. This constituted the Indian Ocean periphery from east Africa to the eastern coast of China. Goa was the centre of government of the *Estado*.

The resulting atlas includes illustrations and detailed textual descriptions of each main place in the *Estado*. It is a summary of the geography and military structure of Portugal's eastern empire as it was in 1632-1635. Its fortresses then ran from Sofala in Mozambique to Mombasa in Kenya, to the Oman Peninsula, to Hurmûz, to Goa, the Portuguese capital in India, to Sri Lanka and then via Malacca to Macao in southern China. As a result of King Philip's command, we have preserved a series of plans that show the fortresses still held by the Portuguese in 1632-1633 in south-east Arabia and Hurmuz on the Iran coast opposite, which was no longer in their hands by this date<sup>3</sup>.

The Portuguese fortresses in south-east Arabia included those at Qaryat, Masqat, Matrah, al-Sîb, Barka, Suhâr, Khawr Kalba, Khawr Fakkân, al-Badi'îya, "Mada" (once thought to be Murbah, but now tentatively identified as Dhadnah<sup>4</sup>) and Dibba, all of which are now in the territory of the Sultanate of Oman or of the United Arab Emirates.

The task commissioned by King Philip was supervised at Goa by the Conde de Linhares, the Viceroy of the *Estado*. The result of this project was the atlas known as the *Livro das Plantas de todas as Fortalezas, Cidades e povoações do Estado da Índia Oriental*, a work which survives in a number of versions. We therefore have a fairly precise record of the fortresses that the Portuguese had built over the previous century along the coasts of south-east Arabia as well as on the coasts of Africa, India and beyond, in China.

The *Livro* was not for general circulation and it should probably be regarded as having been a secret state document, confined in terms of access to Portuguese/Spanish government officials around King Philip. This is confirmed by the circumstances of its commissioning whereby the King commanded the Viceroy at Goa, the Conde de Linhares, to provide the

following:

"..the descriptions of all the coasts, ports, harbours and anchorages of this State (i.e., the *Estado da Índia Oriental*), each government and captaincy separately..."<sup>5</sup>

In effect, what he required was a survey of all of the Portuguese possessions between Africa and China - possessions which had now passed into his hands in his capacity as King Philip III of Portugal.

The *Livro* project arose because the King appears to have decided that he needed a record of the sprawling Portuguese Empire along the coasts of the Indian Ocean and beyond, to understand in a single concise document the position of the Portuguese in the east and the territories that he ruled. This was by no means an academic exercise. From the Americas to east Asia, the Dutch and the English were raiding and encroaching on territories where Spain and Portugal had once held undisputed dominion. King Philip, as ruler of all of this, must have been well aware of the significance of the catastrophic loss in 1622 of Hurmûz, Portugal's former Arabian Gulf power base which had been taken by the Safavid Shah 'Abbâs I with English support. In the same period, the Dutch were becoming a separate competitor for Portugal's eastern trade. Having the rule of such vast and important territories without a clear idea of what they comprised made the *Livro* the King requested a document of state necessity, especially in the complex circumstances of the early 17<sup>th</sup> century.

After issuing orders to de Linhares at Goa in 1632 for the compilation of the *Livro* atlas, the King became increasingly impatient for its completion and pressed de Linhares on the matter in a letter of December, 1633. One must recall the slowness of communications, not only because of the great distance between Spain and Goa but also because the exchange of messages depended on a ship-sailing schedule tied to the Indian Ocean monsoon and its twice yearly change of direction. This dictated navigation and communication.

De Linhares replied to the King's December 1633 letter that he had given the *Livro* task to António Bocarro, the keeper of the *Torre de Tombo da Índia* at Goa and official Chronicler of the *Estado da Índia Oriental* and that the matter was in train<sup>6</sup>.

<sup>3</sup> The inclusion of Hurmuz is anachronistic as it had been lost to Safavid Iran in 1622. However, it had been central to Portuguese regional power and it remained a place they probably hoped to recover. Such a key fortress could not be left out if King Philip was to be able to comprehend the full scale of Portugal's past, current and potential future in the East.

<sup>4</sup> Dr M.C. Ziolkowski of Fujairah, who has examined Later Islamic sites along the eastern coastline of the United Arab Emirates, from Khawr Kalba to Dibba and who excavated the Portuguese fort at al-Badi'îya, has identified a possible site at Dhadnah which is between al-Badi'îya and Dibba. This may also be a candidate for identification as the lost "Mada" fortress site.

<sup>5</sup> Armando Cortesão and Avelino Teixeira da Mota, *Portugaliae Monumenta Cartographica. Comemorações do V Centenario da Morte do Infante D. Henrique*, Imprensa Nacional-Casa da Moeda, Lisbon (1960; reproduced in facsimile, 1987), V, p. 60.

<sup>6</sup> António Bocarro was a "new Christian", i.e., a Jew forced to convert. He served with the Portuguese fleets in the Indian Ocean and lived for some time at Cochin which had a major Jewish community. He returned to Judaism in ca 1610 but later recanted. He was appointed chronicler and keeper of the *Torre de Tombo da Índia* at Goa by the Conde de Linhares. See Armando Cortesão and Avelino Teixeira da Mota, *op. cit.*, V, pp. 59-69.



The process of the preparation of the *Livro* seems to have caused a degree of resentment towards Bocarro on the part of the main contributor to the *Livro*, Pedro Barreto de Resende, the Secretary of de Linhares. Because of the pressure that was put on de Linhares by the King for the completion of the task, Bocarro in effect requisitioned work that de Resende was already doing on the Portuguese possessions in the *Estado da Índia Oriental*. De Resende apparently took a dim view of this but he gained some degree of satisfaction subsequently by preparing a second edition of the *Livro* that claimed to correct Bocarro's more hasty work.

The manuscript of the *Livro* that was prepared under Bocarro's direction at Goa was sent in two copies to King Philip *via* Lisbon. The consequences of the speed demanded by King Philip are explained politely but clearly in the letter that Bocarro sent to the King on de Linhares's behalf, dated 17<sup>th</sup> February, 1635. He explains that the maps of the fortresses in the report should be treated with caution and he is quite open about their defects. However, his letter emphasises that the written reports were precise and made up for any defects in the illustrations.

This point must be stressed, for it cannot but affect how we assess the illustrations of the fortresses as a whole, including those on the Bâtina coast of the United Arab Emirates and of Oman, the primary concern of this discussion. Bocarro's letter is a useful health warning on the reliability of the illustrations and implicitly blames the King's own impatience for the defects of the work. In his letter of 17<sup>th</sup> February, 1635, Bocarro wrote diplomatically but firmly to the King on behalf of de Linhares:

"The Conde de Linhares, Viceroy, charged me to give effect to a letter of Your Majesty ordering him to send to Your Majesty these plans of all the Fortresses in this state, with the particular descriptions of everything that is in them, which knowledge is needed to give information of everything that is in them, which knowledge is needed to give information of all the things that should be done to improve them. And although to carry this work to suitable perfection it was necessary to survey in great detail each of the Fortresses, Cities, and Towns, in order to see or consider all the said matters, and it was not possible all the things to do everything while remaining in this City [Goa] with the custody of the Torre do Tombo and also the duty of writing the chronicles of the events of this State [*i.e.*, the *Estado da Índia Oriental*], in accordance with Your Majesty's urgent order that all the information required be sorted out,

I now present and send it to Your Majesty in this volume, in two drafts, affirming that even the great labour which it cost me was not sufficient to perform it in the manner which I intended and desired, with the plans oriented and measured out, and drawn to scale, which was not possible for the great lack of persons skilled in these arts in this State, and the fortresses being so many, and I have attempted to make good their defects in the description, which may be fully trusted, while no more is to be expected from the Plans of the Fortresses and Cities than their form and figure, since in some the measurements are uniformly taken in proportion, while in others they have been less precisely determined; nor is the number of cannon painted in the plans to be accepted unless it is confirmed by the text..."<sup>7</sup>

Bocarro's letter is a masterly list of excuses, meaning, politely, "Yes, Your Majesty, we know it is not right but, under-resourced as we are, despite your impatience, we have given a result and we have made up for our defective plans by doing good descriptions."

The atlas and the accompanying text of the *Livro* provides a snap-shot of the fortresses in the hands of the Portuguese in the period before 1632-3 and it survives in a number of recensions. The oldest MS is in the Biblioteca Pública at Évora and it is taken to be either one of the two MSS sent to Philip IV from Goa by de Linhares or a copy from the originals made at Goa.

The Evora MS includes accounts and plans of the Portuguese fortresses in northern Oman and Musandam: these are *Soar* (Sohar), *Corfacão* (Khawr Fakkân), *Quelba* (Khawr Kalba); *Libédia* (al-Badi'iyá); *Mada* (Dhadnah or Murbah); and *Doba* (Dibba). From Dibba on the borders of Musandam, Bocarro's list jumps to *Dio* (Diu) in western India<sup>8</sup>. The same places are recorded in other recensions of Bocarro's work<sup>9</sup>.

A rather different list is given by de Resende in his revision of the *Livro* entitled *O Livro do Estado da Índia Oriental* completed in *ca* 1636, compiled, as we have seen, because de Resende appears to have been annoyed at the inaccuracies in Bocarro's work. De Resende's MS of *ca* 1636 is in the Bibliothèque Nationale in Paris<sup>10</sup> and gives the following list of places in northern Oman, the United Arab Emirates and the Gulf: *Soar* (Sohar), *Quelba* (Khawr Kalba); *Corfacão* (Khawr Fakkân), *Libédia* (al-Bid'iyá); *Mada* (Dhadnah or Murbah); *Doba* (Dibba); *Ormuz* (Hurmûz); *Bacorá* (al-Basra); and *Ilhas Barem* (Islands of al-Bahrayn). De Resende's map then jumps to Diu in India and continues to the east.

<sup>7</sup> Armando Cortesão and Avelino Teixeira da Mota, *op. cit.*, p. 60 after Barbosa Machado, Bibliotheca Lusitana, Lisbon (1741), t. I, pp. 221-2.

<sup>8</sup> Cortesão and da Mota, *op. cit.*, V, p. 61.

<sup>9</sup> Cortesão and da Mota, *op. cit.*, V, p. 62-63; and p. 63 for a copy made in Lisbon *ca* 1635, now in the Bibliotheca Nacional, Madrid made by João Teixeira Albarnaz I; *ibid.*, p. 63 for a copy made in Lisbon by António de Maris Carneiro in 1639, now in the Bibliotheca Nacional, Lisbon.

<sup>10</sup> *Livro do Estado da Índia Oriental*, Bibliothèque Nationale, Paris. It has been suggested that illustrations are not by de Resende but by an anonymous artist. See Cortesão and da Mota, *op. cit.*, V, p. 66.

The same order is followed in the British Library MS of de Resende's work of 1646<sup>11</sup> but with more places marked as follows: *Soar* (Sohar), *Quelba* (Khawr Kalba); *Corfacão* (Khawr Fakkân), *Libédia* (al-Bidi'ya); *Mada* (Dhadnah or Murbah); *Dobo*, *Doba* and *Mocombi* (Dibba); *Ormuz* (Hurmûz); *Bacorá* (al-Basra); map of India; *Ilhas Barem* (Islands of al-Bahrayn); the list then continues to *Dio* (Diu) in India, South East Asia and the Far East.

The fortifications shown at Dibba are particularly interesting. They are more complex than those at al-Bidi'ya, Khawr Fakkân, Khawr Kalba or 'Mada'. Indeed, only the fortress at Suhâr surpasses that at Dibba among those of south-east Arabia shown in the *Livro* in its various recensions.

In a version of the *Livro* of 1646, sufficient is shown that corresponds to modern Dibba to allow us to assume that the map is a fairly precise record of the place in the early 17<sup>th</sup> century<sup>12</sup>. To accompany this illustration of Dibba we have a description of the town from the original *Livro* text sent to King Philip<sup>13</sup>:

"The fortress of Doba [Dibba] is two leagues from Libédia [al-Bidi'ya], northwards along the coast. It is built in the shape of a square with four round bastions in the corners and an artillery tower in the middle with a well. Each wall is seven bracas long and four in length and eleven palmos in width. It is made of stone and has parapets. Inside the fortress there is a house for the Captain, a Church and an underground warehouse for ammunition; there are hollow spaces among the bastions for storing provisions. As well as this, the fortress has an outer fence which is very long and is built in the shape of a square with five bastions, one of them over the gate and the other four in the corners. The gate is used as a guard's quarters. Each wall is 25 bracas long and two and a half bracas high; it is made of adobe with loopholes because there are no parapets. There are houses for the soldiers inside the enclosure".

This description of Dibba is confirmed by the illustration of the town in de Resende's revision of the *Livro* of 1639, contained in Antonio de Maris Carneiro's *Descripcam da Fortaleza de Sofala*, now in the Biblioteca de Lisboa.

De Resende's illustration of Dibba is drawn facing westward from the sea (Plate 1). The oasis is shown as consisting of three separate fortified parts---DVBO, DOBA and MOCOMBI---all running along the coast and distributed in a precise reflection of the modern subdivision of the town and its associated palm groves between the United Arab Emirates of Fujairah and Sharjah and the Sultanate of Oman territory. None of these fortifications survive today, but local people

speak of finding wall foundations of a large structure in the gardens of Dibba in the past<sup>14</sup>.

The 1639 illustration (Plate 1) shows the town hemmed in on the landward side by mountains although it does not indicate that in fact, compared with the high mountains of Musandam to the north, the mountains on the west and south sides of Dibba are far lower. In the foreground, an island is shown in the bay of Dibba with trees and plantations inland from the settlements, looking much as the palm gardens around the town appear even today.

In the southern part of Dibba, a settlement of huts is shown in the illustration. These appear to be *arîsh*. They are enclosed by a wall fortified by rounded buttresses and there is a two storey round tower at the north-west corner. The walls are probably of mud. This southern area of the Dibba settlement is termed "DVBO" in the illustration. Today, it is part of Fujairah in the United Arab Emirates.

The Portuguese fortress at the centre of the Dibba settlement is recorded as "DOBA". It seems to coincide with the area of Dibba today known as Dibba al-Husn (Dibba the fortress) which lies in Sharjah Emirate territory. It is a square building with an outer wall with rounded corner towers and a circular tower to seaward. The building material is marked by rectangular blocks which are probably a convention intended to indicate the stone masonry that de Resende refers to in his text as the construction material of DOBA. The lack of these rectangular blocks representing cut stones in the illustrations of the outworks of DVBO to the south and MOCOMBI to the north suggests that their walls were of mud-brick, rather than stone.

Within the outer fortress wall of DOBA, the 1639 illustration shows another inner fortress, again with the convention indicating the stone blocks that we see in the outer wall. There are nine small towers marked in the empty ground between the inner and the outer wall. Inside the inner fortification is a two-storey circular tower in the centre of the courtyard. There are also three other structures in the courtyard. That to the south-east seems to be the house of the Portuguese captain commanding DOBA. On the west side of DOBA is a tower, a church and a structure to the north which I take to be the underground ammunition store.

To the north of DOBA, *i.e.*, on the right side of the map, there is yet another separate village forming a part of the Dibba settlement, the MOCOMBI mentioned above. The name MOCOMBI does not seem to relate to any place name in current usage in the Dibba oasis. It may be related to Dibba al-Bayah, the Omani portion of the town, but this is speculative.

<sup>11</sup> Sloane MS 197. See Cortesão and da Mota, *op. cit.*, V, p. 67-68.

<sup>12</sup> *Relacao das plantas & dezcripsoes de todas as Fortalezas, cidades e povoacoes que os Portuguezos tem no estado da India Oriental*, Biblioteca Nacional, Lisbon (1936).

<sup>13</sup> Cortesao and da Mota, *op. cit.*, V, pp. 581-2. The account of Dibba is provided by de Resende.

<sup>14</sup> Personal communication, Shaykh 'Abdullah. b. Suhail al-Sharqi, 20<sup>th</sup> April, 2005, Al Ain, United Arab Emirates.

The illustration of MOCOMBI shows its fortress in a manner very similar to DVBO to the south of DOBA, with the same style of illustration convention as that of DVBO and presumably in mud-brick. At the angles of its surrounding walls were rounded towers and within the walls were a series of small buildings that appear to have been *arīsh*.

The illustrations of Dibba in the *Livro* constitute the only record that we have of the vanished Portuguese fortress of DOBA and its immediately neighbouring settlements amidst the Dibba palm-groves. It passed into the hands of the local Arabs in the mid-17<sup>th</sup> century but its fate thereafter is unknown<sup>15</sup>.

The town was subsequently illustrated by Captain Speelman<sup>16</sup>, the leader of a Dutch expedition to south-east Arabia of 1644 but his map of Dibba is only a small sketch that shows the bay and soundings of the depths of the sea but nothing of the fortresses on shore.

Another Dutch skipper, Captain Vögel, described Dibba from offshore in 1666. He reports that there were four fortresses there, one more than referred to in the *Livro*. It may be that the central fortress at DOBA of the *Livro* was double counted, or that the local Arabs had built an additional fortress since the Portuguese withdrawal but as Vögel was unable to land because of the winds, his testimony on the fortresses is not conclusive.

Dibba was visited in 1827 by Captain Brucks who described it in the following terms<sup>17</sup>:

“Dibbah, the first town on the Batinah Coast, is in lat. 25 37’ 25” N., long. 56 20’ 20”. From Ras Laoote to the town of Dibbah, and from it to Ras Dibbah, the coast forms a deep bay, with regular soundings of from twenty to three fathoms, sandy bottom. The coast now gets low, and is covered with date groves, and at this place we found good water, and the finest cattle I have met with in the Gulf; and, for the season, fair supplies of vegetables. The inhabitants have a few trading boats here, and supply some of the Bedouin Tribes with grain. The place belongs to the Imaum of Muskat, whose nominal revenue from it is about four thousand German crowns [Mary Therasas]; but it is not always paid. A fort named Jilla [Qal’a] Hirshee is situated about two-thirds of a mile to the northward”.

This seems to be the latest reference to a fort at Dibba but it is unclear which is intended. Thereafter, records of the fortresses appear to cease.

\*\*\*

The fact that illustrations of the Portuguese fortresses in the *Livro* were part of an atlas with limited circulation---confined to King Philip IV and his officials---meant that they had little impact on subsequent 17<sup>th</sup> century mapping of south-east Arabia. Because of their restricted circulation, the *Livro* maps were not intended to be available outside the Spanish-

Portuguese court and especially not to the English or the Dutch, the predators on Portugal’s eastern trade and its overseas possessions in the Estado da India Oriental. As a result, there is no reflection in non-Portuguese maps of the level of military detail recorded in the work ordered by King Philip. .

As to Dibba, it is by a fortunate accident that King Philip’s commission to the Conde de Linhares preserved the only precise information we have to date on the appearance of one of the more important coastal settlements of the United Arab Emirates and Oman in the early 17<sup>th</sup> century.

## Bibliography

G. B. Brucks, in R. Hughes Thomas and Robin Bidwell, **Arabian Gulf Intelligence, Selections from the Records of the Bombay Government, New Series**, No. XXIV, 1856, Oleander Press, Cambridge and New York (1985).

Armando Cortesão and Avelino Teixeira da Mota, *Portugaliae Monumenta Cartographica. Comemorções do V Centenario da Marte do Infante D. Henrique*, Lisbon (1960; reproduced in facsimile, Imprensa Nacional-Casa da Moeda, 1987).

B.J. Slot, **The Arabs of the Gulf, 1602-1784**, Leidschedam (1993).

Logbooks of the *Zeemeeuw*, ARA Geleynssen de Jongh Papers nos 280 and 280a, The General State Archives in The Hague, Dutch General State Archives, The Hague.

G.R. Tibbetts, **Arabia in Early Maps**, Falcon-Oleander, Cambridge (1978).

Michele Ziolkowski, **The Historical Archaeology of the coast of Fujairah, united Arab Emirates; from the Eve of Islam to the Early Twentieth Century**, Ph. D. Thesis, University of Sydney (2002).

**Geoffrey King**

*School of Oriental and African Studies, SOAS,  
University of London, Thornhaugh Street,  
Russell Square, London, WC1H 0XG, U.K.  
email: gk3@soas.ac.uk*

<sup>15</sup> Slot, *The Arabs of the Gulf, 1602-1784*, Leidschedam (1993), p. 47..

<sup>16</sup> Logbooks of the *Zeemeeuw*, ARA Geleynssen de Jongh Papers, The Hague, nos 280 and 280a.

<sup>17</sup> G. B. Brucks, in R. Hughes Thomas and Robin Bidwell, *Arabian Gulf Intelligence, Selections from the Records of the Bombay Government*, Oleander Press, Cambridge and New York (1985), p. 623.

## An old tree in Qidfa: a mute witness to an episode in UAE history?

by Peter Hellyer



Fig 1. The *sidr* tree north of Qidfa

Throughout the United Arab Emirates, as in every country, there are particular places which are associated with events in the country's history. Some, such as the Qasr al-Hosn in the centre of Abu Dhabi and similar forts and castles in other Emirates, serve as focal points for historical memory, since major events took place in or adjacent to them. Such highly-visible locations are well-recorded in the archives and, by and large, receive due credit for their role in the country's recent history. This does not, of course, always apply to the older structures that may be relatively well-known, at least to local inhabitants, such as, for example, the early to mid-Islamic Qasr az-Zubba (Sheba's palace) in Ra's al-Khaimah or the Islamic hillforts at Jebel Buhais (Sharjah) and Husn Safad (Fujairah), quite apart from much earlier structures like the Iron Age fortresses at Awhalla and Husn Madhab, both in Fujairah. For these, only archaeological investigations can offer some insight.

There are other locations, however, less obvious to the casual observer, whose historical significance or possible significance may not be widely known beyond the community in which they are located. Unless recorded, not only may the knowledge of that significance eventually fade but the location itself may

be destroyed, instead of receiving the attention it deserves.

One such location – actually a living organism, a *sidr* tree, *Ziziphus spina-christi* (Fig. 1) – is located just north of the Al Yaradia district on the northern edge of the town of Qidfa, part of the Emirate of Fujairah on the UAE's East Coast. It lies on the eastern side of the main highway at the point where a spur of the mountains comes close to the road. The tree is situated on a level area between the spur, whose lower slopes have been affected by recent construction work, and the remains of a stone structure, up to c. 1.80 metres in height, now fenced by the Fujairah Government. This was described by Ziolkowski (2002) as "A large stone wall located between a small jebel and the base of the mountains. The wall was constructed with mountain rocks on either side and an interior consisting of packed earth and rubble... This wall was part of an irrigation system connected to various water channels located within the nearby mountains. The wall was used to deflect the water runoff and re-direct it onto the plain" (Fig. 2).

