TRIBULUS

Bulletin of the Emirates Natural History Group

Vol. 11.2 Autumn/Winter 2001

NOTES FOR CONTRIBUTORS

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

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

Correspondence and enquiries should be sent to:

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

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

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

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

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

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

International Standard Serial Number (ISSN): 1019 - 6919.

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Picture by Hanne & Jens Eriksen

Back: A modern stone-built fox-trap in the Hajar Mountains, Ra's al-Khaimah
Picture by Mark Beech

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

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

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

The Group is a non-governmental member of IUCN, the World Conservation Union.

Published by the Emirates Natural History Group, P.O. Box 45553, Abu Dhabi, UAE

Printed by Dar Al Fajr Press, Printing, Publishing and Advertising, P.O.Box 505, Abu Dhabi, UAE

EDITORIAL

As promised, this issue of ***Tribulus*** offers a broad range of topics, to compensate for the special archaeological focus of the last issue. The Editorial Board is pleased to note that on this occasion not only are we able to welcome new contributors, but to deal with topics that have not previously received much attention in the journal. ***Tribulus,*** like the Emirates Natural History Group itself, has always sought to address a fairly broad range of topics, ranging from archaeology and history to palaeontology, geology and the whole of the disciplines covered by the term 'natural history.'

It has done so, in part, because of the scope of the ENHG, its publisher, but continues to do so because, over a decade after the journal began, there is still no other scientific journal in the English language that is devoted to these topics within a UAE context.

Papers in UAE topics do appear in journals overseas, of course, but rarely reach much of an audience in the country itself. It is the belief of the Editorial Board that not only is the publication of scientific research itself of importance, but also that such research should be made available to those fellow researchers who live and work in the country concerned.

Sadly, thirty years after the formation of the UAE, there is *still* insufficient attention being paid by Government bodies to scientific research, although, to be fair, the situation is better now than it was a decade or so ago. We look forward to seeing this matter being addressed properly in the near future. The formation of a special federal or local body to assess and to fund scientific research proposals might well be a way forward, and would certainly be one that we would welcome.

To the topics in this issue.

Of particular interest is the paper on the phylogenetics of the Socotra Cormorant, a near-endemic of the Arabian Gulf. This sheds light for the first time on its relationship to other cormorant species, and represents an important contribution to the science of ornithology. We would wish that scientists employed by the country's professional bodies might engage from time to time in such detailed work.

Somewhat more mundane, although of equal interest to those interested in the country's birdlife, is the paper on the diet of the Little Owl, which is complemented by another on the diet of the Spiny-tailed lizard or *dhub.* Too little work has been done on the diet of the country's wildlife, yet this is an important aspect of any long-term conservation strategy.

Another paper on the distribution of the Dhofar toad in the Musandam peninsula underlines the fact that much still has to be recorded about the distribution of our wildlife, as well as about its diet and genetics.

Of the above papers, all have authors who have contributed in the past to the journal, Peter Cunningham, co-author of three, Simon Aspinall, of two, and the indefatigable Gary Feulner. We are pleased, though, to welcome Martyn Kennedy and Roderic Page, lead and third author of the Socotra cormorant paper, to the journal for the first time.

Another new author to appear in this issue is Ronald Hawker, whose review of the traditional 19th and early 20th Century domestic architecture of the country not only breaks new ground for the journal, but also for the study of these important buildings, far too many of which have disappeared in the last twenty or thirty years.

A third new author, Peter Hogarth, joins Mark Beech, a regular contributor, as co-author of a short note on the discovery (on a dinner table) of a species of crab not previously recorded in the emirates except on archaeological sites, providing evidence once again not only of the fact that it is worth keeping an eye on dining tables (and the souq) in the search for new information, but also of the way in which archaeological work and the study of today's environment and wildlife can be mutually beneficial.