To the south, the fenced compound abuts a rock outcrop, ( the jebel described by Ziolkowski), on the edge of which remains of the dam wall are visible.



Fig 2. The enclosed small outcrop, with rock-built enclosures, adjacent to (south of) the *sidr* tree (Fig. 1). The dam wall is visible in the centre.

Archaeological survey of the outcrop identified 6 oval-shaped rock-built enclosures and a number of petroglyphs, while red coarse ware and fine ware pottery sherds from the Islamic period have been collected from the site (1).

The tree is evidently of considerable age, with a diameter of approximately 0.75 metres, although it has not been bored to permit accurate dating. It is growing out of the middle of the remnants of a stone wall, of which only a single course remains. To the south, this wall extends towards the dam wall mentioned above, although it is no longer possible to determine on the surface whether it was originally part of that wall. To the north, the wall extends for approximately 2 metres to reach a heavily-disturbed small circular enclosure, then curving again east and south. The purpose of this wall and associated enclosure cannot be determined without further investigation. Since the tree is growing out of the remnants of the wall, however, it would seem probable that the wall and structure had been abandoned or destroyed before the tree began to grow.

A local tradition, dating back two centuries, is associated with the tree. This was reported to the author several years ago by a Qidfa resident with an interest in local archaeology and history and was recorded initially in English in an unpublished report (2).

Around 1800, the emergent Wahhabi state in central Arabia, led by the Al Saud family, took control of much of the Al Ain / Buraimi area, later extending its influence, by around 1803, to the coastal areas of

al-Sirr, (Ra's al-Khaimah), there forging an alliance with the ruling Qawasim family. The activities of Qawasim ships against British and other vessels led to three British military expeditions against the Qawasim, in 1805-1806, 1809-1810 and 1819-1820 and, ultimately, to the signing in January 1820 of the General Treaty of Peace between Britain and the sheikhs of the emirates that marked the beginning of the relationship that lasted until the establishment of the United Arab Emirates in 1971. This aspect of the UAE's history has been extensively researched and discussed, for example by the Ruler of Sharjah, H.H. Dr. Sheikh Sultan bin Mohammed Al Qasimi in his book *'The Myth of Arab Piracy in the Gulf'* (1986).

Less attention, however, has been paid, at least in English, to the conflict on land between the Qawasim and their Wahhabi allies, on the one hand, and the Bani Yas of Abu Dhabi and the Imamate of Oman, on the other.

During 1808, the Wahhabi and Qawasim forces "took possession of the forts of Fujairah, Bithna, Khor Fakkan, Dibba and Khor Kalba", which they held until 1809-1810 (3). The precise dates when each fort was taken are not recorded, but the campaign included at least one major battle at Khor Fakkan.

In May 1808, an Omani army led by Seyyid Qais, governor of Sohar, uncle of the then-Imam of Oman, Seyyid Said bin Sultan, and supported by Mohammed bin Matar, the 'headman' of Fujairah, attacked the fort at Khor Fakkan, then held by Sheikh Sultan bin Saqr al-Qasimi and his allies (4). The expedition was supported at sea by an Omani fleet commanded by

the Imam (5). In the battle that ensued, according to Omani chronicler Ibn-Razik, “the fire of muskets rang, swords were brandished, spears pointed and daggers reached the hearts of all” (6).

Local oral traditions, collected by the above-mentioned Qidfa resident and local historian, Mohammed Hassan, suggest that the Omani army, said to number around 6,000 men, initially captured the fort, but were driven back in a counter-attack by the stronger Wahhabi-Qasimi forces, said to have been around double their number.

“There were many Omani losses and the commander of their army, Qais, was killed along with all of his bodyguard. Tradition states that he (Qais) was buried under a *sidr* tree that still bears his name, in the Fujairah town of Qidfa, two kilometres south of Khor Fakkan.” (7).

Historical records make no mention of the precise location where the Omani commander was killed. If, however, the oral tradition from Qidfa is accurate, it would appear possible that, having lost the day in Khor Fakkan itself, Seyyid Qais and surviving members of his bodyguard may have fled southwards towards Qidfa, being caught and killed at or near the buildings on the rocky outcrop just north of the village, with Qais himself being buried by the tree nearby.

Despite the construction nearby of two major gas and water pipelines, the *sidr* tree has survived. Adjacent to it is a small signboard with the text QID-13, the archaeological site code assigned during surveys undertaken prior to the pipeline construction, as a result of which it was clearly identified in reports as being of potential historical significance and worthy of protection (8). It is located at (GPS Reading): N 25.30591 / E 056.35154.

It is hoped that the publication of this note may prompt further investigation of the Qidfa oral tradition, perhaps coupled with a detailed study of the structure out of which the tree is growing, together with the dam wall and outcrop, as well as the publication of other oral traditions that may shed light on the history of the Emirates.

## Acknowledgement

I am grateful to Dr. Michele Ziolkowski for reviewing a first draft of this note and for supplying additional information on the site with the dam wall, petroglyphs and structures adjacent to the tree, as well as for her collaboration over many years of investigations into the history and archaeology of Fujairah.

## References:

1. Ziolkowski, M. (2007). p. 216.
2. Hellyer, P. with Ziolkowski, M. (2001).
3. Ziolkowski (2008). p. 159, citing Kelly (1968: 112) and Lorimer (1986: 1: 778)
4. Ziolkowski (2002). p. 36; Ziolkowski (2008). p. 159.
5. Hassan (n.d.). pp. 8,9.
6. Badger (1986). p. 294

7. Hassan (n.d.). pp. 8,9.

8. Hellyer & Ziolkowski, (2001); Hellyer & Ziolkowski (2007).

## Bibliography

Al Qasimi, S.M. (1986). **The Myth of Arab Piracy in the Gulf**. London: Croom Helm.

Badger, G.P. (ed. and trans.) (1986) (Original publication 1871) **History of the Imâms and Seyyids of Omân by Salîl-Ibn-Razîk, from AD 661-1856**. London: Darf Publishers Limited.

Hassan, M. (n.d.) *An Outline of the History of Fujairah*. Unpublished manuscript.

Hellyer, P. with Ziolkowski, M. (2001). *A Report on a Preliminary Archaeological Survey of the Qidfa to Al Ain Pipeline Route*. Unpublished report, Abu Dhabi Islands Archaeological Survey, ADIAS.

Hellyer, P. (with contributions by Ziolkowski, M.). (2007). *Dolphin Energy Limited: Taweela to Fujairah gas pipeline – Archaeological baseline study of the section from Qidfa to the Abu Dhabi border*. Unpublished report.

Kelly, J.B. (1968). **Britain and the Persian Gulf, 1795-1880**. Oxford: Clarendon Press.

Lorimer, J.G. (1986). **Gazetteer of the Persian Gulf, Oman and Central Arabia**. 9 vols. Reprinted in 1986 by Archive Editions, Gerrards Cross, Buckinghamshire. Original publication 1908-1915.

Ziolkowski, M.C. (2002). *The Historical Archaeology of the Coast of Fujairah, United Arab Emirates: from the Eve of Islam to the Early Twentieth Century. Volume I: Text*. Unpublished PhD thesis, University of Sydney, Australia.

Ziolkowski, M. (2007). Rock on art: petroglyph sites in the United Arab Emirates. *Arabian Archaeology and Epigraphy 18*: 208-238.

Ziolkowski, M.C. (2008) *Historical References to Fujairah and the East Coast of the United Arab Emirates: from the eve of Islam to the twentieth century*. In: Hellyer, P. & Ziolkowski, M.C. (eds.) **Emirates Heritage: Volume 2 – Recent Archaeological Discoveries in the Emirates**. Al Ain: Zayed Centre for History and Heritage.

**Peter Hellyer**  
PO Box 3790,  
Abu Dhabi, U.A.E.  
email: [hellyer@emirates.net.ae](mailto:hellyer@emirates.net.ae)

## Further Investigations of the RAF Wellington Crash at Dhadnah

*by Laurence Garey*



Fig 1. Sergeant Billy Donnelly, RAF. (Picture courtesy of Lesley Botten)

In 2004 and 2006, Peter Hellyer and I gave some details of the February 1943 crash of an RAF Wellington bomber at Dhadnah, on the coastline of Fujairah (Hellyer and Garey, 2004; 2006). A careful search of immediately available records failed to provide further details of the circumstances of the crash, except that enquiries through the British Embassy in Abu Dhabi provided the following information from RAF records.

The Wellington Mark IC, serial HX748, was on the strength of the Aircraft Delivery Unit, No. 4 Ferry Control Unit, Middle East Command. On 13 February 1943, it landed at 44 Staging Post at RAF Sharjah, en route from England to India (via Gibraltar and Alexandria according to recollection by the family of one of the crew). The next day it was refuelled and inspected and took off en route for Karachi. Some 30 minutes later, over the sea, the pilot noticed an oil leak from the port engine. He decided to return to Sharjah, but, soon after, the propeller flew off the port engine. The pilot was forced to land on a rocky strip of coast, and the navigator, Sergeant W.H. (Billy) Donnelly, was killed. He was buried by the surviving crew near the aircraft. The aircraft had been delivered to the RAF in mid-1942, so was perhaps being delivered to an operational squadron when it crashed, but this was unclear.

As no communication was received from the Wellington after it left Sharjah, a search was requested by Karachi. A search by Blenheims of 244 Squadron from Sharjah found nothing. On 16 February a message was received from the Political Agent at Sharjah that the aircraft and surviving crew had been located at Saih Dhadnah, an area inaccessible by land or air. On 17 February supplies were dropped to the survivors by a 244 Squadron aircraft, which reported that the Wellington was badly damaged but four members of the crew were apparently uninjured.

In 2009, Sergeant Donnelly's great-niece, Lesley Botten, contacted Peter Hellyer and I asking if we could help locate the grave of her great-uncle, who was the only known British and Commonwealth World War Two fatality on active service buried in what it is now the United Arab Emirates. She provided a family photograph of "Billy" and his original gravesite at Dhadnah (*Figs. 1 & 2*). The grave appeared to be made from aircraft parts. The photograph was stamped on the back "RAF SHARJAH Ref 244 Squadron" and dated 18 March 1943, a month after the crash. The photograph also recorded the date and location of the accident.



Fig 2. Sgt. Donnelly's grave a month after the accident. (Picture courtesy of Lesley Botten)

In 2006 we obtained further information via the British Embassy in Abu Dhabi that the crash was “at Saih Dhadnah (25 degrees 33 minutes North 56 degrees 22 minutes East). This place was inaccessible by land or air and the Naval Authorities were asked to arrange for the rescue of the crew.”

We attempted to identify the present-day location from these coordinates. The search was led by Brien Holmes, then Chairman of the Al Ain Chapter of the Emirates Natural History Group. After considerable effort, he was able to find villagers at Rul Dhadnah who remembered details of the crash. There was consensus among those who had heard accounts of the incident and one eyewitness. As a result, the area of the crash was identified with some accuracy. Regrettably, the grave had been washed away by floods, along with the graves of several Rul Dhadnah residents, several years after the crash.

In January 2010, the Ruler of Fujairah, HH Sheikh Hamad bin Mohammed Al Sharqi, who had displayed an interest in the story ever since he was first told about the crash, near his weekend farm at Dhadnah, kindly commissioned and paid for a memorial stone to be erected and for Billy Donnelly's surviving relatives to fly to the UAE for its formal inauguration. An honour guard from the Royal Air Force was present, along with

personnel from the Royal Navy, the British Army, the US Air Force and the UAE Armed Forces, along with the British Ambassador. (Morris 2010).

A number of questions remained. The technical fault explaining the loss of the aircraft was well documented. However, what happened after the crash was less clear. The crew must have realised that the Wellington would not be able to return to Sharjah, and were skilled enough to be able to force-land soon after crossing the Fujairah coast. The landing must not have been too violent for, in spite of the aircraft being fairly heavy, and with an almost full fuel load, there was no fire and four crew members survived. But why, then, did Billy die? He was the navigator, and, if he was in his seat, he should have been reasonably well protected by the wing and its main spar. Not only that, but the Wellington was renowned for its very tough geodetic structure. It had previously been suggested that Billy might have been in the co-pilot's seat, but this is unlikely, since the Wellington IC had no such seat. Its single pilot sat just to the left of the rather narrow cockpit. The navigator sat behind the wireless operator, over the bomb bay and protected from a crash by the wings below. In any case why would he have moved from his crew position knowing they were about to crash sooner or later?





Fig 3. The memorial stone at Dhadnah. (Picture: Peter Hellyer)

Date		Time	Summary of Events
Jan.	1943		35 aircraft passed through the Staging Post. 5 aircraft delayed with total loss of 8 flying days, two for maintenance reasons, two on account of bad weather.
Feb.			24 aircraft passed through the Staging Post. 4 Wellington NX 742 found to be 80 miles east of Sharjah, 14th Feb. Transport Sgt. Donnelly lost his life.
March			42 aircraft passed through the Staging Post, 30 of which night stopped. 4 Wellington NX 729 delayed 8 days for carrying out repairs on Standard Engine Plans, caused failure being rejected 19/3/43 whilst flying from Bahrain. repairs completed by sand storm and rain for 4 days.
April			58 aircraft passed through the Staging Post, 18 of which night stopped. 4 Wellington NX 744 delayed 7 days.
May			49 aircraft passed through the Staging Post, 25 of which were fighter aircraft, none of which night stopped or were delayed. 19 Wellingtons and 1 communication aircraft passed through, one (NX 743) delayed 17 days whilst double engine change was carried out, of the other 18, 9 night stopped but none were delayed. 5 U.S.A. aircraft were refuelled, none night stopped.
June			20 aircraft passed through the Staging Post, which were 13 fighters, 50 Wellingtons, 7 U.S.A. of them 2 fighters and 3 Wellingtons stopped one night only. 11 Wellington NX 972 was delayed 17 days awaiting propeller number. fuselage 252 was damaged, unusable and left for Sharjah 29 June being later delayed for several months.

Operations Records Book of 44 Staging Unit, Sharjah for the first half of 1943

Further, why was Billy buried on the spot, rather than being returned to Sharjah?

Also, what was the mission of this aircraft? Was it simply being delivered, as a new aircraft, to an operational unit? Why was the passenger, Lt Col De Watteville, of the Royal Engineers, on board, and what was his mission?

Several lines of research seemed of potential value to shed more light on the circumstances of the accident. The archives of the Royal Air Force Museum at Hendon contained a copy of the accident record document, which we obtained, but it merely gave technical details of aircraft and crew. Further, the Air Historical Branch of the RAF had details of the Court of Enquiry which took place soon after the accident but they added nothing further to our enquiries.

Of potentially most importance, the (British) National Archives at Kew house a number of documents which might have thrown light on the fatal flight. I divided my search into several lines of investigation: War Office records, Foreign Office records, Operations Records Books (ORBs) of the unit operating the Wellington and of RAF Sharjah, personnel records, and the records of HMS Capetown, which had been involved in picking up the survivors from Rul Dhadnah. Overall, however, these records produced disappointingly little new information.

### War Office and Foreign Office records

These contained nothing of relevance. Many letters and official documents concerning the Middle East in 1943 dealt with the urgent need to reinforce the Indian subcontinent to stem the advances of the Japanese through Burma and into India itself. Their main concerns at that time were to do with not enough aircraft available for the Burma front. There was nothing to suggest why an officer of the Intelligence Service might have been on board the aircraft and no references were found to clandestine operations around Sharjah or Karachi at that time.

### Operations Records Books for our period (ORBs)

The relevant records of the Aircraft Delivery Unit (ADU) that operated the Wellington were found and examined. These were divided into several sub-units and, surprisingly, there was nothing in the ORBs of any of them: no reference to any Wellington loss in February 1943, either in the daily reports or the accident summaries. A complicating factor was the renaming of ADU sub-units. However, careful examination of all potentially relevant ADUs revealed nothing of relevance. Number 4 Ferry Control Unit, at 44 Staging Unit, RAF Sharjah, reported on 17 August 1943 that "F/LT EVANS ... left by air ... after investigating causes of recent crashes", but there is no report available and we cannot determine which crashes were investigated. The Dhadnah crash, of course, had been as much as six months earlier, so perhaps had not been investigated.

In the ORB of 44 Staging Unit, Sharjah the only reference was a hand-written note about our Wellington crashing: "Wellington HX.748 forced landed 60 mls, East of Sharjah 14th Feb. Navigator Sgt. Donnelly lost his life."

Otherwise, there was no official record. There was no mention of a search and rescue operation to retrieve the missing crew or aircraft. However, as we knew already that Blenheims of 244 squadron, RAF, had been sent to search and drop supplies to the marooned aircrew, I checked the 244 squadron ORB for the days following the crash. Nothing was found.

The ORBs of the two squadrons operating Wellingtons in India at that time, 36 Squadron at Tanjore, and 215 at Chaklala, contained no reference to any expected deliveries which had crashed en route (although there were reports of new arriving aircraft, including new Mark X Wellingtons).

### Personnel records of the crew

The only National Archive records of personnel in World War Two are those who were concerned in particularly noteworthy events during service; nothing of the crew of the Dhadnah Wellington was found.

Several mentions were found of the passenger, Lt Col Hermann Gaston de Watteville, but nothing related to his participation in the events we are studying or why he was travelling on the plane. One might, however, speculate on the basis of his career. De Watteville was an interesting man. Born in 1875, he died in 1963. He was the son of Armand de Watteville (1846-1925), whose family was originally from Switzerland, but had settled in Great Britain. Armand was a neurologist at St Mary's Hospital, London, and became its director as well as being Editor of *Brain*, and was well known for his mountaineering skills, including an ascent of the Eiger. According to the *London Gazette*, Hermann was gazetted a Second Lieutenant in 1900, Major in 1916 and Lieutenant-Colonel in the Royal Artillery in 1918. He was an Instructor at the Staff College, Camberley and a renowned military historian and prolific author on military and social affairs. He wrote articles for the Encyclopædia Britannica (1911) and his works also include *The military administration of occupied territory in time of war* (1922), *Waziristan, 1919-1920* (1939), *Lord Kitchener* (1939), and *The British Soldier: His Daily Life from Tudor to Modern Times* (1954). He was awarded the CBE.

According to the RAF Museum, De Watteville may have worked for the Political Intelligence Department of the Foreign Office in 1943 and 1944, but no documentary evidence has been located. In relation to our research, it may be relevant to consider his book on the so-called Waziristan Revolt of 1919-1920, published in 1939. This area, now in Pakistan but part of India until 1947, was invaded by Afghan forces in 1919 and heavy fighting took place between the Indian army and the invaders. The revolt was finally put down



Fig 4. HMS Capetown log.

after bombing by the RAF. With his expert knowledge of the North-West Frontier region, one might surmise that De Watteville may have been on his way to northern India.

### Naval records

We knew that a Royal Navy cruiser, HMS Capetown, was involved in the rescue of the crash survivors. Naval records in Kew produced the ship's log. (Fig. 4).

De Watteville and the three crew were picked up by an Indian minesweeper (Local Naval Defence Vessel), HMIS Hiravati, from the beach, then transferred to Capetown. The hand-written entry for 18 February 1943, at Khor Kuwait (at the northern extremity of Musandam), records (sic): "Lt. Col Waterville & 3 R.A.F. ratings came on board (survivors picked up by Hiravati)".

On 20 February Capetown sailed from Khor Kuwait to Sharjah where "3 R.A.F. sergeants left ship."

On 22 February at 0630 Capetown left Sharjah. At 1645 the same day the Dutch ship "SS "Valentijn" came alongside" and at 1715 "Lt. Col. de Watville left ship."

No trace was found of where the Valentijn took him.

As to why Sergeant Donnelly was buried at the site, information obtained from the Air Historical Branch of the RAF, said that he was killed when he fell through

the floor of the aircraft, which broke in the impact. Another member of the crew was trapped under the front of the aircraft but was rescued by other crew members. (During the memorial service at Dhadnah, village residents said that Donnelly had been seriously injured and had been rescued and moved to the nearby house of a villager where he died a day later). Sergeant Donnelly was buried by his crewmates, due to the length of time (four days) before they were rescued.

There is no record of any wreckage being transported to Sharjah, although, as noted in Hellyer and Garey 2004, citing records of the British Political Residency in the Gulf for the period, "the Sheikh of Fujairah, Sheikh Mohammed bin Hamad al-Sharqi, 'arrived at Dhadnah and arranged for a guard to be placed on the machine until the salvage of all valuable equipment had been completed'".

The reason for Donnelly being killed by the floor breaking in so strong an aircraft as a Wellington, in a crash in which others were not injured, remains a mystery.

In conclusion, although the technical aspects of this accident are adequately explained, there is some mystery still surrounding the circumstances of the flight, enhanced by the paucity of documentary evidence in official records.

### Acknowledgements

I should like to thank the ENHG for providing a grant from its Conservation and Research Fund support to make my research in London possible, and to Brien Holmes for the considerable effort he made in locating the crash site and for his continued interest.

This work originally began because of the discovery by Peter Hellyer of archive reports relating to the crash. He has continued to support and encourage, and kindly commented on the present text.

### References

Hellyer, P. and Garey, L. 2004. World War Two Plane Crashes in the UAE. *Tribulus* 14.1: 9-11

Hellyer, P. and Garey, L. 2006. The RAF Wellington Crash at Dhadnah. *Tribulus* 15.2: 27.

Morris, L. (2012):

<http://www.thenational.ae/apps/pbcs.dll/article?AID=/20100128/NATIONAL/701279842/1010>

Fujairah unveils tribute to RAF man

**Laurence Garey**  
CH-1166 Perroy  
Switzerland  
email: l.garey@sunrise.ch

## Swinhoe's Storm Petrel *Oceanodroma monorhis*: new to the waters of the United Arab Emirates

by Simon Lloyd



Along with a resident group of birders in the United Arab Emirates, I had participated in weekly pelagic trips out of Khor Kalba, on the coast of the Gulf of Oman, with local boatman Abdullah Al Zaabi throughout the summer of 2011. It was proving a very good year so far for seabirds, with high numbers of Sooty *Puffinus griseus* and Flesh-footed Shearwaters *P. carneipes* as well as the first ever records of Cory's Shearwater *Calonectris borealis* for the UAE. Throughout June and July, Wilson's Petrels *Oceanites oceanicus* had been well represented and numbers had risen to a maximum count of 45 on 28th June. However, we were always aware of the possibility of Swinhoe's Storm Petrel *Oceanodroma monorhis*, especially since that species is recorded almost annually off the coast of Oman.

Most of our previous pelagic trips had been out to around 25 km but on 8<sup>th</sup> August, we managed to venture out much further. We left Khor Kalba at 3pm and headed out to a deep water fishing site in search of tuna. At around 35 km from shore, at coordinates N 25 12.668 E /56 42.109, I spotted a storm petrel off to the starboard (right) side of the boat and, as we slowed and managed to get a first glimpse, we were immediately struck by two things: This bird was a

completely different in size and structure to Wilson's Storm Petrel, and it had an all- dark rump. We knew immediately that we were probably watching a Swinhoe's Storm Petrel.

A chase ensued as Abdullah skilfully followed and drove alongside the bird, allowing excellent views and for photographs to be taken. At one point, the bird was watched as it flew alongside a Wilson's Storm Petrel low over the sea, allowing a convenient comparison of size and shape to be made. Once satisfied with the identification, we headed back in the direction of the tuna site but after another short journeytime at high speed, Graham Talbot spotted located another bird. Again, as we slowed, it was clear that we had found a second Swinhoe's Storm Petrel, and with some more manoeuvringmanoeuvring by Abdullah, further photographs of this second bird were obtained.

When out at the 50 km mark, we had a rather fruitless attempt at fishing but, as we raced back to shore with the light starting to fade, our paths crossed with one last bird over an otherwise bird-less sea. This time it was a magnificent Jouanin's Petrel *Bulweria fallax*, with its characteristic arcing flight - the second record of this species for the UAE.



With this discovery of both Swinhoe's Storm Petrel and Jouanin's Petrel at a range that had previously rarely been visited, subsequent trips in August and September 2011 after this date involved the long journey out to the 50km mark. Participants were not disappointed as Swinhoe's Storm Petrels were located on a further four occasions: on 19th August (2 birds), 26<sup>th</sup> August (5 birds), 2<sup>nd</sup> September (3 birds) and 9<sup>th</sup> September (1 bird). All records outlined here have been accepted by the Emirates Bird Records Committee, EBRC.

### Description

Size and structure of a large, long-winged storm petrel with a long, slightly notched tail and overall quite similar in structure to Leach's Storm Petrel *O. leucorhoa*. The Swinhoe's was roughly 1.5 times the size of Wilson's Storm Petrel with much longer, straighter wings and a longer tail. There were no feet extending beyond the tail, normally a feature of Wilson's Storm Petrel. The flight action was very different to Wilson's, being more direct with lower downbeats.

The plumage was dark brown all over with black primaries and secondaries. There was a prominent pale carpal bar on the upper-wing of both birds. From

photographs, short white bases to the outermost three primaries can be seen, giving the impression of a small "skua-flash". This was not noticed in the field. The rump and under-tail coverts were clearly dark on both birds. The head, upper-parts and upper-wing coverts actually appeared a slightly paler, chocolate brown; this that was noticeably different to the darker Wilson's Storm Petrel.

Some of the features outlined here are discernible in the images that accompany this paper.

### Similar Species

There are a number of similar dark-rumped storm petrels that occur in the North Pacific but only two species show white bases to the shafts of the outer primaries. These are Swinhoe's Storm Petrel and Matsudaira's Storm Petrel *O. matsudairae*. The latter can be discounted as it has a much more prominent white flash to the base of the primaries that is clearly visible in the field and has a much more deeply forked tail (Brazil 2009). A third species, Markham's Storm Petrel *O. markhami*, occurring in the south-east Pacific, can also show white bases to its primaries as distinct as Swinhoe's but, like Matsudaira's, Markham's Storm Petrel has a much more deeply forked tail (Garner and Mullarney, 2004).

## Range

Swinhoe's Storm Petrel breeds in the northwest Pacific on remote islands off the coast of China, Japan and Korea. It migrates southwest around the East Indies to winter in the warmer Indian Ocean (Onley and Schofield, 2007). Like all storm petrels, it nests in colonies close to the sea and, being a strictly pelagic species outside the breeding season, it spends the rest of the year on the open ocean. Its non-breeding range extends far across the Indian Ocean to the east coast of Africa and the Arabian Sea. It is now known that the waters around the Singapore Strait are a key passage area for migrating Swinhoe's Storm Petrels, with over 500 being recorded in September 2011. (Poole *et al*, 2011)

There are 36 accepted records for Swinhoe's Storm Petrel in Oman to date, the first being in November 1997, following a cyclone in the Indian Ocean. That month, a maximum count of 99 birds was recorded from Ra's Janjari on 10th November. Since 1997, they have been observed most years in Oman but, interestingly, 2011 was a particularly good year for the species with nine records. These included a record of 4 birds seen from Muscat on 6th September 2011 (Jens Eriksen, *pers comm.*)

The first record of Swinhoe's Storm Petrel for the Western Palearctic was of a bird seen from Eilat, Israel on the Red Sea in 1958. Surprisingly, given their known breeding range, there have been several records in the North Atlantic. The first of these was a bird trapped on Madeira in 1983 and subsequently there were a number of records from the United Kingdom in the early 1990s, where three individuals were trapped over a five year period (Cubitt 1995). The identity of these three birds was confirmed after the study of vocalisations and DNA sequencing. In fact, as a result of these records of Swinhoe's Storm Petrel in the North Atlantic, it has been suggested that there is a small breeding population somewhere in the Atlantic Ocean (Brazil 2009). However, this has not been proven.

## Acknowledgements

I would like to thank Tommy Pedersen for supplying me with pelagic records from the UAE and Hanne and Jens Eriksen for supplying me with data on the occurrence of Swinhoe's Storm Petrel in Oman. I am also grateful to Khalifa Al Dhahiri and Steve James for the use of their photographs.

## References

- Brazil, M. 2009. **Birds of East Asia**. Christopher Helm, London.
- Cubitt, M. 1995. Swinhoe's Storm-petrels at Tynemouth: new to Britain and Ireland. *British Birds* 88: 342-348
- Garner, G. and Mullarney, K. 2004. A critical look at the evidence relating to the 'Chalice petrel'. *British Birds* 97: 336-345
- Onley, D. and Scofield, P. 2007. **Albatrosses, Petrels and Shearwaters of the World**. Christopher Helm, London.
- Poole, C., Brickle, N. and Bakewell, D. 2011. Pelagic Birding: South-East Asia's final frontier. *Birding ASIA* 16: 26-31

**Simon Lloyd,**

*The English College, Dubai,  
PO Box 11812, UAE.*

*email: [simonpeterlloyd@googlemail.com](mailto:simonpeterlloyd@googlemail.com)*

## Oscar Campbell, Chairman of the Emirates Bird Records Committee, has commented as follows:

The acceptance of this (and subsequent records in 2011) as Swinhoe's Storm-Petrel was straightforward. Photographic evidence accompanied each record and most committee members managed to see at least one or two of these wonderful and enigmatic birds. The established occurrence of the species in Omani waters, including records from as near as Muscat, made occurrence in UAE waters eminently feasible and the timing of UAE records in 2011 fits in well to the apparent pattern of records from Oman.

# First record of the Great Stone-curlew, *Esacus recurvirostris*, for the United Arab Emirates

by Sálím Javed and Shahid Khan



Picture by Sálím Javed

Great Stone-curlew, a new species of bird for the United Arab Emirates, was recorded from the Bul Syayeeef area, (west Musaffah channel), just west of the city of Abu Dhabi, on 27<sup>th</sup> September 2011 under a young mangrove tree during a routine count of Greater Flamingos, *Phoenicopterus roseus*.

Owing to the relative inaccessibility of the area, no attempt was made at the time by other UAE-based birdwatchers to find the bird. However, what was presumed to be the same bird was observed again in the same location on 27<sup>th</sup> February, on 3<sup>rd</sup> March 2012, when it was seen by at least six people, and again on 6<sup>th</sup> March 2012, seen by one person. The bird is assumed, therefore, to have over-wintered in the area. This record was accepted by the Emirates Bird Records Committee as the 448<sup>th</sup> species recorded in the UAE and is depicted in the accompanying photograph.

A resident breeder on the coastline of south-east Iran, and further east in Pakistan, India and Sri Lanka into South-east Asia (Robson, 2000), Great Stone-curlew was included in a list of birds predicted to occur in the United Arab Emirates, 'particularly (to) the East

Coast', over twenty years ago (Richardson and Bannon 1991). It was first recorded in Oman in January/February 1989. Since then, there have been a further 17 records from Oman, where the species is accorded the official status of: "Rare winter visitor from late-October to mid-February, once to late-April".

Most records are from the Shinas-Liwa area, not far south of Khor Kalba, at the southern extremity of the UAE's East Coast, where it has been almost annual in recent years (J. Eriksen, *in litt.* 5 June 2012).

Hence, while its occurrence in the UAE was not unexpected, it was something of a surprise that the first record came from the Arabian Gulf coast of the country, rather than from the East Coast.

The first record of this species in the UAE is a significant find and is another addition to an impressive list of bird species in the UAE. Its discovery highlights the importance of regular monitoring of important bird areas within the country, which is not only essential to document trends in bird numbers but is also helpful in recording the presence of rare or vagrant species. or, indeed, species, like this Great Stone-curlew, which are new to the UAE.

This record from Bul Syayeeef is further evidence of the importance of this area. Home to a large number of migratory and resident birds, Bul Syayeeef is one of the most important marine areas in the vicinity of Abu Dhabi with a rich marine life and a diverse range of marine habitats. The area supports, on a regular basis, nearly 60-70% of all Greater Flamingos (*Phoenicopterus roseus*) in the UAE and is an important area for many species of waterbirds. In 2009, the largest successful breeding of Greater Flamingos in the UAE was recorded from the area. However, there is continuing pressure on the area from industrial development in the vicinity and continuing vigilance is required to protect Bul Syayeeef and its populations of flamingos and many other species of waterbirds.

### Acknowledgement

The authors thank Peter Hellyer for undertaking literature searches and for obtaining details of the Omani records from Jens Eriksen, Recorder of the Oman Bird Records Committee.

### References:

- Richardson, C. & Bannon, J. (1991). Prospective new bird species for the UAE. *Tribulus 1.1, ENHG, Abu Dhabi*. pp. 9-13
- Robson, C. (2000). **A Field Guide to the Birds of South-East Asia**. New Holland, London.

**Sálim Javed and Shahid Khan**

Environment Agency - Abu Dhabi, EAD,  
P.O. Box 45553,  
Abu Dhabi  
United Arab Emirates  
email: [sjaved@ead.ae](mailto:sjaved@ead.ae)

### Oscar Campbell, Chairman of the Emirates Bird Records Committee, comments as follows:

This record of Great Stone-curlew, once accepted by the EBRC in January 2012, became the 448th species of bird recorded in the UAE. With the availability of photographic evidence, acceptance was straightforward. The only similar species requiring consideration is Beach Stone-curlew *E. neglectus* which, whilst geographically unlikely (occurring as a very localised and generally rare resident from south-east Asia to Indonesia and Australia) may be theoretically possible as a zoo escapee. The two species differ in exact facial pattern, this being easy to determine in the image provided. With a history of occurrence in Oman, the wild credentials of this bird were not in doubt.



## Basra Reed Warbler in Abu Dhabi: the first record for the United Arab Emirates

by Oscar Campbell

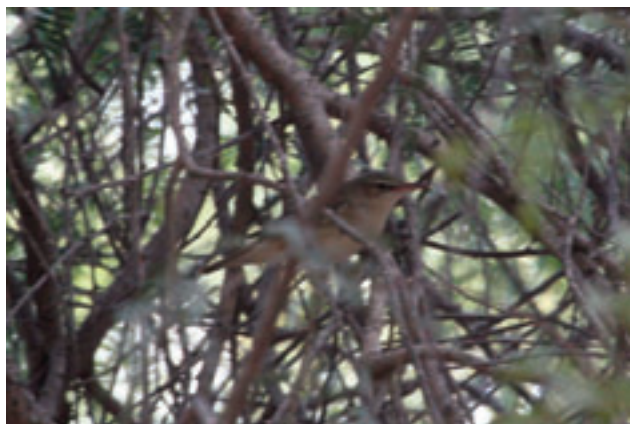


Plate 1. Basra Reed Warbler, Mushrif Palace Gardens, Abu Dhabi, 27th April 2010. Picture by Steve James



Plate 2. Basra Reed Warbler, Jahra Pool, Kuwait, 6th May 2011. Picture by Oscar Campbell

On 26th April 2010, I was birdwatching in Mushrif Palace Gardens, Abu Dhabi when, at approximately 0630, I heard a warbler singing quietly in a Ghaf *Prosopis cinerea* tree. I approached and, from almost directly underneath, located an *Acrocephalus* warbler. I was immediately perplexed that I was unable, on initial views, to judge whether it was either a large *Acrocephalus* (i.e. Great Reed Warbler *A. arundinaceus* or Indian (=Clamorous) Reed Warbler *A. stentoreus*) or a small one (i.e. Eurasian Reed Warbler *A. scirpaceus* or Marsh Warbler *A. palustris*). This was quite unsettling and I became even more intrigued as I noted a rather long, narrow bill. I was aware that these features matched Basra Reed Warbler *A. griseldis*, a species not thus far recorded in the UAE, but the seemingly rather creamy, saturated underparts appeared to count against this. With the bird generally overhead and often at least partially obscured, obtaining good views was not easy and, with work looming, I had to leave.

On my return that afternoon, I had only brief and inconclusive views, although the bird was still singing quite strongly in the same tree. That evening I called Steve James (SJ) and explained my dilemma.

I saw the bird again quite well the following morning and met SJ observing it at 1630 that afternoon. He had obtained reasonable views and was convinced that we were indeed watching with a Basra Reed Warbler. Over the next two hours, despite the difficulties inherent in looking for a skulking warbler overhead in thick foliage, we were able to obtain a series of good views and piece together a detailed description of the bird's structure and plumage. We also obtained a series of photographs that were invaluable for checking certain features. We informed a number of other local observers and several were able to see the bird that evening. I returned the following morning, 28<sup>th</sup> April, but the bird was not singing and I failed to relocate it; it was not seen again.

## Identification

*Acrocephalus* warblers are notoriously difficult to identify in the field and this particularly applies to individuals on migration, when they forsake their typical (and often characteristic) habitat and, sometimes, behaviour. The identification of the Abu Dhabi bird as Basra Reed Warbler required an in-depth examination of plumage and structure and detailed comparisons against a number of references (including, but not limited to, Harris *et al.*, 1996, Svensson *et al.*, 2009 and Cramp, 1993). At the risk of over-simplifying a complex issue, the key features that supported the identification as Basra Reed Warbler are:

**Size and structure:** Like a small, slim, short-tailed and rather long winged Great Reed or Clamorous Reed Warbler. The tail was rather square-ended and blunt, not graduated (as is typical for most *Acrocephalus*) and the primaries were clearly long, extending well beyond the ventral area when viewed from below.

**Bill:** long and pointed, looking narrow at base and tapering into a long tip. When seen in side profile, combined with flat forehead, looked very long and thin.

**Head:** quite strongly marked for an *Acrocephalus*. Supercilium was white and very obvious before the eye; it extended slightly beyond and was exaggerated by the rather dark eyestripe below.

**Underparts:** Pale (but not clean white); instead rather creamy tinged (but not buff or warm) and rather weakly washed: possibly exaggerated by reflections from foliage. However, this tinge of colour, especially on the flanks, was definite; the vent and belly were rather paler. Breast and throat paler still: appeared very white on glimpses in full sun. My initial views suggested a rather more saturated underside and this concerned me as I knew Basra Reed Warbler is generally reported as very clean and pale below. However, this feature was very difficult to interpret exactly and, on prolonged viewing during the afternoon of 27th April, the bird looked rather paler and less saturated. I subsequently have found web images of Basra Reed Warblers in Kuwait that show some saturation on the underside.

**Upperparts:** hard to judge exactly, due to the bird being exclusively observed from below. Appeared drab brown, lacking russet tones or any warmth, with a rather darker tail and flight feathers.

**Legs:** drab, dirty grayish.

**Song:** The bird sang frequently and was easy to locate, as a result. Although not loud, the song was distinctive and essentially a steady stream of even, monotonous and rather croaking warbles; it entirely lacked the loud, guttural and frog-like tones of a large *Acrocephalus* warbler and was much slower and less erratic or excited than is typical of a small *Acrocephalus* warbler.

All four *Acrocephalus* warblers noted in the introduction are eliminated by at least several of the above characters. All field characters noted above are consistent with Basra Reed Warbler and, taken in combination, equate to a compelling case.

In April 2011, this record was accepted by the Emirates Bird Records Committee as the first for the UAE. As both 1st-year and adult Basra Reed Warblers have a complete moult in the winter quarters (Svensson, 1992), ageing them is not possible in spring. However, the bird can be sexed as a male on the basis of its persistent singing.

## Discussion

For much of the latter half of the 20th century (although not when first described in 1891, from a specimen collected in Tanzania) Basra Reed Warbler was treated as a subspecies of Great Reed Warbler; a strong case for treating it as a full species was made by Pearson and Backhurst (1988) and subsequent authors have generally followed this. Although widespread and, in places, common during passage and winter in eastern Africa, the (currently known) breeding range of Basra Reed Warbler is very restricted, being limited to wetlands along the Tigris and Euphrates Rivers in southern Iraq (Cramp, 1993). As a result of this, and due to habitat destruction, the IUCN Red List 2008 categorised the species as endangered (Jennings, 2010).

However, since 1995 the species has been observed regularly at Jahra wetlands, Kuwait (amongst other sites) and at Riyadh, Saudi Arabia and is considered likely to have bred, at least at Jahra, on an erratic basis (Jennings 2010); the latter author considered that the Arabian breeding population may be less than 20 pairs. There are a number of records of migrant birds from sites between Kuwait and the Red Sea coast of Saudi Arabia, all from a well-defined corridor across central Arabia. Although rarely observed, ringing has indicated that the species can be locally numerous in both Arabia and, especially, on its wintering grounds in eastern Africa. For example, 69 were trapped in a six week period from mid-April at Jahra, Kuwait (Cleere and Kelly, 2009). Given this relative abundance, and despite its restricted breeding range, the occurrence of the species on spring migration in the UAE, only a small distance east of its well-established route, is not too surprising.

## Acknowledgements

I am grateful to Steve James for assistance in the field and for supplying the image used with this note.

## References

- Cleere, N. & Kelly D.J. 2009 Status of selected migrant species in Kuwait: observations and ringing, spring 1997 *Sandgrouse* 31 (1): 61-64
- Harris, A., Shirihai H. & Christie, D. (1996) **Birders Guide to European and Middle Eastern Birds**. Macmillan, London.
- Jennings, M.C. (2010) Atlas of the Breeding Birds of Arabia *Fauna of Arabia* 25: 551-553
- Pearson, D.J. & Backhurst G.C. (1988) Characters and taxonomic position of Basra Reed Warbler *British Birds* 81: 171-178
- Svensson, L. (1992) **Identification Guide to European Passerines**. Privately published, Stockholm.
- Svensson, L., Mullarney K. & Zetterstrom D. (2009) **Collins Bird Guide**. Harper Collins, London.
- Cramp, S. (editor) (1993) **Handbook of the Birds of Europe, the Middle East, and North Africa: The Birds of the Western Palearctic Volume VI: Warblers**. Oxford University Press, USA.

**Oscar Campbell**

c/o British School Al Khubairat,  
PO Box 4001, Abu Dhabi  
email: [ojcampbell25@yahoo.com](mailto:ojcampbell25@yahoo.com)

# The status of Collared Kingfisher in the United Arab Emirates, with comments on the status of Sykes's Warbler and Indian Pond Heron

by Oscar Campbell, Ahmed Al Ali and Neil Tovey



Picture by Ahmed Al Ali

The Collared Kingfisher, *Todiramphus chloris kalbaensis*, is a flagship species of the avifauna of the United Arab Emirates. A virtually endemic subspecies, it is known as a breeding resident only from Khor Kalba, an exclave of Sharjah Emirate, at the southern end of the UAE's east coast, where it inhabits mature mangrove *Avicenna marina* forest along the sheltered, intertidal creeks. The Middle East is at the western extremity of the species' world range; from there it occurs discontinuously along the western seaboard of India and from south east Asia to northern and eastern Australia and across the eastern Pacific islands to Fiji (Fry *et al.*, 1999).

Within the Middle East, the range of Collared Kingfisher is highly localised and fragmented. A small population of the subspecies *T. c. abyssinica* (possibly only several hundred pairs) occurs on the Red Sea coast of southern Saudi Arabia and northern Yemen (and also along the adjacent Red Sea coast of Sudan). A tiny and isolated population (of unknown subspecies) was discovered, with breeding confirmed, in 1999 on Mahawt Island, Oman (see Jennings 2010, and references therein). The UAE population was discovered at Kalba in 1962 and the species is virtually unknown elsewhere in the country (there is only one

record outwith Kalba, at Fujairah, 15km to the north in February 2009; T. Pedersen *pers. comm.*). However, the population at Kalba is clearly not completely sedentary as there are regular records from Khor Shinas and Khor Liwa, Oman. These sites lie respectively 25km and 60km south of Kalba, which presumably acts as the source population as no more than four individuals have been located at either and breeding has not been confirmed (J. Eriksen *pers. comm.*). The only census of the Kalba population was carried out in May 1995, when 44-55 pairs were located (Aspinall, 2010). Due to the small and extremely localised nature of the population, its requirement for mature, undisturbed mangrove forest for nesting and a recent number of damaging developments (some resulting in direct loss of areas of intertidal mud and mangrove) at Khor Kalba, the species is classified as regionally threatened (Aspinall, 2010). Indeed, loss of this population would equate to the global extinction of *kalbaensis*. For this reason, the authors, supported by a generous grant from the Emirates Natural History Group, publishers of *Tribulus*, carried out a comprehensive survey of the Kalba population in 2011. This paper presents the results of this survey.



Fig 1. Distribution of breeding pairs of Collared Kingfisher *Todirhamphus chloris kalbaensis* at Khor Kalba in April – May 2011. Figures within each box indicate the minimum and maximum number of pairs located in each sector of the site. The area in the top right of the khor was not surveyed; it contains no suitable habitat for the species.