Despite the pledge in **Vol.** 11**.1** to focus on issues other than archaeology, there is, however, one paper on the subject, with Gareth Longden and Salvatore Garfi reporting on work on a Late Islamic fort at Qurayyah, in Fujairah. This project was partly funded by the ENHG's Conservation Fund, and we are delighted to be able to report the results. Further work in the vicinity of the fort has been undertaken since this paper was written, revealing new information about settlement in the Qurayyah area, and we look forward to being able to publish a summary report in due course.

Finally, the Editorial Board is delighted to welcome Michael Gallagher to the Journal's Advisory Board. Long active in Oman and the UAE, although now retired to England, he is not only a highly respected ornithologist, but very much an all rounder, as his bibliography suggests. His expertise and his contribution to knowledge of the natural history of Oman and the UAE can be simply attested by the numerous species or sub-species of invertebrate, reptile, mammal and plant endemic to the area have been named after him.

The introduction of our Advisory Board several years ago has helped to enhance substantially the academic quality of contributions appearing in the journal. We are grateful to the Board members, as well as to others who provide blind peer reviews of papers, for their assistance and support.

New contributors are always welcome, and should not be discouraged by the presence of the Advisory Board! Its task, as well as that of the editorial team, is primarily to assist in ensuring that original observations and studies come to print. As such, the objective is to provide shrewd and accurate editorial advice, which, if necessary, will also include advice on how papers and short notes submitted can be enhanced so as to bring them up to the standard required by the journal.

Corporate Members of the ENHG

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

Abu Dhabi Company for Onshore Oil Operations, (ADCO), Al Fahim Group, Al Sayegh Richards Butler, British Petroleum, (BP), Denton, Wilde, Sapte, Environmental Research and Wildlife Development Agency, (ERWDA), GAMCO, Hyder Consulting Middle East, Jashanmal National Company, Metco, Mohammed Bin Masood & Sons, Nama Development Enterprises, National Bank of Abu Dhabi, Omeir Travel Agency, Penspen International Limited, Ready Mix Abu Dhabi Ltd, Simmons & Simmons, Trowers & Hamlin, WESC.

The phylogenetic position of the Socotra Cormorant *Phalacrocorax nigrogularis* A near-endemic of the Arabian Gulf

by Martyn Kennedy, Simon Aspinall & Roderic D. M. Page*

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Abstract

A recent sequence-based phylogeny for the cormorants and shags did not include the **Socotra Cormorant** Phalacrocorax nigrogularis. To estimate the phylogenetic position of the Socotra Cormorant, sequence data for this species from three mitochondrial genes (12S, ATPase 6, and ATPase 8) was added to the existing data-set. The results of weighted parsimony analyses on the sequence data show that the Socotra Cormorant is sister taxon to a group that includes several species of shags and cormorants (P. carbo, capillatus, capensis, sulcirostris, varius, featherstoni and punctatus). The phylogeny shows, moreover, that the Socotra Cormorant is not particularly closely related to any of the other 22 shags and cormorants in this data-set. Our estimates suggest that this species diverged from the ancestor of its closest relatives over four million years ago, even though the Arabian Gulf, to which, at the present time, it is largely confined, is far younger.

Introduction

The two biologically most important recent classifications for the shags and cormorants **(Phalacrocoracidae)** are the osteologically based taxonomy of Siegel-Causey (1988), and the taxonomy of van Tets (1976) which was based on the behaviour, ecology and anatomy of the group. These two taxonomies largely agree with each other, but disagree on the placement of certain taxa. Although the two taxonomies place the Socotra Cormorant Phalacrocorax nigrogularis in the genus Leucocarbo, van Tets (1976) places it in a large subgenus, Leucocarbo, with 15 other species, whereas Siegel-Causey (1988) groups it with only two other species. Both of these taxonomies suggest that geographically the nearest relatives of the Socotra Cormorant can be found in southern Africa.

The Socotra Cormorant occurs only in the Arabian Gulf and in the Arabian Sea (N.W. Indian Ocean), being far more abundant (and resident) in the former (Aspinall 1996). The range of this species overlaps that only of wintering Great Cormorant P. carbo. Given that the Arabian Gulf has only existed in its current form for less than 10,000 years (see e.g. Lambeck 1996; Teller et al. 2000), several possibilities exist as to the evolutionary history of the Socotra Cormorant. The Socotra Cormorant may have:

i. evolved recently following the formation of the Gulf;
ii. already been present in the Tigris/Euphrates river valleys and become fully marine in habit after the Gulf flooded
or
iii. entered the newly formed Gulf from outwith the Straits of Hormuz.