## Methodology

Four comprehensive visits were made to Khor Kalba, from October 2010 to May 2011. These followed on from preliminary fieldwork carried out in February 2009 and 2010 by OC. Because of the size of the site (estimated as 6 square kilometres, Boer & Aspinall 2005), and the fact that Collared Kingfishers are generally inactive, and thus difficult to locate, during periods of high water, it was generally not possible to survey the entire site on one visit. For this reason, a population total was arrived at by combining counts from different dates. During the course of fieldwork, it was discovered that birds are much more conspicuous, and much less likely to move long distances when disturbed, during the breeding season (April – June). For this reason, only data gathered during visits on 29th April and 21st May 2011 is utilised. On each visit, the survey was conducted by a team of four observers walking slowly along the main channels and creeks. Both sides of the channel were covered simultaneously and an effort was made to locate birds resting in the interior of the mangrove forest. This was done both visually and orally, including the use of tape-recordings to encourage hidden individuals to call back. All Collared Kingfishers located

were mapped and all obvious pairs were identified as such. It is believed that a good degree of coverage was obtained, although the southernmost part of the site, abutting the UAE – Oman border fence and several very dense (and effectively impenetrable) areas of mangrove lying west of the main channel were only superficially investigated. Mainly consisting of rather young mangrove, none of these areas are believed likely to hold significant numbers of additional pairs of Collared Kingfisher.

Other aspects of the project included the censusing of two other nationally important bird species that occur at Khor Kalba (Indian Pond Heron, *Ardeola grayii* and Sykes's Warbler *Iduna rama*) and the production of a comprehensive portfolio of images (both still and video) to be used to document the unique wildlife of this rich and endangered locality. The former were recorded during surveys searching primarily for Collared Kingfishers (see above); the latter was achieved by AA both during survey work and on numerous other visits. Data gathered on Indian Pond Herons and Sykes's Warblers is briefly presented below, and some of the images acquired during the fieldwork are presented within this paper.



Fig 2. Distribution of Sykes's Warbler territories at Khor Kalba, October 2010 to May 2011. All individuals recorded, either visually or orally, are plotted. Different colours of plots indicate different dates.

## Results

In total, 26 confirmed pairs of Collared Kingfishers were located on territory at Khor Kalba in April – May 2011. However, a number of additional birds, clearly on territory but with no sign of a mate, were also located. Making the reasonable assumption that these birds were indeed paired (with, for example, their mate incubating) brings the total number of pairs to 35. Similar reasoning was used to derive the total of 44-55 pairs in May 1995 (S. Aspinall *pers. comm.*). Assuming that just a small number of additional pairs were missed during the fieldwork (for reasons as discussed above) the maximum population total of Collared Kingfishers at Khor Kalba, as of 2011, is likely to be no more than 40 pairs. The distribution of breeding pairs located is illustrated in *Figure 1* and the significance of this result is discussed below. Although all Collared Kingfishers located showed evidence of being on territory and were recorded as such, little further indication of breeding behaviour was noted. It was undoubtedly too early in the season for fledged juveniles (although AA discovered one on a visit later in summer) but the absence of, for example, courtship feeding or extensive bouts of calling, was surprising. The exception to this was a pair located on 29th April in the process of nest-excavation. This was in a

horizontal bough in a large mature mangrove only a few metres from a large channel. Subsequent visits to the nest by AA failed to relocate the birds; it seems that this nesting attempt was abandoned.

Indian Pond Herons were recorded on three out of four visits, from 16th October until 29th April. The maximum count was 22 on 28th January; only 3 remained on 29th April and none were present on 21st May. The daily maximum for Sykes's Warbler was just 5 individuals. Sightings were widely scattered across the Khor Kalba but it is estimated that the number of territories may be as low as 4-7. The distribution of all Sykes's Warblers recorded (during all visits) is indicated in *Figure 2*.

## Discussion

The total of 35 pairs of Collared Kingfishers recorded in this survey represents more than many local birdwatchers expected to find and greatly exceeds any daily maxima for records submitted to the UAE Bird Database (T. Pedersen *pers. comm.*). However, it still represents a decline of 20 – 36% of the total recorded in 1995. Even if a more optimistic total of 40 pairs is assumed, the decline is still 9-27%.

In the long term, such a rate of decline is clearly unsustainable and will result in the loss of the species as a breeding bird in the UAE. It is also likely, as noted above, to result in the global extinction of the subspecies *kalbaensis*.

Although the Kalba ecosystem as a whole faces many pressures, not all of these are relevant to the conservation of the Collared Kingfisher population there. Unmanaged development and greatly increased visitor pressure on the sand dunes and foreshore, whilst undesirable, does not seem to directly impact the species. Instead, the primary concern is habitat deterioration and loss. The former, including dredging to deepen certain areas and the subsequent inevitable changes to tidal hydrology and increased erosion will lead unavoidably to the latter. Deliberate infilling of mangrove areas for land reclamation is irreversible; this, for example in an area close to the current road leading from the bridge to Kalba Corniche, directly accounts for at least some of the population decline since 1995 (S. James, *pers. comm.*).

The data collected for Indian Pond Heron confirms that Khor Kalba is, by some margin, the single most important site for this species in the UAE (and, by extension, Arabia) and the maximum count of 22 is likely to be close to the total number of individuals over-wintering at the site. Although Jennings (1995)

and Aspinall (2010) considered this species as a potential breeding colonist in Arabia, there is no evidence of this having occurred yet. This species is abundant across the Indian sub-continent and the Kalba wintering population, whilst of national interest, is not otherwise significant. The same could be said of Sykes's Warbler, a species with an extensive breeding range from the Caspian Sea area to northern Pakistan (Castell, 2010). However, Sykes's Warbler is known to breed nowhere else in the Middle East so it is of concern that its population, whilst always rather low at Kalba, also appears to be declining. Aspinall (2010) states that fewer than 15 pairs nest annually and the current work, although not specifically targeting the species, suggests that this may now be somewhat optimistic. If this is the case, the loss of this species as a Kalba breeder may occur sooner rather than later.

To reverse the trends noted here, a comprehensive management plan for Khor Kalba is required without delay. Whilst ideally encompassing the entire ecosystem in a holistic manner, this should, as a minimum, include an assessment of mangrove health in all parts of the site and (subsequent protection or amelioration measures where deemed necessary), provision for annual censuses of both Collared Kingfishers and Sykes's Warblers and contingency measures to guard against the potentially catastrophic



Picture by Ahmed Al Ali

effects of, for example, a major oil spillage. All of this was first suggested over fifteen years ago (Aspinall, 1996) and is still pertinent advice today.

The declaration by the Government of Sharjah, in May 2012, of a protected reserve covering the whole of the Khor Kalba area, including not only the mangroves and creek but also much of the acacia-covered gravel plains stretching inland to the edge of the Hajar Mountains is a major step forward in offering hope of long term conservation of the site and of its avifauna. As part of this reserve, the provision of visitor and tourist facilities has been proposed and is currently being put out to tender. Being colourful and conspicuous, Collared Kingfishers are an ideal flagship species for this reserve but it must be ensured that any developments in no way impact the extent or health of the mangrove forest and associated intertidal areas that they depend on.

### Acknowledgments

We are grateful to the Emirates Natural History Group for their financial support and encouragement for this survey. We are also grateful to a large number of individuals who helped us initially set up the project (Peter Hellyer, Simon Aspinall, Richard Porter), assisted in the field during survey work (Dave Clark, Mark Smiles, Joshua Smithson, Nick Moran) or responded to our numerous queries and requests for information and advice (Tommy Pedersen, Jens Eriksen, Mike Jennings, Simon Aspinall, Steve James). We acknowledge, in particular, the support provided by Simon Aspinall during the latter stages of the illness that led to his death in October 2011.

### References

Aspinall, S.J. 1996. **Status and Conservation of the Breeding Birds of the United Arab Emirates**. Hobby Publications, Dubai.

Aspinall, S.J. 2010 **Breeding Birds of the United Arab Emirates**. Environment Agency – Abu Dhabi, Abu Dhabi.

Boer, B. and Aspinall, S.J. 2005. Life in the Mangroves. In Hellyer, P. and Aspinall, S. (eds) **The Emirates: a Natural History**. Environment Agency – Abu Dhabi, Abu Dhabi.

Castell, P (2010) Sykes's Warbler species account. In Jennings, M.C. 2010. *Atlas of the Breeding Birds of Arabia. Fauna of Arabia 25: 562-564.*

Fry, C.H., Fry, K. and Harris, A. 1999. **Kingfishers, Bee-eaters and Rollers**. Christopher Helm, London.

Jennings, M.C. 2010. Atlas of the Breeding Birds of Arabia. *Fauna of Arabia 25: 452-454.*

Jennings, M.C. 1995. **An Interim Atlas of the Breeding Birds of Arabia**. NCWCD, Riyadh, Saudi Arabia.

**Oscar Campbell**

c/o British School Al Khubairat,  
PO Box 4001, Abu Dhabi  
email: [ojcampbell25@yahoo.com](mailto:ojcampbell25@yahoo.com)

**Ahmed Al Ali**

Director of Protected Areas  
Environment and Protected Areas Authority  
PO Box 2926, Sharjah, UAE.  
email: [ahmedalali@epaashj.ae](mailto:ahmedalali@epaashj.ae)

**Neil Tovey**

c/o P360, Office 307,  
Emarat Atrium Building,  
PO Box 6834, Dubai  
email: [neiltovey@gmail.com](mailto:neiltovey@gmail.com)



# Four tern species newly recorded breeding in Dubai, UAE

by Keith D. P. Wilson

According to Aspinall (2010) there are no published records of tern breeding known from Dubai, one of the seven members of the federation of the United Arab Emirates. Following the formation of the fronds and isolated islands associated with the Palm Jebel Ali and Waterfront Crescent Islands developments, several tern species were recorded by the Emirates Marine Environmental Group as nesting each year since 2008 at the aforementioned Dubai marine reclamations. Three species nested in 2008, 2010 and 2011, two species in 2009 and four species in 2012. The tern species involved comprised Saunders' tern *Sterna saundersi*, white-cheeked tern *Sterna repressa*, lesser crested tern *Sterna bengalensis* and lastly, in 2012 for the first time, bridled tern *Sterna anaethetus*. The location of the two island breeding sites at Palm Jebel Ali (N 25° 01.265'; E 54°58.441') and Waterfront Crescent Island 2 (N 24° 58.185'; E 54°52.950') are shown in Figures 1 and 2. Notes on the breeding activities at these sites over the five-year period 2008-2012 are provided for each species.

## Background

Reclamation work on Palm Jebel Ali commenced in 2002 and by the end of 2008 the land formation was largely complete. However, as a result of the 2008 financial crisis, in 2009 the entire project was placed 'on hold' and as of June 2012 there are no plans to resume reclamation work in the near future. The incomplete land formation at Palm Jebel Ali comprises one partially built frond in the northeast of the Palm and the planned isolated Crown Island above the trunk consisting of three small islands. One of these latter small isolated islands, the westernmost island, is 350 m in length and has proved to be highly attractive to breeding terns (see *Figures 1, 3 & 4*).

To the west of Palm Jebel Ali, the Nakheel Waterfront and Waterfront Crescent Islands Projects are located. These are very large-scale developments planned to house some 1.5 million people when completed. Reclamation work on the Waterfront Crescent Islands was placed 'on hold' in 2009. Only two of the planned five Waterfront Crescent Islands have land formations above sea level i.e. Islands 1 and 2. Island 1 is used as a breeding site by Saunders' tern and the partially completed Island 2 is now used as a breeding site by three further species of tern (see *Figures 2 & 5*). The area of reclamation at Island 2 comprises a sandy strip some 570 m by 150 m which is protected by a gabbro rock breakwater on its exposed, outer northwest side.

Apart from the occasional isolated stand of *Zygophyllum qatarense*, the island breeding sites at Palm Jebel Ali and Waterfront are devoid of vegetation.

## Monitoring

The Emirates Marine Environmental Group (EMEG) was contracted by Nakheel over the 2008-2012 period to provide environmental services to Nakheel. These services, *inter alia*, included the completion of beach patrols to remove litter and monitor turtle nesting activity at Waterfront, Waterfront Crescent Islands and Palm Jebel Ali beaches in western Dubai. Any incidental wildlife observations

such as cetaceans and breeding coastal birds were also recorded and documented.

## Saunders' tern (*Sterna saundersi*)

A few pairs of Saunders' tern were first recorded breeding in Dubai on flat sandy areas at the tips of the two north-western Palm Jebel Ali fronds (Frond I and Frond J) in early May 2008 (see *Figures 1, 3 & 4*). They were subsequently recorded nesting on these two frond tips each year from April 2009 to 2011 in small numbers (*ca.* 10 pairs).

In May 2012 all nesting on Palm Jebel Ali fronds ceased due to the presence of Arabian red foxes *Vulpes vulpes arabica*. Arabian red foxes took up residence under the Trunk-Spine bridge structure in the centre of Palm Jebel Ali during the winter of 2011-12 and numerous fox footprints were found at the traditional Saunders' tern frond nesting areas in early May 2012. In mid-May 2012 at least 12 pairs were recorded nesting on flat sandy areas in the centre of the north-westernmost isolated island at the Palm Jebel Ali crown (see *Figure 1*). It appears that the terns may have moved to the isolated island, also used by white-cheeked terns and lesser crested terns in response to fox predation or the threat of fox predation.

In May-June 2011 and again in May 2012 *ca.* 20 pairs of Saunders' tern were also recorded breeding at the inner, eastern facing, sheltered beaches of Waterfront Crescent Island 1 (see *Figures 2 & 5*).

Nests consisted of shallow scrapes decorated with a few small shells located in open, flat sandy areas, adjacent to the sea, usually up to 50 m apart but on occasion >100 m from the nearest neighbouring Saunders' tern nest.

## White-cheeked tern (*Sterna repressa*)

Wilson (2008) reported the presence of 1,000 pairs of white-cheeked terns laying eggs and successfully rearing chicks at the north-westernmost isolated island at the Palm Jebel Ali Crown (see *Figure 1, 3 & 4*). Between 500 to 1,000 pairs also nested successfully



Fig 1. Nest site locations at Palm Jebel Ali.

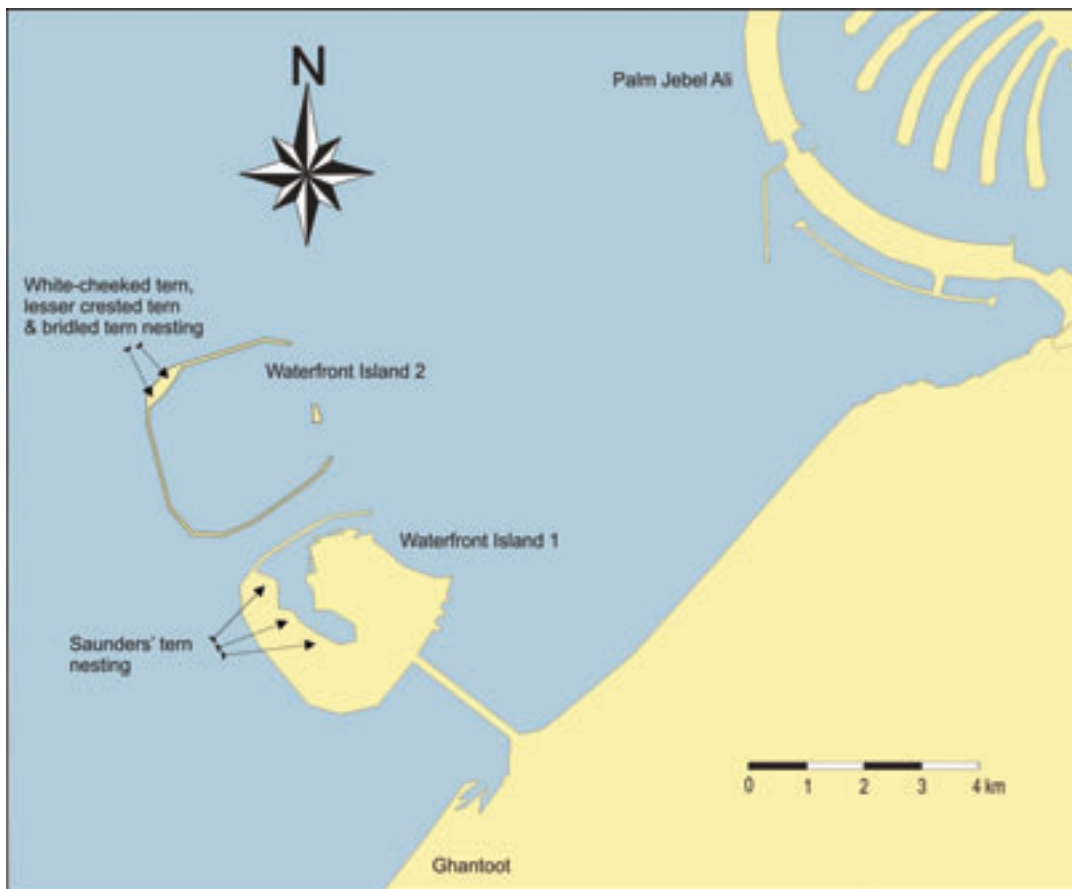


Fig 2. Nest site locations at Waterfront Crescent Islands



Fig 3. Aerial photograph of the four isolated islands formed by incomplete formation of the Palm Jebel Ali Crown (three nearest isolated islands) and the north-easternmost frond (furthest isolated island). Only the closest isolated, north-westernmost island, at its north-western tip, has been used for nesting by white-cheeked terns and lesser crested terns at Palm Jebel Ali.

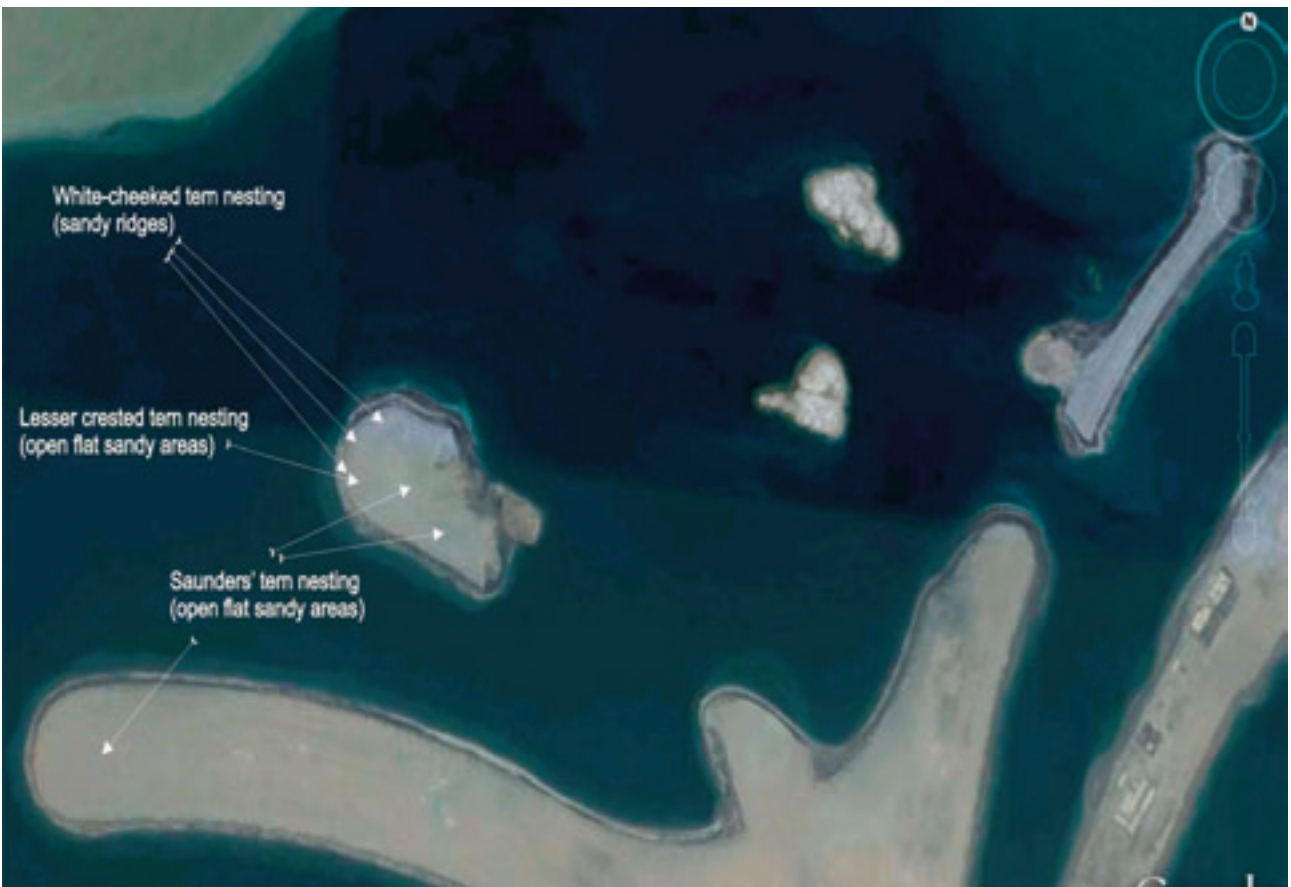


Fig 4. Palm Jebel Ali tern nesting areas at north-westernmost isolated island.

in 2009, 2010 and 2011 with the first eggs laid each year in early May. In 2012 ca. 500 pairs were found actively nesting in May 2012 at the Palm Jebel Ali north-westernmost Crown Island.

In early June 2011 ca. 150 pairs of white cheeked terns were recorded actively breeding at Waterfront Crescent Island 2 where they successfully raised chicks (see *Figure 2 & 5*). In mid-May 2012 the colony was again recorded nesting at Waterfront Crescent Island 2 and the numbers of breeding pairs had significantly increased to ca. 250 compared with 2011.

White-cheeked terns nest in groups exclusively on offshore islands (Jennings, 2010), with each nest scrape separated by a few metres. Nests are decorated with shells and located on flattish open ground but birds prefer low sandy ridges where such land forms exist.

#### **Lesser crested tern (*Sterna bengalensis*)**

Wilson (2008) reported 250 pairs of lesser crested terns laying eggs and successfully rearing chicks at the north-westernmost isolated island at the Palm Jebel Ali Crown (see *Figures 1, 3 & 4*). No lesser crested terns were recorded nesting in Dubai in 2009 or 2010 but in early June 2011 ca. 700 pairs laid eggs at Waterfront Crescent Island 2 (see *Figures 2 & 5*). On 16 May 2012 ca. 700 pairs were again recorded

nesting at Waterfront Crescent Island 2 and egg-laying had already commenced there by mid-May. The colony at Palm Jebel Ali was also active in 2012 with ca. 250 breeding pairs, but eggs were not laid there until 6 June 2012.

The lesser crested tern records provided here represent the most easterly breeding location for this species in the Arabian Gulf (Jennings, 2010). The closest colonies are located at Qarnein Island, Umm Qasar and Ghashah in Abu Dhabi, the westernmost emirate of the UAE.

Egg-laying in each lesser crested tern colony is highly synchronised. Nests are shallow scrapes and are tightly packed together on flat sandy, open ground.

#### **Bridled tern (*Sterna anaethetus*)**

Bridled terns were first recorded actively nesting, either raising chicks or incubating eggs, in rock piles alongside white-cheeked terns at Waterfront Crescent Island 2 (see *Figures 2 & 5*), on 16 May 2012 (Wilson, 2012). Approximately 50 breeding pairs were recorded.

Bridled terns often nest in rocky cliff ledges on offshore islands but will nest amongst rock piles and low vegetation if no rocks or cliff sites are present. At Waterfront Crescent Island 2, all of the nests were located in rock pile crevices.



Fig 5. Waterfront Crescent island 2: tern nesting areas.



Bridled terns nesting at Waterfront Island 2



White-cheeked tern nesting at Waterfront Island 2



Bridled terns nesting at Waterfront Island 2



Lesser crested tern nesting at Waterfront Crescent Island 1, 16 May 2012.



Lesser crested terns gather at Palm Jebel Ali.



Saunder's tern nest on Palm Jebel Ali frond, 28 April 2010.



White-cheeked terns nesting at Waterfront island 2

## Discussion

The very extensive marine reclamation developments placed 'on hold' in Dubai principally comprise Moon Island, Waterfront Crescent Islands, Waterfront, Palm Jebel Ali, The World and Palm Deira. Hitherto only the two sites described above at Waterfront Crescent Islands and Palm Jebel Ali have been confirmed to support breeding populations of terns. Moon Island (N 24° 18.656'; E 54°39.397') was visited by EMEG, 25 April 2011, and a large group of ca. 500+ of mixed adult and sub-adult lesser crested terns were present. It is possible that the adult members of this group may have commenced breeding, perhaps in May or early June 2011 at this location but no subsequent visits were made during the 2012 breeding season to confirm. However, all other lesser crested terns nesting sites in the UAE, including the new Dubai sites mentioned here, and the known breeding sites in Abu Dhabi at Ghashah, Umm Al Kurkum, Umm Qasar, Muhayimat and Qarnein, are located adjacent to breeding colonies of white-cheeked terns. However, Jennings (2010) reports that lesser crested tern may nest alone.

The only known sites selected by white-cheeked, lesser crested and bridled terns, amongst the vast choice of unoccupied offshore newly formed reclamations in Dubai constructed since 2002, comprise just two small, less than 1 km long, isolated islands. White-cheeked terns were the first terns to colonise shortly followed by lesser-crested terns and finally bridled terns on just one of the two islands; the other island currently supports no suitable bridled tern nesting habitat i.e. no rocks or low vegetation. It is highly likely that sites at The World will also be selected as tern breeding sites in the near future provided these developments remain 'on hold' and undisturbed.

The numbers of four tern species newly recorded breeding in Dubai are regionally important and

constitute a significant proportion of their respective UAE breeding populations, which were recently estimated in Jennings (2010); Saunders' tern (300-500 pairs) white-cheeked tern (25,000+ pairs), lesser crested tern (20,000-24,000 pairs) and bridled tern (40,000-45,000 pairs).

If the reclamations at Palm Jebel Ali and Waterfront Islands are resumed at some future date and completed as currently planned then the two small isolated islands currently used for tern nesting will become part of much larger island complexes. The two islands will then be heavily disturbed by dredging, reclamation and ultimately occupation of the islands rendering them unsuitable for tern breeding. It would be possible, given the desire and motivation, to support tern colonies on alternative sites in Dubai or to modify the Master Plans to accommodate the now well established tern colonies.

## References

- Aspinall, S., 2010. **Breeding Birds of the United Arab Emirates**. Environment Agency, Abu Dhabi.
- Jennings, M.C., 2010. *Fauna of Arabia, Volume 25: Atlas of the Breeding Birds of Arabia*. KACST, SWC & Senckenberg, Switzerland.
- Wilson, K.D.P., 2008. Update on tern breeding success at Palm Jebel Ali. *Vision Builder* (Nakheel Newsletter, Dubai, UAE, September 2008). 17: 6-7.
- Wilson, K.D.P., 2012. *Making Waves*. Emirates Marine Environmental Group, Dubai, UAE, Newsletter April-May, 2012. 5:6.

**Keith D. P. Wilson**  
Marine Programme Director,  
**Emirates Marine Environmental Group**  
P.O.Box: 12399 Dubai, UAE  
email: [kdpwilson@gmail.com](mailto:kdpwilson@gmail.com)

## An American ornithologist at Sharjah in 1944-45

by Nicholas Stanley-Price

Records of birds seen in the United Arab Emirates (formerly the Trucial States) before the 1970s are few and far between, and most of those date to the 1960s. Very few indeed come from before 1950.

To the distinguished American wildlife artist Robert M. Mengel (1921-1990), however, we owe a record of several bird species that he noted while based at Sharjah nearly seventy years ago during the latter years of the Second World War. Mengel acquired his reputation for ornithological illustration as a result of his massive **Birds of Kentucky** (Mengel 1962) and his hundreds of illustrations for the four-volume **Handbook of North American Birds** published for the American Ornithologists' Union (Palmer 1962-1988). After completing his BA at Cornell (interrupted by war service), he took MA (1950) and Ph.D (1958) degrees in zoology at the University of Michigan. He spent most of his subsequent career at the University of Kansas: he was made Curator of Ornithology and Associate Professor of Systematics and Ecology there in 1967, becoming a full professor in 1971 (Peck 1991).

A summary of his academic career does not do justice, however, to the wide interests and abilities of Mengel that spanned science, art, history and literature – one of his achievements was an exemplary ornithological bibliography that resulted from his cataloguing the Ellis collection in the University of Kansas libraries. But it is in his art that many would say that his greatest talent lay. He received no formal training in art but was naturally gifted, and used this gift to study and emulate the wildlife art of others whom he admired such as Louis Agassiz Fuertes (1874-1927) who had had a long association with Cornell University (Peck 1991).

How did Mengel come to be based at Sharjah? While still a student at Cornell in 1942, he joined the United States Army Air Forces (USAAF) and was eventually assigned to Airways Communications in the Middle East. There he spent some 21 months, first in Egypt, then at Sharjah in the Trucial States and finally in Tripolitania (Libya). During his eight months at Sharjah (July 1944 to March 1945) he was attached to the Air Transport Command of the USAAF which had its own camp adjacent to the British Royal Air Force (RAF) base there. The two forces shared some of the airfield facilities (Stanley-Price 2012). As part of his work, he made at least one visit (in February 1945) to Jask on the Iranian coast where the USAAF also had aircraft landing rights.

At both Sharjah and Jask (and during his postings to Cairo and Tripolitania) Mengel made sketches in pencil and watercolour. A collection of more than 1000 of his drawings is now in the Ewell Sale Stewart Library at the Academy of Natural Sciences of

Philadelphia (Collection 810. Robert Mengel Drawings and Paintings). Among them, most of his drawings from the Middle East are of birds or other wildlife (for example, the skull of a dromedary in Sharjah) but others depict scenes and companions from his life in the armed forces. A sketch in graphite (reproduced in Peck 1991, Fig. 5) shows two airmen on the beach at Jask, while a watercolour dated 1944 depicts the newly-built control tower at the Sharjah airfield which was shared by the RAF and USAAF (the watercolour is published in Stanley-Price 2012, fig.5.9).

Of the bird species recorded by Mengel at Sharjah, one merited a brief published note since (in Mengel's opinion) its presence "represented a considerable range extension" (Mengel 1948). On March 12, 1945, he saw approximately 25 dowitchers (*Limnodromus semipalmatus*) feeding in shallow water in Sharjah Creek and, on a return visit on March 21, he found more than 100 present. "On this occasion I noticed that they were large, substantially larger than the numerous Redshanks (*Tringa totanus*) with which they were associated. They were very tame, and permitted close approach time after time. I made several sketches of their markings." On his return to the United States, he examined specimens in the Museum of Comparative Zoology at Cambridge, Massachusetts, which led him to believe that his identification had been a correct one.

The Philadelphia collection contains drawings made by Mengel at Sharjah of birds that he identified there as follows: *Coracias b. benghalensis* [the Blue Jay or Indian Roller], *Neophron percnopterus* [the Egyptian Vulture], *Necrocytes* [sic] *monachus* ????, *Oenanthe deserti atrogularis* [the Desert Wheatear], *Charadrius alexandrinus* [the Kentish Plover] and *Burhinus oedicnemus astutus* [the Persian Stone-Curlew]. There are half a dozen other sketches of species that remain unidentified.

Since there are few written ornithological records from Sharjah prior to the arrival in the 1950s of naturalists such as David Harrison (Harrison 1959), it is worth complementing Mengel's observations with those of an amateur who was at Sharjah at the same time as him. Raymond O'Shea was the Station Manager at Sharjah airfield from November 1944 to June 1945. In his memoir of his time there (O'Shea 1947, 96-97), he laments that his knowledge of botany and zoology was abysmally limited, but he made notes and sketches of the wildlife that he saw. (Although their postings to Sharjah overlapped for some five months, there is no indication that the young American and the Station Manager knew each other, let alone discovered their shared interest in wildlife.) Among the bird species that he mentions finding in the desert and wadis inland from the airfield, in addition to vultures,



are the houbara bustard, desert lark, kingfisher, sandpiper, blue jay [Indian roller], hoopoe, blue-headed wagtail, desert wheatear, stonechat, small white owl, [presumably little owl] and a species of nightjar. Doves were common in neam trees and there were numerous raptors and falcons. For several days he observed what he described as a small colony of the migrant Green Bee-eater (*Merops orientalis*) in a clump of date-palms; a more frequent visitor was the Indian roller or Blue Jay (*Coracias benghalensis*) from India. On stagnant salt water, he saw the (White) Cattle Egret (*Bubulcus ibis*), the Grey Heron (*Ardea cinerea*) and wild duck.

## Acknowledgements

My thanks to the Ewell Sale Stewart Library at the Academy of Natural Sciences of Philadelphia for allowing me to examine the Mengel collection, and to Dr Robert Peck for his reminiscences of Robert Mengel.

Rev. March 2012

## References

Harrison, David. 1959. **Footsteps in the Sand**. London: Ernest Benn.

Mengel, Robert M. 1948. *Limnodromus semipalmatus* in Arabia. *Auk* 65, 146.

Mengel, Robert M. 1965. **The Birds of Kentucky**. Monograph 3, American Ornithologists' Union.

O'Shea, Raymond. 1947. **The Sand Kings of Oman, being the experiences of an R.A.F. Officer in the little-known regions of Trucial Oman, Arabia**. London: Methuen.

Palmer, Ralph S. (ed.). 1962-1988. **The Handbook of North American Birds**, American Ornithologists' Union, Vol. 1, 1962; Vols. 2 and 3, 1976; Vols. 4 and 5, 1988. New Haven: Yale University Press.

Peck, Robert M. 1991. 'Robert M. Mengel: the blending of Science and Art.' *The Wilson Bulletin* 103, no. 3, 339-356.

Stanley-Price, Nicholas 2012. **Imperial Outpost in the Gulf: the Airfield at Sharjah (UAE), 1932-1952**. Brighton: The Book Guild.

**Nicholas Stanley Price**

Via Giulia 167, 00186 Roma, Italy.  
email: [nstanleyprice@tiscali.it](mailto:nstanleyprice@tiscali.it)

**Oscar Campbell, Chairman of the Emirates Bird Records Committee**, comments as follows:

Robert Mengel's records constitute an interesting and valuable insight into the avifauna of coastal Sharjah from a time when systematic observations of birds in the United Arab Emirate were virtually non-existent. *Limnodromus semipalmatus*, the Asian (or Asiatic) Dowitcher, breeds in southern Siberia, north Mongolia and north-eastern China in extensive freshwater wetlands in steppe and forest zones and winters on extensive coastal mudflats from eastern India to the Greater Sundas (where the largest wintering populations occur), the Philippines, New Guinea and north-west Australia (Brazil 2009, Robson, 2000). It is rare and very localised in the westernmost part of its wintering range and, globally, is categorised as near-threatened, due to a moderately small population (estimated as 23,000 in 2005) that is likely to be declining (BirdLife International, 2012). It has been recorded in Uzbekistan and north easternmost Kazakhstan (OSME, 2010), and the latter reference includes the intriguing statement 'unknown wintering areas round [sic] the Arabian Sea?'

Hence, its presence in the UAE, whilst unprecedented, at least in recent times, would not be totally unexpected and, indeed, Great Knot *Calidris tenuirostris*, whilst occupying a higher latitude, more easterly, breeding range, has a very similar winter range that does (just) reach as far west as the UAE and Oman. Indeed, the two species may frequently be seen together in winter in the Sundas and northern Australia .

Reports of vagrancy by Asian Dowitcher to the UAE in Hollom *et al.* (1988), according to Richardson (1990), are believed to have been based on Mengel's original paper, Richardson also noting that "These records are under review to rule out Bar-tailed Godwit..." Richardson (*in litt.*, 4 June 2012), also noted that the record had not been accepted for inclusion in the checklist of the Arabian Gulf states published in **Sandgrouse** volume 1 (Bundy & Warr 1980). As further noted by Richardson and Bannon (1991), Mengel's published note on his record of Asian Dowitcher in Sharjah (Mengel, 1948) contains no substantiating details that would allow a contemporary record committee to assess whether the record meets modern criteria for acceptance nor do they, equally unfortunately, include any comparative mention of Bar-tailed Godwit *Limosa limosa*. This species, not either of the American species of dowitcher, one of which (Long-billed *L. scolopaceus*) has been recorded

in Oman (OSME 2010) is certainly the species with which Asian Dowitcher is most likely to be confused. *L. limosa* is, of course, a common winter visitor to all intertidal areas of the UAE. The number of dowitchers recorded by Mengel at Sharjah (up to 100) is exceptional but may conceivably reflect a former abundance (and more westerly wintering distribution) for the species. Given the undoubted stature of Mengel as one of the pre-eminent ornithologists of his day, the EBRC are endeavouring to contact the Ewell Sale Stewart Library in Philadelphia in the hope that it may be possible to examine any relevant sketches executed by Mengel and verify this potentially remarkable historical record.

Two further brief comments on Mengel's other records:

His identification to sub-specific status for Desert Wheatear and (Persian) Stone Curlew may be open to question since even today, seventy years later, some of these races are little studied and their field identification is likely to be tentative rather than definite.

Finally, his identification of *Necrostyctes* [sic] *monachus* ??? [probably *Necrosyrtes monachus* – the Hooded Vulture] may be open to question. This is a widespread African species and, doubtless, was even more widespread 70 years ago but, even then, there are no historical records from anywhere in Arabia as per the regional checklist of the Ornithological Society of the Middle East, OSME, It is mentioned there only because of a bird seen on a ship in the middle of the Red Sea in about 1959. There are no records from Israel, known for the large passage of raptors migrating to and from Africa.

O'Shea's reference to a colony of 'migrant Green Bee-Eater ... in a clump of date-palms' may refer to Blue-cheeked Bee-Eater, which, unlike Green, is a migrant, although both species breed not in date-palms but in holes in sandy banks and similar locations.

#### **BirdLife International. 2012. Species Factsheet:**

Asian Dowitcher *Limnodromus semipalmatus*  
<http://www.birdlife.org/datazone/speciesfactsheet.php?id=3038> Accessed 27 May 2012

Brazil, Mark. 2009. **Helm Field Guide: Birds of East Asia**. Christopher Helm: London .

Hollom, P.A.D., Porter, R.F., Christensen, S. & Willis, I. (1988). **Birds of the Middle East & North Africa**. Poyser.

OSME. 2012 OSME Region List of Bird Taxa: Part A, non-passerines  
[http://www.osme.org/orl/non-pass\\_v2.3.pdf](http://www.osme.org/orl/non-pass_v2.3.pdf) Accessed 27 May 2012

Robson, Craig. 2000. **A Field Guide to the Birds of South-East Asia**. New Holland : London .

Richardson, Colin & Bannon, John. 1991 Prospective bird species for the UAE. *Tribulus* 1.1 9-13.

# Stick Insects (Order Phasmida) of Eastern Arabia: A Photographic Review

by Gary R. Feulner

## Abstract

Records and photographs of stick insects (Insecta: Phasmida) from the UAE and northern Oman, made by a number of experienced resident naturalists, are compiled and presented here. The available information indicates that at least two species of the genus *Clonaria* (Phasmida: Diapheromeridae: Pachymorphini: Gratidiini) (Brock, *Phasmida Species File Online*) are represented. Determination to species will depend on the collection of male specimens.



Fig. 1a. Stick insect, Dubai, 1990 (collected by Carolyn Lehmann).



Fig. 1b. Stick insect, Dubai, 1990, profile of head (collected by Carolyn Lehmann).

Stick insects or walking sticks (Order Phasmida or Phasmatodea†) are leaf-eating insects best known for their elaborate camouflage. Some 2,500 species are known worldwide. They resemble the stems or twigs of plants, or in some cases the leaves. Their disguises may include warts, ridges, thorns, blotches and changing colouration. Their stillness and body carriage enhance the deception. For most, camouflage is their only defence, but a few are poisonous or exude noxious chemicals (Sivinski 1992).

Stick insects are rare in the arid and sparsely vegetated environment of the UAE and northern

Oman. They are not normally collected in most traps (van Harten, *pers. comm.*) and it is inherent in their lifestyle that they are not easily noticed. As a result they have either been omitted (Walker & Pittaway 1987, van Harten 2008-2011) or treated summarily (Tigar 1996, Gillett 1996, Gillett & Gillett 2005, Howarth & Gillett 2008) in most comprehensive accounts of UAE insects to date.

The UAE Insect Project, which has so far produced four volumes of *Arthropod Fauna of the United Arab Emirates* (van Harten 2008-2011), collected only a few specimens of stick insects, of which one male was



Fig. 1c. Stick insect, Dubai, 1990, ventral oblique view of anterior (collected by Carolyn Lehmann).



Fig. 2. Stick insect, Muscat, 1999 (photo by Hanne & Jens Eriksen).



Fig. 3. Stick insect, Wadi Qinan, 1999.

identified by specialist Oskar Conle as being probably *Clonaria dicranura* (Uvarov, 1939) (van Harten, *pers. comm.*), a species described from the edge of the Empty Quarter in southwestern Saudi Arabia (Brock, *Phasmida Species File Online*). Synonyms are *Gratidia dicranura* Uvarov, 1939 and *Ramulus dicranurus* (Uvarov, 1939) (van Harten, *pers. comm.*).

The genus *Clonaria* Stal, 1875 is found in Africa, the Middle East, Central and Southeast Asia, as well as Paraguay(!) (Brock, *Phasmida Species File Online*). It is distinguished from the genus *Ramulus* Saussure, 1862, which, according to the present interpretation, has an exclusively Asian distribution from Pakistan eastwards (Brock, *Phasmida Species File Online*; van Harten, *pers. comm.*). At least two other species of *Clonaria* have been recorded from Saudi Arabia (Brock, *Phasmida Species File Online*).

Recent inquiries to a number of experienced resident naturalists and nature photographers attentive to insects has revealed fourteen records of Phasmida over the past 22 years. Those records are set out in Table 1, along with the corresponding photographs, where available (*Figs. 1 through 10*).

Through the assistance of Antonius van Harten of the UAE Insect Project, the accompanying photographs, excluding *Figs. 2* and *9*, have been reviewed by Oskar Conle. He considers that they represent at least two different species of a single genus, but more detailed photographs or collection of male specimens, mating pairs or eggs are required in order to permit specific determinations. Conle wrote

as follows:

"Thank you for the photos. These show at least two species of the genus *Clonaria*. I need to see more detailed photos of the males end of the abdomen from dorsal, lateral and ventral view. This will give me a chance to identify the species."

Males can be distinguished by the pair of claspers at end of abdomen, used to hold the female during copulation. Thus *Figs. 2, 4, 6, 7, 8* and *10* appear to show male stick insects, whereas *Figs. 1, 3, 5* and *9* show females. Males are also normally smaller than females of the same species, sometimes very much smaller. Consistent with that, the females shown in *Figs. 1* and *5* are the two largest of the stick insects among the UAE records.

As to female stick insects, Conle added:

"The females are nearly impossible to identify without having them collected together with a male *in copula*. Eggs could also help a lot, so in case you might be able to catch some females and make them lay eggs and send them to me, this would also help, as these are very helpful for identifying a species."

The injunction to collect mating pairs may seem like a rather ambitious one, but the possibility of finding stick insects *in copula* is not as fortuitous as it might at first seem. Copulation in stick insects is notoriously prolonged, lasting hours, days or even weeks (Sivinski 1992). The record is said to be 79 days in an Indian species.