Prior to the end of the last Ice Age, c18,000 BP, the "Gulf" was merely the marshy valley of the merged Tigris-Euphrates (Teller et al. 2000). Flooding of the Arabian Gulf commenced around 14,000 BP and continued over the subsequent eight to ten thousand years (Lambeck 1996).

If the Socotra Cormorant evolved recently as a consequence of the formation of the Gulf, to which it is virtually endemic, one would predict that it would be very closely related to another cormorant or shag species. It could be surmised that the Socotra Cormorant, although certainly not derived from Great Cormorant stock, might have evolved from an eastern form of the **European Shag** P. aristotelis. Alternatively, if the Socotra Cormorant inhabited the Tigris/Euphrates river valleys before the formation of the Gulf, or if it entered the Gulf after it flooded, it could be a relatively ancient species. If the latter, the questions then to be asked would be where was it before and why isn't it still there now ?

In an attempt to differentiate between these possible evolutionary scenarios we sequenced mitochondrial DNA from Socotra Cormorant and combined it with the data previously used to estimate the phylogeny of the cormorants and shags (Fig. 1). The combined sequence data-set can thus be used to estimate the phylogenetic position of the Socotra Cormorant within the shags and cormorants. Sequence data also offers a measure of the relative level of divergence between the Socotra Cormorant and the, other shags and cormorants. Moreover, a sequence-based phylogeny including the Socotra Cormorant allows us to evaluate its evolutionary history, including an estimation of the timing of its ancestral divergence.

Methods

Total genomic DNA was extracted from Socotra Cormorant tissue using the DNAeasy Tissue Kit (Qiagen). Following extraction, the DNA was amplified for three mitochondrial genes, the 12S ribosomal RNA gene and the overlapping ATPase 6 and 8 genes. The polymerase chain reaction (PCR) was used to amplify these regions following the procedure of Kennedy et al. (2000). Negative controls were included with each PCR reaction. The PCR product was purified using the QIAquick Gel Extraction Kit (Qiagen) and then sequenced by an automated sequencer using either the PCR primers or internal primers (see Kennedy et al., 2000). The ATPase 8 gene was also amplified and sequenced for **Red-legged Shag** P. gaimardi and the **Guanay Cormorant** P. bougainvillii. Ambiguity codes were used when it was not possible to discriminate between alternative bases at a site and were analysed as uncertainties.

The Socotra Cormorant (all three genes) and Red-legged Shag and Guanay Cormorant (ATPase 8) sequences were added to, and aligned with, the pre-existing data-set of Kennedy et al. (2000). The sequences have been submitted to GenBank (Accession number AF410794-410797) and the data matrix and resultant phylogenetic tree to TreeBASE (http://www.treebase.org/treebase/index.html). Analyses were conducted using version 4.0b8 of PAUP* (Swofford, 2001). Phylogenetic trees were constructed with maximum parsimony using heuristic searches with 1000 random addition sequence replicates and TBR branch-swapping. We used the PTP test (Faith and Cranston, 1991) and g1 statistic (Hillis and Huelsenbeck, 1992) to investigate whether the data contained significant phylogenetic signal. To investigate the level of support for the branches of the phylogenetic tree in the sequence data, both bootstrap and jack-knife analyses were employed. For the bootstrap and jack-knife analyses 1000 replicates were performed using a heuristic search with TBR branch-swapping.

Results

Our alignment gave a total of 1141 base pairs of sequence data, including a 383-bp fragment of 12S and a 758-bp fragment of the overlapping ATPase 6 and 8 coding genes. Of the 378 variable sites, 246 of the characters were parsimony informative. Both the significantly skewed tree-length distribution (g_1 = -0.783 from 10000 random trees, $P < 0.01$; Hillis & Huelsenbeck, 1992), and a PTP test (1000 replicates, $P = 0.001$) showed that the data contain significant phylogenetic signal.