**Table 1: Stick insect (Phasmida) records from the UAE and northern Oman.**

Date	Location & Elevation (above sea level)	Fig No.	Habitat	Remarks	Observer/s
1990	Dubai est'd 10-30 m	Fig. 1(a-c)	Grounds of beach hotel.	Head + body length = 92 mm. Short antennae. Distal abdomen not well preserved but no terminal claspers evident.	C. Lehmann
c.1992-1996	Abu Dhabi est'd 100-250 m	-----	Sand desert. "Several stick-like specimens ... on the desert grass <i>Pennisetum divisum</i> ..." (Tigar 1996, p. 179).	The identity of these insects was said by Tigar (1996) to be "unknown", but subsequently a specimen at EAD, likely to have been collected by Tigar, had been identified as <i>Ramulus</i> sp. (Howarth & Gillett 2008, Table 9.3).	B. Tigar
15-11-1996	Jebel 1442, Wadi Rayy Wilayat Mahdhah, Oman 1100 m	-----	In drying shrub in steep, rocky wadi.	Small, straw-coloured.	GRF
20-06-1997	Wadi Baqarah Ra's al-Khaimah, UAE 500 m	-----	In shrub along wadi bank.	Small, green. Short antennae held in "V" shape. Swayed gently side-to-side after each step.	GRF
18-02-1999	Sultan Qaboos University, Muscat, Oman 50m	Fig. 2; See Gillett & Gillett (2005) p. 173.	Residential area with mature gardens. Botanical gardens nearby.	Terminal claspers.	H. & J. Eriksen
15-04-1999	Wadi Qinan, Shawkah Ra's al-Khaimah, UAE 400m	Fig. 3	In dwarf shrub of <i>Taverniera cuneifolia</i> along wadi bank in low hills.	Small, straw-coloured, smooth bodied. Short antennae (visible under magnification). No terminal claspers evident.	GRF
15-04-2001	Sultan Qaboos University, Muscat, Oman 50m	Fig. 4	Residential area with mature gardens. Botanical gardens nearby.	Terminal claspers.	H. & J. Eriksen
17-01-2003	Jebel Sumayni Wilayat Mahdhah, Oman 1000 m	Figs. 5 (a & b)	Vegetated mountain slope (in shallow crack in bedrock near summit ridge, sheltering from high wind).	Head + body length = 70 mm. Legs and abdomen distinctly banded. Striped head, bark-like texture. No terminal claspers evident.	GRF
21-11-2003	Wadi Hassatayn, Hatta Dubai, UAE 450m	Fig. 6	Wadi terrace (perched on varnished boulder).	Striped head, terminal claspers.	GRF
28-01-2005	Jebel Sfai Ra's al-Khaimah, UAE 750 m	Fig. 7	Rocky mountain slope (on weathered rocks).	Short antennae. Short terminal claspers. Bark-like texture.	GRF
11-03-2005	Wadi Musayliq (upper) Wilayat Mahdhah, Oman 900m	Fig. 8	Wadi terrace (perched on varnished rocks).	Terminal claspers.	GRF
c.2000-2005	Al Faqah Eastern Region Abu Dhabi, UAE 250m	-----	Grassy sand desert. "[U]nidentified adult insects ...in areas of grassy desert near Al Faqah, Abu Dhabi" (Gillett & Gillett 2005).		M.P.T. Gillett & C. Gillett
c.2005-2008	Al-Hayer Eastern Region Abu Dhabi, UAE 300m	Fig. 9; See Howarth & Gillett (2008), p. 400.	Sand desert. "Found at roadside lights in the desert just north of Al Hayer . . ." (Howarth & Gillett 2008).	Short antennae. Howarth & Gillett (2008) believe this is "probably the same species" recorded by Tigar (1996) from Abu Dhabi.	B. Howarth & M.P.T. Gillett
07-03-2012	Abool Wilayat Mahdhah, Oman 600 m	Figs. 10 (a-d)	Mountain front oasis settlement (found on mud wall of mosque).	Short antennae. Short terminal claspers. Bark-like texture. Prior to 2005, small nymphs were known from the Mahdhah area of Oman (Gillett & Gillett 2005).	M.A.R. Khan



Fig. 4. Stick insect, Muscat, 2001  
(Picture by Hanne & Jens Eriksen).



Fig. 6. Stick insect, Wadi Hassatayn, 2003.



Fig. 5a. Stick insect, Jebel Sumayni, 2003.



Fig. 7. Stick insect, Jebel Sfai, 2005.



Fig. 5b. Stick insect, Jebel Sumayni, 2003, close-up of head.



Fig. 8. Stick insect, Wadi Musayliq, 2005.



Fig. 9. Stick insect, Al Faqah, ca. 2008 (Picture by Michael Gillett).



Fig. 10a. Stick insect, Abool, 2012 (Picture by M.A.R. Khan).

What is the purpose of such a prolonged coupling? Male stick insects have been found to often outnumber females. Female stick insects store male sperm, like many other insects, but, unlike many other insects, they lay only a few eggs at a time. Under these conditions it may be advantageous to the male to monopolise the female to prevent access by other males. And for the female, the physical presence of the male may confer a measure of protection from attack by potential predators, particularly birds (Sivinski 1992).

It is tempting, as a heuristic device, to try to propose a tentative division of the available records into morphological and/or ecological groupings that might correspond to distinct taxa. Stick insects undergo incomplete metamorphosis (juvenile stages or nymphs resemble the adults) and among the gross differences likely to indicate distinct species is the relative length of the antennae: compare *Figs. 2, 4, 5, 6 and 8*, having relatively long antennae (reaching more or less to the first articulation of the forelegs) with *Figs. 1, 3, 7, 9 and 10*, having relatively short antennae (1.5 to 2.0 times the length of the head). Such a division is consistent with Conle's reckoning that at least two species are present, although it is not supported by additional correlation with any obvious ecological parameters or with morphological features such as surface texture and colouration. However,

there is currently very little experience of how, in these insects, such additional features may vary or change with individual development and/or with the environment to which they are exposed.

The author acknowledges with thanks the assistance of Antonius van Harten, who was, as always, both generous of his time and judicious in his advice, and the ready cooperation of Dr. Mohammed Ali Reza Khan, Hanne and Jens Eriksen, and Carolyn Lehmann. This note is dedicated to Mrs. Lehmann, who died in October 2011, before the specimen which she had so carefully collected many years before could be incorporated into the larger body of knowledge which she was dedicated to advancing.

[†The Order Phasmida is referred to by some authors as Order Phasmatodea. The two are synonymous and derive from the Greek and Latin *phasma*, meaning apparition or ghost. Phasmida is considered incorrectly formed as the name of an Order under the rules of the International Code of Zoological Nomenclature. Phasmatodea is correctly formed and is said to be gaining in popularity (Wikipedia), but Phasmida is used by a number of authoritative references (e.g., Brock, *Phasmida Species File Online* and *BugGuide.Net*) and the common noun form phasmid(s) is used even by some sources, such as Wikipedia, which adopt Phasmatodea.]



Fig. 10b. Stick insect, Abool, 2012, dorsal close-up of head  
(Picture by M.A.R. Khan).



Fig. 10c. Stick insect, Abool, 2012, specimen on hand.  
(Picture by M.A.R. Khan).



Fig. 10d. Stick insect, Abool, 2012, details of head  
(Picture by M.A.R. Khan).

## References

- Brock, P.D. *Phasmida Species File Online*. Version 2.1/4.1. [Accessed 14 August 2012] Available at: <<http://phasmida.speciesfile.org>>.
- BugGuide.Net. *Order Phasmida – Walkingsticks*. Available at: <<http://BugGuide.Net>> [Accessed 21 September 2012]
- Gillett, M.P.T. 1996. Insects. In P.J. Vine (ed.) *Natural Emirates*. Trident Press. pp. 95-106.
- Gillett, M.P.T., and Gillett, C. 2005. Insects & Other Arthropods. In P. Hellyer and S. Aspinall (eds.) *The Emirates – A Natural History*. Trident Press. pp. 169-194.
- Howarth, B., and Gillett, M.P.T. 2008. The Terrestrial and Freshwater Arthropods of Abu Dhabi Emirate. In R. Perry (ed.) *Terrestrial Environment of Abu Dhabi Emirate*. Environmental Agency – Abu Dhabi. pp. 378-463.
- Khan, M.A.R. 2012. Date with a Stick Insect. **Gazelle 27(4)**: 6-7. Newsletter of the Dubai Natural History Group (April 2012).
- Sivinski, J. 1992. When Is a Stick Not a Stick? **Natural History 06/92**: 30-35.
- Tigar, B. 1996. A Preliminary Assessment of the Arthropods of Abu Dhabi. In P.E. Osborne (ed.) *Desert Ecology of Abu Dhabi*. National Avian Research Centre, Abu Dhabi. pp. 172-195.
- van Harten, A. (ed.) 2008-2011. *Arthropod Fauna of the United Arab Emirates*, Vols. 1-4. Dar Al Ummah Printing, Publishing, Distribution and Advertising, Abu Dhabi.
- Walker, D.H., and Pittaway, A.R. 1987. *Insects of Eastern Arabia*. Macmillan, London. 175 pp.
- Wikipedia. *Phasmatodea*. Available at: <<http://en.wikipedia.org/wiki/Phasmatodea>>. [Accessed 21 September 2012]

**Gary R. Feulner**  
c/o PO Box 23927  
Dubai, UAE  
email: [grfeulner@gmail.com](mailto:grfeulner@gmail.com)



## BOOK REVIEWS

### **Birds of Dubai – Pictorial Guide, by Reza Khan. Publishers: Dubai Municipality. 294 pp.**

Reza Khan should be congratulated on his latest book on the natural history of UAE. For nearly thirty years he has been enthusiastically studying, recording and photographing the flora and fauna of the country, and this new book will be a helpful aid to many people, particularly newcomers to the subject. Although the book only appeared in late 2011, the publication date is actually 2008. The delay is unfortunate because the species order, taxonomy and nomenclature are not in line with other more recent books on birds in UAE that have followed the guidance of the Ornithological Society of the Middle East ([www.osme.org/or](http://www.osme.org/or)). It is also a pity that the book could not be updated to cover recent taxonomic splits such as in the shrikes. This could be irritating and confusing to serious students.

The book describes itself as a field guide but this is really appropriate because many of the photographs are not helpful for identification, and the size, shape and weight of the book strongly mitigate against its use in the field. There is a lot of white space on every page, and there can be no doubt that a smaller format, with narrow margins and thinner paper, would have been a lot more useful. The lightweight cover of the book will clearly limit its lifetime if it is subjected to any heavy use. It should therefore be kept indoors, but, unfortunately, the quality of the photographs doesn't really allow it to be treated as a coffee table book!

Nevertheless, it contains a lot of useful information. This includes descriptions of some of the more popular birding sites in Dubai, and, surprisingly, information about planted trees and shrubs which is otherwise hard to obtain.

The book purports to describe and photograph exactly 200 species of bird that occur in Dubai. In fact it includes Collared Kingfisher, which has not been recorded in Dubai, and a few others of doubtful pedigree. One suspects the availability of photographs (all taken by the author) played a part in the selection of species. Black-headed Ibis, Cinereous (or Black) Vulture and Great White Pelican are surprising inclusions as they are either not on the UAE checklist or have not been seen for many years. More surprising is the omission of several relatively common species such as Saunders' Tern, Greater Hoopoe Lark and Bar-tailed Lark. The book only contains one species of sparrow and one bunting. The omission of the two larks mentioned above, as well as several less common migratory species of lark, reinforces the impression that the book concentrates more on the species that have colonised the new green spots in Dubai rather than the declining species of open desert which have had to retreat in the face of advancing residential and industrial development.

There is a dearth of information about range, both inside and outside of Dubai and the rest of the UAE, and the brief statements about status often give a

misleading impression. Most descriptions end by blandly stating that the species is "not endangered", but this refers to IUCN's international Red List. It would have been helpful to mention that many species have small and declining UAE populations. The naive reader will get the impression that all is going very well for birds in Dubai and will learn nothing about the real conservation issues.

More attention to proof-reading would have been very useful. A particularly irritating feature is that there is heavy use of hyphenation at the end of the line, but the hyphens have not printed!

Despite some serious and some not-so-serious limitations, Reza Khan has pulled together a lot of good information, and Dubai Municipality must be very grateful to him for the boost that the book will give public relations in the city.

*Richard Hornby*

### **Birds of the United Arab Emirates – a Helm Field Guide. By Simon Aspinall and Richard Porter. Christopher Helm, London. ISBN: 978-1-4-81-5257-7. 240 pp.**

I first met Simon Aspinall when I arrived in the UAE during the spring of 2005. Over the following years, up until his death in 2011, he became a great friend and a truly inspiring birding mentor. So to be asked to critique a field guide, of which he was co-author, was both daunting and an honour.

This guide, *Birds of the United Arab Emirates*, is an abridged version of the larger guide, *Birds of the Middle East* (2nd edition), by the same authors and maintains much the same representation in terms of plates and formatting. Of course, it contains a species list specific to the UAE, which currently sits at 454, nine more than when this book was published!

The UAE is truly a remarkable birding destination. Resident and visiting species include some hard to come by species (given their range restrictions) and include crab plover, collared kingfisher and Sykes's warbler, through to Hume's, red tailed and variable wheatear. The vagrant list is astounding, with recent firsts including great stone curlew, Asian paradise flycatcher, black-naped oriole, Radde's accentor and even white-rumped sandpiper. Besides the above, and remarkably, the list of vagrant waders to the UAE is quite astonishing. Painted snipe, Eurasian woodcock, Kittlitz's plover have been observed and even buff-breasted sandpiper, pectoral sandpiper, lesser yellowlegs and Wilson's phalarope are on the national checklist.

The book is an immensely useful guide for the increasing number of visiting birders to the UAE. Overall the book is very birder-friendly, with text, maps and plates appearing alongside each other. The text, while brief, is generally quite accurate and it is good to see species in a variety of plumages. The spacing and placement of the species on the plates is also good. The additional pages that cover escapes and

non-native species makes for interesting, although quite sad, reading. This list is not exhaustive, either. I have seen several species of escapes not listed here, including black swan, Hadada ibis and galah.

There are some criticisms however. The maps are those of the entire Middle East region, not the UAE and the key to the maps is not the easiest on the eye, especially the hatched reference for passage/ winter visitors. I was also slightly disappointed with some of the species reconstructions. Several of the *Sylvia*, *Hippolais* and *Acrocephalus* warblers are very strange-looking individuals indeed, nothing like they appear in the field.

These points aside, this is a very useful field guide, both for residents and visitors. If you are planning to bird the UAE, you simply must get this guide. Even resident birders and nature lovers should keep a copy of this guide to hand. I'm also told there are plans for an Arabic version of this guide, something that would only help to encourage the slowly increasing number of Emiratis who are taking up birding.

As the first bird field guide devoted to a single country anywhere in the Middle East, it sets a benchmark for others to follow in due course. The Environment Agency – Abu Dhabi, EAD, which funded publication and also contributed substantially to the cost of the 2nd edition of *Birds of the Middle East*, deserve credit for their valuable contribution to knowledge of the birdlife both of the UAE and of the region as a whole.

**Neil Tovey**

*Neil Tovey is a member of the Emirates Bird Records Committee*

**From Pearls to Oil: How the oil industry came to the United Arab Emirates. By David Heard. Motivate Publishing, Dubai. ISBN 978-1-86063-311-9. 629 pp. UAE dirhams 175.00**

In the history of the United Arab Emirates over the last century, at least in terms of its economy and development, there can be few more important dates than 11th January 1939, the day on which the then-Ruler of Abu Dhabi, Sheikh Shakhbut bin Sultan Al Nahyan, signed the oil exploration concession agreement with Petroleum Concessions Limited covering the whole of the onshore territory of the Emirate and coastal waters up to a distance of three miles from shore. With a life of seventy five years, the concession, albeit considerably amended, remains in force until January 2014 and provides the legal framework upon which the foreign oil companies involved in the PCL consortium, which, after several name changes and mergers, have become BP, Shell, ExxonMobil, Total and Partex, own their forty per cent share of the oilfields operated by the country's leading petroleum producer, the Abu Dhabi Company for Onshore Oil Operations, ADCO.

Thanks to the delay of exploration until after the Second World War and then the drilling of several

unsuccessful wells, it was to take around 20 years before commercially-viable oil reserves were identified onshore, in what became the Bab field. PCL, through a subsidiary, went through several changes of name to become the Abu Dhabi Petroleum Company, and continued to own the entire concession (although only the oil discovered, not the gas), until the signing of the Participation Agreements with Government in the early 1970s, which led to the Abu Dhabi National Oil Company, founded in 1971, taking a majority, sixty per cent, share. ADCO, a joint venture between the PCL shareholders and ADNOC, has operated the concession since 1979. The revenues accruing to Government, directly or through ADNOC, both from the onshore fields and from others offshore, have made possible the remarkable programme of economic and social development that has transformed the Emirates over the last fifty years since oil production began. It was that signature, back in 1939, that set the process on train.

The development of Abu Dhabi's oil and gas industries has been the subject of several books over the years, including, for example, those by former Minister of Petroleum and Mineral Resources, Dr. Mana Saeed Al Otaiba, and other, company-specific, histories written by myself. Sadly, these are all out of print or were intended primarily for give-away distribution and are difficult to obtain. Until now, however, there has been nothing that sheds detailed light on the negotiations between PCL, itself a subsidiary of the Iraq Petroleum Company, IPC, and the Rulers, not just of Abu Dhabi but of other emirates, that led to the signing of the agreements that represent the founding of the UAE's most important industry and source of revenue.

*'From Pearls to Oil'* sheds that light and, moreover, its author, David Heard, is amply qualified to tell the tale. A resident of Abu Dhabi for nearly fifty years, he first arrived to work for what became the Abu Dhabi Petroleum Company in 1963, working first in the fields and then at its head office until the newly-created ADCO took over operations in 1979. He then managed the ADPC office in Abu Dhabi for nearly thirty years until his recent retirement, intimately engaged in the evolution of the relationship between Government, ADNOC and the foreign industry shareholders.

Few others, I suspect, would have been able to persuade the IPC/PCL/ADPC shareholders to permit access to the papers in the Company's archives. Even fewer, if any, would have been able to combine such access with an intimate knowledge of the life, traditions and heritage of the people of Abu Dhabi.

Some of the story which Heard relates can be discerned, albeit in vague outlines, from the official British records of the period, now available, at considerable expense, for researchers. The particular value of this volume is its analysis of the oil company's own archives, with many of the most important documents being reproduced in full in nearly 200 pages of appendices.

Heard commences with a first chapter describing Abu Dhabi in the days before oil, going on to provide a valuable introduction to the topic 'How the Middle East oil industry started'. He then goes painstakingly through the story of the first visits by oil company personnel and the long, complex and often very difficult negotiations that finally led to the signature of the 1939 concession agreement, as well as earlier agreements with other emirates. Leading characters, both from the company and from the UAE side, are described, warts and all, from the telegrams and memoranda written at the time.

*'From Pearls to Oil'*, of course, tells the story of the origins of the UAE's oil industry primarily from the point of view of the oil company, since it is based on the company's own documents, though Heard's own knowledge of the company, the industry and Abu Dhabi permits him to place that raw archive data in context.

Sponsored by the Abu Dhabi Company for Onshore Oil Operations, ADCO, who deserve thanks for their support of this important publication, it is a book that anyone interested in the modern history of the Emirates should read. There is much to learn from it – not least the fact that the negotiations came so close, on more than one occasion, to failure.

I look forward with eager anticipation to a promised further volume that will continue the story to nearer the present day.

*Peter Hellyer*

**Imperial Outpost in the Gulf. The Airfield at Sharjah (UAE) 1932 – 1952. By Nicholas Stanley-Price. Published 2012. The Book Guild Ltd, Brighton, UK .pp238 . ISBN 978 1 84624 684 5 . GBP 17.99**

Coming just a few months before the eightieth anniversary of the opening of the first airfield in the Trucial States (now the United Arab Emirates) in 1932, and a few years after the publication of Colin Richardson's excellent study of the airfield on Masirah Island in Oman ("Masirah. Tales from a Desert Island", 2003, Scotforth Books, Lancaster), this scholarly work by Nicholas Stanley-Price brings a new and powerful resource relating to the history of the modern Gulf states.

The author describes the background to the establishment of an air staging post at Sharjah after Imperial Airways had initially elected to use a route along the Persian coast for their development of an England to India air route. When diplomatic strife interrupted this Persian project, negotiations began to set up a landing ground on the Arabian side. These negotiations involved the leaders of several Gulf states, but ultimately an agreement was reached with the Ruler of Sharjah to develop a landing ground just outside the small Gulf-side town. A sand runway was prepared and work began on a solid, fort-like "rest house" for the overnight accommodation of Imperial Airways passengers in transit to and from Karachi. It

was considered that the rest house should be built like a fortress in case of any need to defend the site. The service began in October 1932 initially with their, for then, huge and comfortable HP42 biplane airliners. In 1937 Imperial Airways also opened a service to India using Short Empire flying boats, but they could not use the shallow waters of Sharjah, and used instead the nearby Dubai Creek. These flights were, however, handled by staff from Sharjah and the passengers often used the rest house facilities.

From 1932 until the outbreak of World War Two, the relatively luxurious rest house facilities were much appreciated by the passengers. The development of a Royal Air Force station during the war provided much less satisfactory accommodation, as stressed by various air and ground crew who suffered the heat, humidity and discomfort of a posting to Sharjah. The RAF had enjoyed a presence in the Gulf region for many years, including survey flights which resulted in the building of Sharjah airfield. In 1942, a staging post was set up to handle military aircraft delivery to the Far East, and the same year an operational squadron of Blenheim light bombers moved in to patrol the Gulf waters and perform anti-submarine duties. The American air force also used the facilities during the War, especially for ferry flights. After the war, military operations declined, but some continued, even using early jet aircraft, such as Vampires. During the 1950s the RAF was again actively flying from Sharjah to support ground troops in the Buraimi and Jebel Akhdar conflicts. The old sand runways were totally unsuitable for use by jet aircraft, and accidents and were frequent, so a new hard runway was laid down in the early 1960s. RAF operations ceased in 1971, with the establishment of the federation of the United Arab Emirates and the withdrawal of British forces from 'East of Suez', but civilian activities continued until the opening of the new Sharjah airport, further outside the town, in 1977.

Today the rest house and a control tower from the original airport survive as the Al Mahatta Museum, and the main runway has become King Abdul Aziz Street in the centre of Sharjah.

The author has written a well-researched, and readable, account, based on wide-ranging examination of original archives, as well as on books by major players in the story of Sharjah. It is of interest that he devotes sections to a consideration of the reliability of two important documents he consulted in depth. The first is a film, "Air Outpost", showing a day in the life of the airport in 1936. The second is the memoirs of Raymond O'Shea, Station Manager from 1944 to 1945, "The Sand Kings of Oman" (1947). Both, although prone to a certain artistic licence, seem to be valuable contemporary sources of first-hand information.

Overall, this scholarly and timely work is to be recommended for anyone who wishes to know more about what the region was like before it changed unrecognisably in the last couple of decades. The text

is enriched by photographs of the area before and after the airport, and others showing the various stages of its development. The fact that the rest house still survives, and can be visited, makes this account even more compelling.