The appropriate transition to transversion ratio for this data-set was estimated on the equally weighted parsimony tree. With the optimality criterion set to maximum likelihood, the transition to transversion ratio was estimated at approximately 7:1 (this is also the value found by Kennedy et al. 2000). With the weight of transversions increased by this ratio we found a single most parsimonious tree (Fig. 2). All but one of the branches in this phylogeny received more than 50% bootstrap support, and all the branches receive over 50% support from the jack-knife analysis. All of the exploratory analyses performed with this data-set (e.g. including equal weighted parsimony analysis) placed the Socotra Cormorant in the position found in the weighted parsimony analyses (i.e. as sister taxon to the group spanning carbo to punctatus). Apart from the addition of the Socotra Cormorant, the tree topology is the same as Fig. 1(b) (Fig. 2b of Kennedy et al. 2000).

There are a variety of sources of error associated with dating divergence times (e.g. in estimating the number of sequence changes and in the calibration used for the rate of change), and thus any estimates made must be treated as only coarse approximations (Hillis et al. 1996). Following Kennedy et al. (2000), using a rate of change for transversions of 0.2% per million years, an approximate divergence time and date can be estimated for the Socotra Cormorant. The mean number of transversions calculated from all possible pair-wise comparisons for the divergence point of interest were used (i.e. between the Socotra Cormorant and each of carbo, capillatus, capensis, sulcirostris, varius, featherstoni and punctatus). The resulting estimate suggests that the Socotra Cormorant diverged from the common ancestor of the carbo-punctatus (Great Cormorant-Spotted Shag) group about 4.7 million years ago.

Discussion

The results show that the Socotra Cormorant has had a long, independent evolutionary history. This finding clearly discounts the possibility that the Socotra Cormorant evolved recently as a consequence of the (equally recent) formation of the Arabian Gulf. Our phylogeny shows that the Socotra Cormorant is not sister taxon to either the Great Cormorant or European Shag, and, even if it had have been, it still would have had to have diverged from them millions, rather than tens or even hundreds of thousands of years ago. While the level of bootstrap support for the position of the Socotra Cormorant is relatively low (the jack-knife support, however, is reasonable; see Fig. 2), all of the analyses performed with this data-set consistently place this species in the same position.

In addition to adding the Socotra Cormorant sequence to the Kennedy et al. (2000) data-set, we also added the ATPase 8 sequence for the Red-legged Shag and Guanay Cormorant. These data affected the level of bootstrap support found for some parts of the phylogeny and reduced the number of optimal trees from two to one (see Figs. 1 & 2). In the analysis of the previous data-set the two maximum parsimony trees found differed only in the placement of the Guanay Cormorant P. bougainvillii (see Fig. 1). With the additional data the current analysis recovers and supports the topology that places the Guanay Cormorant outside of the group of campbelli - onslowi - chalconotus - purpurascens - albiventer (i.e. Fig. 1b). The additional Red-legged Shag sequence does not affect the tree topology, but does alter the level of support for its position in the tree. Bootstrap support for the branch placing the Red-legged Shag as the second most basal cormorant or shag lineage, for example, increased from 67% to 85% (see Figs. 1b & 2).

There are several species of extant cormorant and shag still missing from the sequence data-set. However, none of the missing species can apparently be very closely related sister species to the Socotra Cormorant, again discounting that it evolved within the last 10,000 years as a consequence of the Gulf forming. Most of the species missing from this data-set can readily be eliminated as potential sister taxa of the Socotra Cormorant, not only because their ranges are geographically distant from the Gulf, but because they are behaviourally, ecologically and morphologically all markedly different. Geographical distance itself does not preclude the possibility of close phylogenetic proximity. Three other species, with ranges currently nearest the Gulf (i.e. around the Indian Ocean; from Africa to S. Asia), namely, Javanese Cormorant P. niger, Long-tailed Cormorant P. africanus and Pygmy Cormorant P. pygmaeus, are members of a morphologically very distinct group (the microcormorants) which would be expected to form a monophyletic group with the Little Pied Cormorant P. melanoleucos, a species actually from Australasia. In our phylogenetic tree, the Socotra Cormorant does not group with the Little Pied Cormorant, suggesting that it cannot be closely related to any of the other microcormorants. Morphological, ecological and behavioural evidence (see e.g. Johnsgard 1993) would also all make it difficult to accept the Socotra Cormorant as sister species to any of the microcormorants. The remaining species missing from this data-set with a range nearest the Gulf is the Indian Cormorant (or Indian Shag) P. fuscicollis. Although the possibility that the Socotra and Indian Cormorants are sister species cannot be eliminated, it is highly improbable that they separated within the last 10,000 years given the dramatic differences in their general ecology and foraging behaviour (Johnsgard 1993), quite apart from their physical dissimilarity.

For similar reasons, nor could have the Bank Cormorant P. neglectus of southern Africa, this being the only other species from the Indian Ocean region not yet considered, and also still absent from the data-set. Once again, however, this species is ecologically far-distanced from Socotra Cormorant. Tissue samples are being sought from both of these species to elucidate any possible relationship.

Given that the sequence data suggest that the Socotra Cormorant diverged over four million years ago, it is most likely that either the species already inhabited the Tigris/Euphrates river valleys and became fully marine in habit after the Gulf inundated, or that it colonised the Gulf from another marine area, i.e. from the Indian Ocean. Since the Socotra Cormorant is only exceptionally seen feeding in estuaries or along rivers at the present day (in this region, in Mesopotamia, the latter situation already being occupied by the Pygmy Cormorant), the second possibility has to be the more plausible. This is given strong support by the relatively short time elapsed since the possibility arose to colonise the Gulf, and by the species' highly specialised marine habit, foraging ecology and predator:prey relationship.

An estimated global sea level drop of as much as 120m occurred during the last glaciation (Glennie 1991). If a setting similar to that of the present day Gulf was found in the Arabian Sea, or elsewhere in the western Indian Ocean at such times of eustatic sea level fall, then perhaps the environment did exist outwith the Gulf to permit speciation. The time frame is rather too short, the

Ice Age only lasting c2 million years, and even if this were long enough for speciation to occur, it is sufficiently short of the estimated 4.7 million years since the Socotra Cormorant diverged from its ancestral stock to suggest that this is the entire story.

A further line of investigation would be examination of the possible local situation in each of the preceding interglacials to the present current one. If the Gulf flooded in each of several such episodes during the c2 million year long Ice Age, (the last inter-glacial having lasted c50,000 years), might the Socotra Cormorant have then been present repeatedly? If so, it is easy to hypothesise that during glacial advances, as sea levels fell once again, the Socotra Cormorant had on each occasion no alternative but to move out of the "draining" Gulf. This too might explain why only two colonies now occur outwith the Gulf, in what may actually have constituted, at such times, glacial 'refugia' to which the species was compelled to relocate. Even if this hypothesis were the case, it confounds the species' evolutionary history as it is hard to contend that it could have evolved in a repeatedly flooding and draining Gulf, over, once again, an overall period of too short a time, especially considering its specialised niche of today.

If the species did indeed evolve in the western Indian Ocean, as seems increasingly likely, it is possible that the post-glacial global sea level rise made this area ecologically unsuitable for either or both predator or prey, Socotra Cormorant and shoaling fish respectively, which conceivably then migrated into and colonised the newly formed Gulf, regardless of whether or not they had been there in any of the preceding interglacials.

According to this data-set, the Socotra Cormorant diverged from the common ancestor of its closest extant relatives over four million years ago, thus indicating that it has had a long, independent evolutionary history. The paradox lies in the fact that the Socotra Cormorant is endemic to the Gulf region, but that the Arabian Gulf, the core of its present range, has itself only existed in something like its present form for less than 10,000 years. As to the reason for the species' almost complete extirpation outwith the Gulf, as must seemingly be the case, this currently remains something of a mystery, save being a relic from an as yet unfathomed Arabian Sea history.