(<https://sites.google.com/site/lgarey/rafsharjah%2Calmahattamuseum>).

*Laurence Garey*

**In the Land of the Emirates: the archaeology and history of the UAE. D.T. (Dan) Potts. Trident Press, London, & Sultan bin Zayed's Culture and Media Centre, Abu Dhabi. 2012. 219 pp.**

**The Necropolis of Jebel al-Buhais: prehistoric discoveries in the Emirate of Sharjah, United Arab Emirates. Sabah Abboud Jasim. Department of Culture and Information, Government of Sharjah, UAE. 2012. 323 pp.**

These two volumes are a fundamentally important contribution to our understanding of the archaeology of the United Arab Emirates. Potts' volume begins with a detailed but accessible overview of the natural resources of the UAE. It is against this canvas that he investigates the first Holocene occupation of the region during the Neolithic period. Recent evidence from Jebel Faya in the Emirate of Sharjah concerning the Pleistocene/Holocene transition is incorporated but most of this chapter focuses on the manner in which the nomadic pastoralists who occupied the UAE from c. 7000 to 3000 BC crafted a unique subsistence strategy that blended cattle, sheep/goat pastoralism with exploitation of the natural resources of the sea, deserts and mountains. Chapters 3 to 6 deal with the expansion of settlement throughout south-eastern Arabia during what is now generally referred to as the Bronze Age, but which incorporates the Umm an-Nar and Wadi Suq periods. Here due balance is given to competing theories that emphasise the importance of external demand for copper to indigenous innovations in agriculture. Potts draws upon the rich repertoire of tomb discoveries for this period while emphasising that recent excavations, particularly his own at Tell Abraq, have attested to continued sedentary occupation at settlements across these millennia. In Chapter 6, Potts brings together the great diversity and quantity of evidence concerning the Iron Age (1300 - 300 BC) occupation of the region. He emphasises that two innovations, the *falaj* irrigation system and the appearance of the domesticated dromedary, were fundamentally important not only during the Iron Age, but set in train a series of ecological adaptations that characterised Arabian life until the present day. Chapters 7 to 10 continue the account of UAE's archaeology from the pre-Islamic period up until the present day. An Epilogue which reflects upon current developments in the UAE and a bibliographic essay complete the book.

There are few, if any, scholars who have the breadth and simultaneous depth of Potts' knowledge of

UAE archaeology. This manifests itself throughout the volume where he moves from specific archaeological/historical detail to the broader picture with ease and clarity. Combined with the beautiful colourful illustrations throughout, this makes the volume an accessible and learned resource for the general public who are interested in the past of a country whose modern achievements and developments are well-known, but whose ancient past is rarely mentioned, let alone understood. For the scholar of Arabian prehistory and adjacent regions, the book can be read as a review essay which covers the important developments in each period and which guides the reader to further research. It is an invaluable contribution.

Whereas Potts' volume provides an overview of the outcomes of UAE archaeological research over the last 50 years. Sabah Abboud Jasim's report on the excavations undertaken at Jebel Buhais provides a detailed analysis of one of the most important sites excavated in the last 20 years. Jebel Buhais lies in the interior region of the Emirate of Sharjah and has been the subject of archaeological enquiry since the 1980s. The excavation at Jebel Buhais 18 by a joint project between the University of Tübingen and Jasim, head of Sharjah's Directorate of Antiquities, revealed one of the most important Neolithic burials excavated in the Middle East. The importance of that site is reflected in the many references to it made in Potts' volume and the two volumes already published by Jasim, Hans-Peter and Margarethe Uerpmann and their colleagues on the site have fundamentally altered our understanding of Neolithic lifeways in Arabia. In this volume, Jasim turns his attention to the publication of 91 Bronze and Iron Age tombs excavated by him and his team between 1994 and 2005.

The volume begins with an overview of the geographical and environmental setting of Jebel Buhais. Here, Jasim incorporates the recent research detailing environmental change in this region as well as noting that the size and location of the Jebel made it a natural focus for human activities long after the Holocene moist phase had come to an end around 4000 BC. In the subsequent chapters, the tombs are presented tomb by tomb with detailed plans, photographs of the tombs and associated artifacts. The latter are presented in a consistent fashion throughout, thanks to the good work of Khalil Darwish, the draughtsman for the project. It is not too much to say that this catalogue of tombs and their associated finds represents the most complete published record to date of any multi-period site excavated in the UAE. It provides for the first time a detailed picture of how tomb shape, position and associated artifacts change from the Umm an-Nar period (2500-2000 BC) through to the end of the Iron Age (1300-300 BC). The published detail for each tomb is of such importance not just because it is incumbent upon archaeologists to present their finds in a comprehensive fashion, but also because the burials at Jebel Buhais were so rich

and well-preserved. The range of bronze, soft-stone and ceramic finds is nothing short of stunning. The bronze hoard from Buhais 2, for example, contains 37 socketed spearheads, 3 short blades, 3 daggers, 2 large bronze bowls and a bronze goblet. Such discoveries speak to the vitality of prehistoric life in the UAE and the ability of its inhabitants to exploit local materials and produce an innovative and rich material culture. There are several collections of artifacts that this reviewer finds particularly interesting: the hundreds of bronze arrowheads, for example, many of which contain enigmatic engraved symbols, will add to our understanding of bronze production in the poorly understood Late Bronze and Early Iron Ages.

The book concludes with an overview of the tombs of each period of the Umm an-Nar, Wadi Suq and Iron Ages and a short essay on Jebel Buhais and the outside world. Reports on the bio-archaeological evidence from the tombs reported by Adelina and Johannes Kutterer are included in the appendices. In sum, the volume represents a fundamentally important contribution to our understanding of the archaeology of the UAE. It does so in a fashion that raises the bar in the standard of archaeological reporting and should act as a catalyst for the publication of other sites that, although known through word of mouth, remain inaccessible to the ever-increasing community of scholars who work on the prehistory of Arabia.

*Peter Magee*

*Peter Magee* is a professor of archaeology at Bryn Mawr College, Pennsylvania, USA, and is director of excavations at Muwailah and Tell Abraq in Sharjah. He obtained his doctorate, under Professor Dan Potts, at the University of Sydney and has been engaged in archaeological studies of the Emirates since 1992. He is the author of *The Iron Age settlement at Tepe Yahya, Iran*, Harvard University Press, 2004 and *The archaeology of prehistoric Arabia: Adaptation and social formation from the Neolithic to the Iron Age*, Cambridge University Press, 2013.

**Environmental Atlas of Abu Dhabi Emirate. Editors: Peter Hellyer & Dr. Richard Perry. Motivate Publishing, Dubai, for the Environment Agency – Abu Dhabi. ISBN 978-1-86063-316-4. 200 pages. UAE dirhams 270.**

The Environment Agency Abu Dhabi (EAD) has excelled itself in publishing this massive and very attractive tome, which will serve many purposes and will be valuable for many years to come. The text is very readable and good for several hours of quiet browsing. It is a very good source of information which is otherwise scattered or inaccessible, and, last but not least, it is beautifully produced and will make a wonderful coffee table book.

It contains a lot of data that is nicely displayed. There are some very interesting maps that have seldom appeared elsewhere, such as the distribution

of recorded earthquakes in the region, the Arabian Watershed and the distribution of all the oil and gas fields in UAE. On the negative side, there is no indication of which oilfield areas are off-limits to the public, i.e. areas for which Oilfield Security passes are needed.

The Atlas is very good on archaeology, but it is slightly annoying that the subject is covered in two separate sections, each with no reference to the other. The archaeological periods shown on page 86 apparently bear no relation to those on page 178, and the Grand Tomb at Umm al Nar is illustrated in both.

The Atlas is very honest about some major environmental issues such as the “Water Crisis”, but this gets little mention where we are told about the progress being made towards sustainability. This subject seems to be forgotten in the description of Abu Dhabi’s amazing record in globalisation, urbanisation and population growth.

The information present on some of EAD’s own success stories is very good, e.g. the Arabian Oryx programme and satellite tracking of Houbara Bustard and Greater Flamingo, as well as captive breeding and release of Houbara.

The book is a tremendous compilation of information, but, surprisingly, it is as an atlas that, in many respects it is weakest. A subject on which we have excellent geographical information is birds, but although Simon Aspinall’s *Breeding Birds of UAE* was published by EAD in 2010 (and the new atlas was published in 2011), there is very little depiction of the distribution of birds (breeding or otherwise). The atlas underlines the importance of seabird colonies but there is little indication of where they are, and anyone hoping to discover the location of Bu Tinah (after EAD’s determined efforts to get people to vote for it as a “Natural Wonder of the World”) will be disappointed.

Many of the topographical maps will be difficult to use because more emphasis was apparently put on artistic effect than scientific utility. Geologically and geomorphologically, the Atlas is very strong, with, for example, nice descriptions of diapirs and zeugen, but, unfortunately, no maps to show where they are.

A subject notable by its absence is the tribes and family groupings of the people of Abu Dhabi. There are many photographs of forts but no indication of who built them, or when, or whether they played any important role in history. Likewise, there is information about Aflaj (water channels) but no maps showing their locations, and tantalising information about freshwater springs under the sea but without marking any on maps.

There are references to creation of new islands, but no maps to show them, and nothing on bathymetry. Those waiting for a good map to show distribution of mangroves around Abu Dhabi and changes over time, will have to wait a bit longer! Likewise, EAD has very good information on the extent to which the sea could move inland given different rises in global sea level, but sadly this is not included in the Atlas. Perhaps it

was difficult to integrate this with the projections for population growth!

There are good maps about Land Use Suitability, but rather little about present land use. The soil map looks very impressive and is no doubt fully scientifically defensible, but it is strange that the many mesas in the Western Region (hundreds of them, around 10 to 20 metres high) are not identifiable. I fear that the very generalised vegetation map will be of little practical use.

With such a large book it is not surprising that a few errors have crept in. These include a misprint on the salinity of the Red Sea, the misidentification of one crab (called *Grapsus albolineatus* rather than *Eriphia smithii*), and one plant (*Arnebia decumbens* instead of *A. hispidissima*).

The Atlas has played its part in extending the confusion over common names of reptiles. The gecko *Bunopus tuberculatus* is called either Baluch Ground

Gecko or Baluch Rock Gecko in the books most readily available to the naturalist in Abu Dhabi. The Atlas takes its own line on this by calling it both Arabian Desert Gecko and Baluch Desert Gecko on a single double-page spread!

The index is very useful but a surprising number of terms are not included, either because they have been overlooked in the Atlas or the index. These include: gas, gravel, gull, heron, land use, progradation, renewable energy, tern, wader, and waste management.

These weaknesses should not obscure the fact that EAD has done a magnificent job in bringing together a unique collection of information in a ground-breaking manner. Presentation of environmental information is not yet confined to digital media!

**Richard Hornby**

## OBITUARIES

### Simon Aspinall



Simon Aspinall, formerly Chairman of the Emirates Bird Records Committee and of the Emirates Natural History Group, and also a much valued Deputy Editor of *Tribulus* for fifteen years, died at his parents' home in Norfolk, UK, on 31st October 2011, after a long and valiant struggle against motor neurone disease. He was 53.

Educated at Whitgift School and Purley High School, and then at the University of East Anglia, in Norwich, chosen for its proximity to Cley in Norfolk, which later became his home, Simon first came to work in the UAE in 1993, to take up the post of Head of the Wildlife Management Unit at the National Avian Research Centre, which later became part of the Environmental Research & Wildlife Development Agency, ERWDA, (now the Environment Agency – Abu Dhabi, EAD). He brought with him a wealth of experience in birds and other wildlife in the United Kingdom, having worked for nine years with the Royal Society for the Protection of Birds and the Nature Conservancy Council and then for three years for the NCC and the Joint Nature Conservation Committee on projects for Esso and BP in southern England. The latter led to his first two books, (with M.L. Tasker), on *Coastal Birds of East Dorset and Birds of the Solent*.

Simon threw himself energetically both into field research in Abu Dhabi, and into the developing birdwatching fraternity, bringing new levels of skills both to field observations and to the assessment of rarities, and was quickly co-opted to membership of the recently-established Emirates Bird Records Committee. He rapidly began publishing on UAE birds as well – by the end of 1994, he had written or co-authored a total of ten papers and book chapters, including the UAE chapter in BirdLife International's

*Important Bird Areas in the Middle East*, which first established the Emirates on the map of Middle Eastern ornithology.

In 1996, his first book on UAE birds appeared, *Status & Conservation of the Breeding Birds of the United Arab Emirates*, a seminal work based upon hundreds of hours of fieldwork.

In 1997, having been offered the choice between taking a substantial salary cut at ERWDA or leaving the organisation, Simon decided to strike out on his own as a freelance ecological consultant. Two years as Heritage and Environment Editor at the daily *Emirates News* followed, until the paper closed, with Simon taking on much of the responsibility for the weekly 'Twitchers' Guide', which continued on-line until 2006, one of the first regular birding features available on the Internet. He also co-ordinated environmental studies for the Abu Dhabi Islands Archaeological Survey, ADIAS, until it ceased operations in 2006. In that capacity, his keen eye was responsible for the identification of many previously-unrecorded archaeological and fossil sites, playing a fundamental role in developing understanding of Man's relationship with the environment of Abu Dhabi's deserts and elsewhere in the UAE.

During the late 1990s, the carrying out of environmental surveys as part of development plans became increasingly a matter of standard practice and Simon rapidly built up his consultancy business, working on projects throughout the country and also in the rest of Arabia and in Azerbaijan in the Caucasus, often working with BirdLife International and UNESCO on plans for nature reserves.

Whilst in the UAE, his primary interest was always birds and several more books followed, including, in 1998, the popular *Shell Birdwatching Guide to the United Arab Emirates*, written with Colin Richardson. This was followed in 2003 by a revised 2nd edition of *Breeding Birds*, in Arabic, published by EAD, the first in Arabic on the region's birdlife. A 3rd edition, re-titled *Breeding Birds of the UAE*, appeared in 2010, the same year as the highly-acclaimed 2nd edition of *Field Guide to the Birds of the Middle East*, written with Richard Porter. Two more books followed last year, both commissioned by EAD, *Birds of the UAE – a guide to common and important species*, with Salim Javed and Jens and Hanne Eriksen, and the *Field Guide to the Birds of the United Arab Emirates*, with Richard Porter, the first country guide to any of the Gulf states, which was published shortly after his death.

These and other works, like *Important Bird Areas of the United Arab Emirates*, a lengthy co-authored paper that appeared in *British Birds* in November 2006, have done much to introduce the country's birds to an international audience.

Besides his books, book chapters, articles in journals and consultancy reports flowed rapidly. He authored or co-authored well over a hundred different papers and reports on the UAE's birds and other fauna and flora, many published in journals like *Sandgrouse* and *British Birds*, as well as in this journal. He was also the most important single contributor of records to the *Atlas of Breeding Birds of Arabia*, apart from its editor, Mike Jennings.

Simon was never interested just in birds. Terrestrial ecology as a whole fascinated him, from reptiles to plants to mammals while he was also for over a decade, from 1996 onwards, the co-ordinator of the UAE Marine Mammal Database. He also had more than a passing interest in geology and palaeontology and was personally responsible for several major Late Miocene fossil finds in Abu Dhabi's Western Region, including the jaws and tusks of an early elephant. This all equipped him to become involved in publishing that extended far beyond birds. In 2004, for example, he was co-editor of *Jebel Hafit – A Natural History*, this being followed the next year by another joint production, *The Emirates: A Natural History*. As Deputy Editor of *Tribulus*, he produced numerous papers on a wide range of topics. Amongst them were some of the earliest proposals for conservation of the UAE's coastline and of islands important for wildlife.

Simon was an engaging, informative and inspiring colleague in the field – ever ready to share his own expertise with those who were less well-equipped. That willingness to share was by no means confined to the birding fraternity. For many years an ENHG committee member, he served a spell as Group Chairman and was awarded the annual Sheikh Mubarak bin Mohammed Prize for Natural History, the UAE's premier environmental award, for his contributions to knowledge of the country's natural history. He was later made a Life Member of the Group.

Simon will be remembered partly for his unparalleled contributions to the natural history of the Emirates and, of course, as the first UAE birder to pass the 400 mark on his checklist. His final total was 414 species, including 23 'firsts' for the UAE, these including many first records of breeding birds. Of these, he was particularly proud of the UAE's first-ever golden eagle nest, spotted high on a dune during an archaeological survey. A year or so later, accompanying explorer Sir Wilfred Thesiger on a journey on the edge of the Empty Quarter, he found the second, drawing much pleasure from the fact that he had been able to show Thesiger something the explorer had not seen himself on his journeys half a century earlier.

In her introduction to the *Field Guide to the Birds of the UAE*, the Secretary General of the Environment Agency – Abu Dhabi, Razan Al Mubarak, pays this tribute: *I take particular pleasure in acknowledging the contribution made by Simon Aspinall over the last two decades to studies of the UAE's environment,*

*including its birds. His books on the topic, including this one, provide the foundations on which others will be able to build for many, many years to come.*"

With a wry and gentle sense of humour and enormous patience, Simon Aspinall was a mentor to many and a friend to many more. Those attributes were never better shown than through the courage and good spirits with which he faced the inexorable advance of his illness.

It is fitting that his life and his dedication to the cause of conservation is now to be commemorated by the establishment by the Norfolk Wildlife Trust of a Simon Aspinall Wildlife Education Centre, overlooking the Cley Marshes Nature Reserve in Britain, his 'home patch.'

Simon James Aspinall. Born 5th February 1958, died 31st October 2011.

*Peter Hellyer*

### **Robert (Bob) W. Reimer**



Robert (Bob) Reimer, a stalwart of the Emirates Natural History Group (Al Ain), died at his cousin's home in Markham, Canada, on 25th January 2012 after a valiant struggle against melanoma. He was born on 18th December 1953.

Bob arrived in the UAE in 2002 as an IT software engineer and database designer for the United Arab Emirates University, following a 30-year career in Canada that included seven years as a meteorological technician and ice observer for Environment Canada, during which he carried out observations of sea ice to assist shipping, and in other posts as a business analyst, IT specialist and chief technology officer for a software company, systems architect and chief technology officer as a partner in his own custom software company.



On arriving in the Emirates, he swiftly became involved in the ENHG (Al Ain), serving on the committee in a variety of roles which included photography co-ordinator, webmaster, and Vice Chair until ill-health obliged him to return to Canada late in 2011.

Making good use of his knowledge of Information Technology, he also took on the laborious but important task of scanning successive volumes of *Tribulus*, making their contents available online to a much wider audience, in the UAE and overseas.

An active participant in field trips, he proved himself to be an excellent photographer of a wide range of fauna and flora, contributing numerous pictures to *Jebel Hafit – A Natural History, The Emirates – A Natural History and Terrestrial Environment of Abu Dhabi Emirate*.

He also made a major contribution to a previously little-studied aspect of the UAE's fauna, Odonata (dragonflies and damselflies), writing papers for the newsletter of the Worldwide Dragonfly Association and also, with Gary Feulner and Richard Hornby, producing in 2007 and 2009 two major illustrated checklists on species found in the Emirates. In July 2011, his contributions to the study of this group of insects was acknowledged by his election as Secretary of the Worldwide Dragonfly Association, although advancing illness obliged him to step down from the post shortly before his death. While pursuing dragonflies, his keen observational skills led him to the discovery, in Oman, of a midge (Diptera : Nematocera : Ceratopogonidae) new to science – found on the wings of dragonflies, and he was given the honour of naming it. Typically, in his modesty, he did not choose to attach his own name, as many do, instead giving it a local term for a camel jockey, .

In 2007, Bob was presented with the ENHG's Bish Brown Award, to acknowledge his contributions to the promotion of the study and conservation of the UAE's environment and wildlife, in particular for his work on the ENHG website and his preparation of the electronic archive for *Tribulus*.

Bob's interests, though, stretched far beyond IT, dragonflies and photography. A director of the Kitchener-Waterloo (Canada) Symphony Orchestra from 1989-1997, he also actively contributed to the ENHG field trips offered to participants of the annual Al Ain Classical Music Festival, as well as being a passionate fan of sumo gaming. He also served as treasurer for a number of churches in the cities in which he resided during his working life.

When his melanoma was diagnosed, typically, Bob continued to work and to pursue his interests as long as he could, displaying the humour, insight, compassion, understanding and gentle spirit so well-known to his friends and colleagues. « To the end, » his wife wrote in a message announcing his death, « he was brave and strong, but the body just could not handle the demands of living any longer. »

He is survived by his wife, Barbara Ruth Reimer (née Snudden), and son Aaron with his family.

*Wolfgang Schneider, former President of the World Dragonfly Association, adds:*

I came into contact with Bob Reimer in late 2007 when he started to develop interest in Arabian Odonata. A keen and excellent photographer of natural history objects, he started not netting them, but to photographing the damselflies and dragonflies with his camera. These pictures were then sent by e-mail to colleagues with the request to help with identification where necessary. He very quickly became acquainted with a number of odonatologists.

Being a taxonomist of the old school, I have in most cases no confidence in species identification by photography only, and Bob, in turn, was reluctant to collect some voucher specimens and insisted he was able to recognise even some of the more difficult bluetail damsels (genus *Ischnura*), including morphs of both sexes.

Finally, I convinced him to collect a few voucher specimens of "difficult species" and to visit me in the Senckenberg Museum of Natural History in Frankfurt. He and his wife Barbara came in April 2009, and the three of us spent several wonderful days in my laboratory to identify his specimens, comparing them with ones from my Arabia collection. Before they left, we made plans to publish a photographic field guide of the Odonata of the Emirates. I also asked Bob to join as one of the authors of a "Monograph on the Odonata of the Arabian Peninsula".

Bob had joined the Worldwide Dragonfly Association early and became an active member of the society, publishing also in WDA's newsletter as of 2008. With his participation in the Middle Eastern Biodiversity Congress in October 2008 in Aqaba, Jordan, Bob manifested his serious interest in and engagement with the Natural History of Arabia. In July 2010 he participated in the second European Congress of Odonatology in Porto, Portugal – actively participating not only in scientific but also in social activities. After a very short time, Bob had become an active member of a flourishing young scientific society.

Between 2009 and 2011, I had the honour to be President of WDA. When our then Secretary Natalia von Ellenrieder decided not to run for a second term, I asked Bob to stand for election. He accepted his nomination, although as early as March 2011, he learned about his fatal disease.

We continued to plan for the future, and in March 2011 he and Gary Feulner organised a collecting trip in Oman and the UAE for me – despite my bad health. Bob, Barbara, and Gary did their utmost to make my stay comfortable and rewarding in every aspect.

Bob was duly elected in mid-2011 as WDA Secretary at a special biennial general meeting, displaying his usual enthusiasm and commitment and continuing to submit papers for publication until his

advancing illness forced him to step down.

During only a short period of years, Bob made an important contribution to knowledge of the region's Odonata. He will be much missed.

### **Roy Richards**

Roy Richards, a long-time active participant and Life Member of the ENHG, died on 26th June 2011 at University College Hospital in London after a long struggle with cancer. He was 61. His wife Liz was by his side.

A London East-Enders from Hackney, Roy first came to the UAE in 1979 as a Haematology lab technician at the Corniche Hospital to join his boss from Barts Hospital, Professor White. There were further short-term stints at the Corniche, and a six-month trip exploring Australia, before he returned in 1985 and settled down in Abu Dhabi. His expertise and longstanding interest in IT led to a natural move to work on the team that introduced the new computer systems in the lab and then to the rest of the Corniche Hospital. He and his wife, Liz Sowinska, a doctor at Corniche Hospital, became active in outdoor

pursuits, initially as very keen BSAC divers at the Club, then enjoying the thrills of windsurfing on the Corniche, sailing in their Dufour T7, and visiting Nepal regularly for treks in remote Himalayan areas. The love of mountains extended to exploring the Hajar and finding walking and scrambling routes up some popular peaks along with their Saluki-Labrador-cross rescue dog. What started as a love of walking soon developed into a keen interest in history, geology, flora and fauna. Over the years, the landscape changed, dunes were flattened, rocks were quarried and, in some years, high rainfall brought flash floods and the blooming of rare plants on the hillsides and in the deserts. There was so much beauty and so much to discover in the UAE and Oman, which inspired Roy, Liz and other ENHG members and friends to go exploring, and to discover the old settlements and find evidence of past cultures.

Along the way, Roy & Liz organised the ENHG's popular annual mountain hikes (commemorated on their website [www.chirri2000.com](http://www.chirri2000.com)), set up the AUHENHG Yahoo Group site, and edited *Focus*. In 2006, they were recipients of the Bish Brown Award (the first joint award), in acknowledgement of these contributions. In June 2011 they were jointly presented with ENHG Life Membership. Roy is remembered, in partnership with his wife, for his dedication to the ENHG, his open friendship to all and his good humour and good sense, all of which have helped give our Group the shape it has today.

Diagnosed with Mantle cell lymphoma in 1999, Roy received excellent care at UCH London, and after his first stem cell transplant (using his own harvested cells) in 2000, he had over eight disease-free years and returned to life and work in the UAE, becoming

actively involved in the Group. Further treatment in 2008 gave a brief period of remission, but then in February 2010, it became clear that the only hope of a cure was another stem cell transplant, which he received in October 2010.

As ever, Roy was driven to regain his fitness, and when he felt stronger went on numerous outings, accompanied on many by former residents of Abu Dhabi or his wife. His last trip was in May this year, being admitted to hospital a week later with symptoms of graft versus host disease. Despite the best medical and nursing care at UCH, he died a few weeks later.

*Keith Taylor, Drew Gardner,  
Pam & Allestree Fisher and Liz Sowinska*

### **Carolyn Lehmann**

UAE naturalist Carolyn Lehmann died in Germany on October 25, 2011 from complications following surgery and subsequent treatment for advanced ovarian cancer. After more than a decade in Dubai, Carolyn and her husband Dieter, a military pilot, retired in 1997 to Florida, where they kept a sailboat. Carolyn served the Dubai Natural History Group as newsletter editor and later as Librarian, and it was under her stewardship that the DNHG library amassed much of its eclectic collection of reprints and photocopies of articles from scientific journals. Carolyn was one of the UAE's early seashell collectors and contributed Arabian Gulf specimens and information to *Seashells of Eastern Arabia* (Bosch *et al.* 1995). She also published articles in the Abu Dhabi ENHG's Bulletin on UAE marine algae and in early issues of *Tribulus* (Vols. 2.1 and 3.2) on the late Cretaceous sea urchin fossils of the UAE.

In all of these endeavours, Carolyn was known for her attention to accuracy and detail and she encouraged the same standards from others. In the mid-1990s, Carolyn and Dieter were among the more adventurous explorers of the deserts of the Liwa region, which they crossed from end-to-end in the course of periodic trips. Dieter reports that it was a pleasure for Carolyn (through Dieter as an e-mail intermediary) to be able to recall her DNHG experiences with old friends in the months before her death, during what proved to be a challenging medical ordeal.

**(This short Obituary is adapted from one published in the November 2011 issue of *The Gazelle*, bulletin of the Dubai Natural History Group)**

## ARCHAEOLOGY

(also see **MARINE** for papers on molluscs related to archaeological sites)

Beech, M. [2006]. *Book Review: Funeral Monuments and Human Remains from Jebel al-Buhais. The Archaeology of Jebel Buhais, Sharjah, United Arab Emirates. Vol. 1., by H-P Uerpmann M. Uerpmann & S. Jasim (eds.). Dept of Culture and Information, Government of Sharjah. 16.2: 36-37.*

Carter, R. Connan, J., Priestman, S. & Tomber, R. [2011]. Torpedo jars from Sir Bani Yas, Abu Dhabi. 19: 162-163.

Hellyer, P. & Ziolkowski, M.C. [2007]. An Archaeological Baseline Study of Wadi Madhab, Fujairah. 17: 16-36.

Kallweit, H. [2006]. A new type of tool from Umm az-Zamul Neolithic sites, United Arab Emirates. 16.1: 14-15.

Magee, P. [2012]. *Book Review: In The Land of The Emirates, by D.T. (Dan) Potts, & The Necropolis of Jebel al-Buhais: prehistoric discoveries in the Emirate of Sharjah, United Arab Emirates, by Sabah Abboud Jasim. 20: 86-87.*

Ziolkowski, M.C. & Al-Sharqi, A.S. [2006]. Bayt Sheikh Abdullah bin Hamdan al-Sharqi, al-Hayl, Fujairah. 16.2: 3-16.

## BIRDS

Campbell, O. [2011]. *Book Review: Breeding Birds of the United Arab Emirates, by S. Aspinall. EAD, Abu Dhabi. 19: 165-166.*

Campbell, O. [2012]. Basra Reed Warbler in Abu Dhabi: the first record for the United Arab Emirates. 20: 59-61.

Campbell, O., Al Ali, A. & Tovey, N. [2012]. The status of collared kingfisher in the United Arab Emirates, with comments on the status of Sykes's Warbler and Indian Pond Heron. 20: 62-66.

Dryden, M. [2011]. *Book Review: Fauna of Arabia, vol. 25 – Atlas of the Breeding Birds of Arabia, edited by M. Jennings. Senckenberg Gesellschaft für Naturforschung, Frankfurt & King Abdul Aziz City for Science and Technology, Riyadh. 19: 166.*

Hornby, R. [2012]. *Book Review: Birds of Dubai, by Reza Khan. Dubai Municipality. 20: 83.*

James, S.L. & Aspinall, S. [2007]. The first record of Jouanin's Petrel *Bulweria fallax* in the United Arab Emirates. 17: 83-84.

Javed, S., Khan, S.B., Al Mansouri, R. & Al Hosani, E.A. [2006]. Satellite tracking of Greater Flamingos *Phoenicopterus roseus* from the United Arab Emirates. 16.1: 16-17.

Javed, S. & Khan, S. [2012]. First record of the Great Stone-curlew, *Esacus recurvirostris*, for the United Arab Emirates. 20: 57-58.

Khan, S., Javed, S. and Nasser, J. [2007]. Survey of Breeding Osprey *Pandion haliaetus* in Abu Dhabi Emirate. 17: 77-79.

Lloyd, S. [2012]. Swinhoe's Storm Petrel *Oceanodroma monorhis*: new to the waters of the United Arab Emirates. 20: 54-56.

Moran, N. [2007]. The first record of Ashy Drongo *Dicrurus leucophaeus* for the UAE and Arabia. 17: 80-82.

Moran, N. [2011]. *Book Review: Helm Field Guides: Birds of the Middle East (2<sup>nd</sup> edition), by R. Porter & S. Aspinall. Helm, UK. 19:164*

Stanley-Price, N. [2012]. An American ornithologist at Sharjah in 1944-45. 20: 74-76.

Tovey, N. [2012]. *Book Review: Field Guide to the Birds of the United Arab Emirates, by S. Aspinall & R. Porter. Helm, UK. 20: 83-84.*

Wilson, K.D.P. [2012]. Four tern species newly recorded breeding in Dubai, UAE. 20: 67-73.

## FLORA & HABITATS

Aspinall, S. [2006]. Soldier's Orchid *Zeuxine strateumatica* marches on. 16.1: 19.

Brown, G.R., Aspinall, S. & Gardner, D. (A.S.) [2006]. *Cutandia dichotoma* (Forssk.) Trabut, a remarkable new species of annual grass for the UAE. 16.2: 30-31.

Brown, G., Aspinall, S. & Sakkir, S. [2007]. The vegetation of the coastal white sands at Taweela, (Abu Dhabi Emirate). 17: 5-15.

Feulner, G.R. [2011]. The Flora of the Ru'us al-Jibal – the Mountains of the Musandam Peninsula: An Annotated Checklist and Selected Observations. 19: 4-153.

Feulner, G.R. & Karki, M. [2009]. Hidden in plain view: First UAE record of the wadi grass *Saccharum kajkaiense* and notes on its distribution in the UAE and neighbouring Oman. 18: 50-55.

Musselman, I. [2009]. *Book Review*: The Native Plants of Oman, by C. Winbow. Environment Society of Oman. 18: 79-80.

Rothfels, C.L., Gaya, E., Pokorny, L., Rothfels, P(aul)., Rothfels, P(eter) and Feulner, G.R. [2012]. Significant fern, lichen and bryophyte collections from the UAE and northern Oman, including five new records for the Arabian Peninsula. 20: 4-2.

Ziolkowski, M.C. [2007]. Photographic essay: The versatile date palm (*Phoenix dactylifera*). 17: 70-74.

## FRESHWATER FISH

Feulner, G.R. [2006]. Goby Gone for Good. 16.2: 34.

## GENERAL NATURAL HISTORY & MISCELLANEOUS

Aspinall, S. [2006]. *Book Review*: Discovering Qatar, by F. Gillespie. 16.2: 37.

Feulner, G.R. [2006]. Rainfall and climate records from Sharjah Airport: Historical data for the study of recent climatic periodicity in the U.A.E. 16.1: 3-9.

Fisher, A. [2006]. *Book Review*: The Emirates: A Natural History, by P. Hellyer & S. Aspinall [eds.]. Trident Press. 16.1: 23-24.

Gardner, A.S. (D.). [2009]. *Book Review*: Arabian Wildlife – Arabia's Wildlife Centre – Sharjah by O.S. Abdulla. EPAA, Sharjah. 18: 78-79.

Hornby, R. [2012]. *Book Review*: Environmental Atlas of Abu Dhabi Emirate, by P. Hellyer & R. Perry (eds.). EAD, Abu Dhabi. 20: 87-88.

James, S.L. [2009]. *Book Review*: Terrestrial Environment of Abu Dhabi Emirate by R. Perry (ed.). EAD, Abu Dhabi. 18: 75-76.

Llewellyn-Smith, R.E. [2011]. Fresh water input to Khor Hulaylah: an unusual feature of Ra's al-Khaimah's wetlands. 19: 154-157.

Llewellyn-Smith, R.E. [2012]. Coastal wetlands in Ra's al-Khaimah, United Arab Emirates: an update on their status, biodiversity, values and protection. 20: 24-35.

## GEOLOGY

Evans, G. & Kirkham, A. [2009]. A Geological Description of Belghelam Island, North-East Abu Dhabi, U.A.E. 18: 4-9.

Evans, G. & Kirkham, A. [2009]. A Report on a Geological Reconnaissance of Al Aryam Island, March 2004. 18: 10-17.

Stevens, T., Kirkham, A. & Evans, G. [2011]. Quaternary Sea Levels: Recent Evidence from Abu Dhabi. 19: 158-159.

## HISTORY

Brown, C. [2009]. *Book Review*: Building on Desert Tides, by R. Hawker (2008). WIT Press. 18: 72-73.

Garey, L. [2012]. Further investigations of the RAF Wellington crash at Dhadnah. 20: 49-53.

Garey, L. [2012]. *Book Review*: Imperial Outpost in the Gulf. The Airport at Sharjah, (UAE) – 1932-1952, by N. Stanley-Price. The Book Guild, Brighton, UK. 20: 85-86.

Hellyer, P. [2012]. An old tree in Qidfa: a mute witness to an episode in UAE history? 20: 46-48.

Hellyer, P. [2012]. *Book Review*: From Pearls to Oil, by David Heard. Motivate, Dubai. 20: 84-85.

King, G.R.D. [2012]. A 17<sup>th</sup> C. Portuguese description and map of Dibba in south-east Arabia. 20: 41-45.

## INSECTS (excluding Lepidoptera) and OTHER ARTHROPODS

Reimer, R.W., Feulner, G.R. & Hornby, R.J. [2009]. Errata and Addeenda: Updated Illustrated Checklist of Dragonflies of the UAE – including a third species of *Ishnura* damselfly. 18: 28-36.

Feulner, G.R. [2011]. *Book Review*: Arthropod Fauna of the United Arab Emirates, Vol. 3, edited by A. van harten. Dar al Ummah Publishing, Abu Dhabi. 19: 167-168.

Feulner, G.R. [2012]. Stick insects (Order Phasmida) of Eastern Arabia: A Photographic Review. 20: 77-82.

Feulner, G.R., Reimer, R.W. & Hornby, R.J. [2007]. An Updated Illustrated Checklist of Dragonflies and Damselflies of the UAE. 17: 37-62.

Gillett, M.P.T. [2009]. Records of the phytophagous ladybird *Henosepilachna elaterii orientalis* (Zimmerman, 1936) from the Al Ain/Buraimi area of the UAE and Oman (Coleoptera: Coccinellidae). 18: 60-61.

Gillett, M.P.T. [2009]. Unknown or little-known large ground beetles from the United Arab Emirates (Coleoptera: Carabidae: Scaritinae, Harpalinae, Platyninae). 18: 62-64.

Gillett, M.P.T. [2009]. New status for the tiger beetle *Grammognatha euphratica* (Latreille & Dejean, 1822), formerly included in the genus *Megacephala* Latreille, 1802 (Coleoptera: Cicindelidae: sub-tribe Megacephalina). 18: 65.

Gillett, M.P.T. [2009]. *Book Review: Arthropod Fauna of the UAE, Vol. 2.*, by A. Van Harten (ed.). Dar Al Ummah. 18: 776-78.

Howarth, B. [2006]. Diptera of the UAE – collated records from the literature with addition of new records, accompanied by some notes on Mydidae and Stratiomyidae new to the UAE. 16.2: 24-29.

Howarth, B. [2006]. *Book Review: Insects of the UAE: A Checklist of Published Records*, by A. Van Harten (2005). Dar Al Ummah, Abu Dhabi. 16.2: 37.

Howarth, B. [2007]. *Book Review: Arthropod Fauna of the UAE, Vol. 1*, by A. Van Harten (ed.). Multiply Marketing Consultancy Services. 17: 105-106.

## LEPIDOPTERA

Campbell, O. [2009]. Migration of Blue-spotted Arabs *Colitis phisadia* and associated insects at Sila'a, Western Abu Dhabi, in November 2008. 18: 66.

Campbell, O. [2011]. Crimson-speckled Footman moths occurring preferentially on *Heliotropium kotschyi* during migration through Abu Dhabi. 19: 160-161.

Cock, M.J.W. [2009]. Observations of the biology of *Pelopidas thrax* (Hubner) (Lepidoptera: Hesperidae: Hesperinae) in the Hajar Mountains, Oman. 18: 42-49.

Feulner, G.R. [2007]. An unexpected resident butterfly of northern Oman: the Arabian Grizzled Skipper *Spialia mangana* (Lepidoptera: Hesperidae). 17: 99-101.

Gardner, D. (A.S.) & Howarth, B. [2007]. A Butterfly Migration: Blue-spotted Arabs at Jebel Barakah, Western Abu Dhabi. 17: 98.

Gillett, M.P.T. [2006]. *Lindenbergia indica* (Scrophulariaceae) a newly-recorded foodplant for the Blue Pansy butterfly *Junonia orithya here* in Arabia (Lepidoptera: Nymphalidae). 16.1: 18.

Gillett, M.P.T. [2007]. The early stages and larval foodplants of *Bufoidia larseni* Wiltshire and Legrain 1997 (Lepidoptera: Lasiocampidae). 17: 87-90.

Gillett, M.P.T. [2007]. A record of a micro-moth pest, the Teak Defoliator, *Hyblaea puera* (Cramer, 1777), apparently new to the Gulf Region (Lepidoptera: Hyblaeidae). 17: 91-92.

Gillett, M.P.T. [2007]. Three species of snout moths previously unrecorded for the United Arab Emirates (Lepidoptera: Noctuidae: Hyperinae). 17: 93-94.

Gillett, M.P.T. & Gardner, A.S. (D.). [2009]. An unusual observation – attraction of caterpillars to mercury vapour light in the Abu Dhabi desert (Lepidoptera: Pyralidae). 18: 56-59.

Gillett, M.P.T. & Howarth, B. [2007]. The Hawklet or Savannah Hawkmoth, *Sphingonaepiopsis nana* (Walker, 1856), new to the United Arab Emirates (Lepidoptera: Sphingidae). 17: 95-97.

## MAMMALS (including MARINE MAMMALS)

Beech, M. [2006]. Status and Conservation of dugongs. 16.1:20.

Grandcourt, E. [2007]. *Book Review: Dolphin*, by R., Baldwin & T. Al Abdessalaam. Seawords (sponsored by Dolphin Energy). 17: 104-105.

Hellyer, P. [2009]. Golden jackal in Qatar. 18: 70-71.

## MARINE (excluding Marine Mammals, Reptiles)

Beech, M. [2009]. *Book Review: Marine Environment and Resources of Abu Dhabi*, by T. Z. Al Abdessalaam (ed.). EAD, Abu Dhabi. 18: 74-75.

Feulner, G.R. & Hornby, R.J. [2006]. Intertidal molluscs in UAE lagoons. 16.2: 17-13.

Feulner, G.R. [2006]. Occurrence of the large mangrove mud creeper *Terebralia palustris* (Linnaeus, 1767) (Gastropoda; Potamididae) within the Arabian Gulf, at and near Qeshm Island, Iran, in the Strait of Hormuz. 16.2: 32.

Feulner, G.R. [2007]. UAE specimens clarify Marine Gastropod Taxonomy. 17: 103.

Hellyer, P. [2009]. *Book Review: Guide to Common Marine Phytoplankton in Abu Dhabi Waters*, by A. Rajan & T.Z. Al Abdessalaam (2008). EAD, Abu Dhabi. 18: 80.

Hellyer, P. & Aspinall, S. [2006]. An archaeological and ecological curiosity – *Terebralia palustris* (Linnaeus, 1767) in the north-east of the Emirate of Abu Dhabi. 16.1: 10-13.

Hellyer, P. & Aspinall, S. [2006]. More *Terebralia palustris* near Abu Dhabi. 16.2: 33.

Hellyer, P. & Hornby, R. [2007]. A note on molluscs from a Late Islamic desert site in Abu Dhabi. 17: 75-76.

Jabado, R. [2012]. Assessing the need for shark management initiatives in the United Arab Emirates. 20: 36-40.

Tourenq, C., Shuruqi, M.K., Foster, G., Foster, K. Chellpermal, C., Lebon, S. & Rei, D. [2007]. A Note of Elasmobranchs (sharks and rays) of UAE and Oman, with special mention of Bowmouth Guitarfish or Shark Ray (*Rhona ancyclostoma*). 17: 63-69.

## OBITUARIES

Anon. [2012]. Robert (Bob) W. Reimer. 20: 90-91.

Anon. [2012]. Carolyn Lehmann. 20: 92..

Feulner, G.R. [2009]. Alexander 'Sandy' Fowler. 18: 72.

Hellyer, P. [2009]. Michael Kyrle-Pope. 18: 72.

Hellyer, P. [2012]. Simon Aspinall. 20: 89-90.

Hellyer, P. & Richardson, C. [2009]. J.A.D. (Adrian) Chapman. 18: 71-72.

Loughland, R. & Boer, B, [2006]. Professor Ronald Phillips. 16.1: 23.

Schneider, W. [2012]. Robert (Bob) W. Reimer. 20:94-95.

Taylor, K., Gardner, D. (A.S.), Fisher, Fisher, P. & Sowinska, L. [2012]. Roy Richards. 20: 92..

## PALAEONTOLOGY

Lokier, S., Al-Suwaidi, A.E. and Steuber, T. [2012]. Stable isotope sclerochronology of Pleistocene shells of the 'Giant Clam' *Tridacna* from Abu Dhabi. 20: 21-23.

## REPTILES & AMPHIBIANS

Aspinall, S. & Gardner, D. (A.S.), [2007]. Snakes Alive: Gray's Racer Snake *Platyceps cf. ventromaculatus* (Gray 1834) *sensu* Schatti and Schmitz 2006, on Sir Bani Yas island. 17: 85-86.

Gardner, D. (A.S.), [2007]. *Book Review: Snakes of Arabia: A Field Guide to the Snakes of the Arabian Peninsula and its Shores*. D. Egan (2007). Motivate Publishing, Dubai. 17:103-104.

Gardner, A.S. (D.). [2009]. Two new gecko species for the United Arab Emirates: *Pristurus carteri* (Gray, 1863) and *Hemidactylus persicus* Anderson, 1872. 18: 18-23.

Gardner, A.S. (D.), Tovey, N. & Els, J. [2009]. The Arabian cat snake (*Telescopus dhara* (Forsskal, 1775)): a new species record for the United Arab Emirates with notes on the species in Oman. 18: 24-27.

## Index

Index to Tribulus Vols. 11-15. 16.1: 27-28.

Index to Tribulus Vol.s 16-20. 20: 93-96.

# ترييلوس

مجلة جمعية الامارات للتاريخ الطبيعي

مجلد 20 - 2012



*Calotropis procera*