Acknowledgements

This study was supported by NERC grant GR3/11075 and the Wolfson Foundation. MK was supported by a NZ Science & Technology Post-Doctoral Fellowship. Peter Hellyer is thanked for stimulating discussion and for researching and loaning papers on the post-Quaternary evolution of the Gulf.

Postscript

On the basis of preliminary analysis of tissue samples recently received, following completion of this paper, of the southern African Bank Cormorant P. neglectus, this species is also now apparently eliminated as a sister species of Socotra Cormorant.

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Appendix 1.
Common names of species mentioned in the text

P. africanus	Long-tailed (or Reed) Cormorant
P. albiventer	Falkland Is. (Imperial or Blue-eyed) Shag
P. arisfotelis	(European) Shag
P. bougainvillii	Guanay Cormorant
P. campbelli	Campbell Island Cormorant
P. capensis	Cape Cormorant
P. capillatus	Japanese (Temminck's) Cormorant
P. carbo	Great Cormorant
P. chalconotus	Stewart Island Cormorant
P. featherstoni	Pitt Island Shag
P. fuscicollis	Indian Cormorant or Shag
P. gairnardi	Red-legged Shag
P. melanoleucos	Little Pied Cormorant
P. neglectus	Bank Cormorant
P. niger	Javanese Cormorant
P. nigrogularis	Socotra Cormorant
P. onslowi	Chatham Island Cormorant
P. punctatus	Spotted Shag
P. purpurascens	Macquarie Is. (Imperial) Shag
P. pygmeus	Pygmy Cormorant
P. sulcirostris	Little Black Cormorant
P. varius	Pied Cormorant

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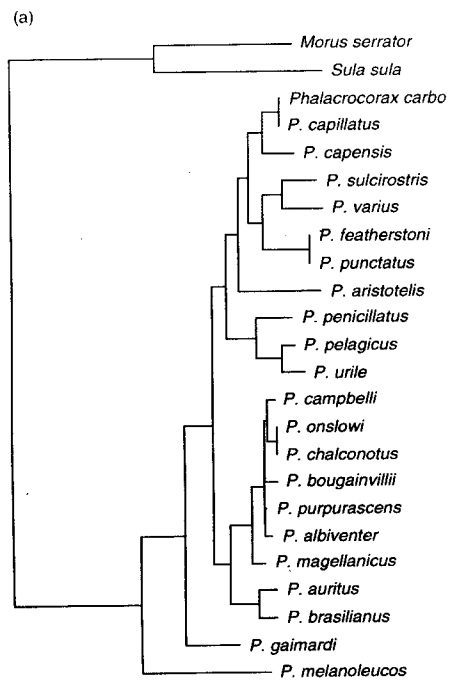
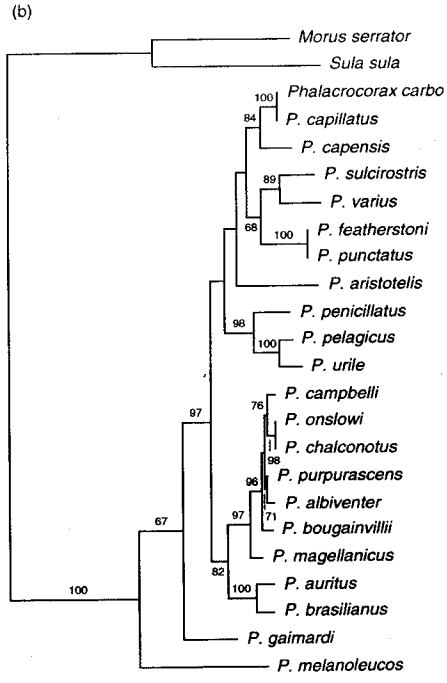




Figures 1a. & 1b (*above, left and right)* The two most parsimonious weighted phylograms redrawn from Fig. 2 of Kennedy *et al.* (2000). Bootstrap values (>50%) are shown on **(b).**

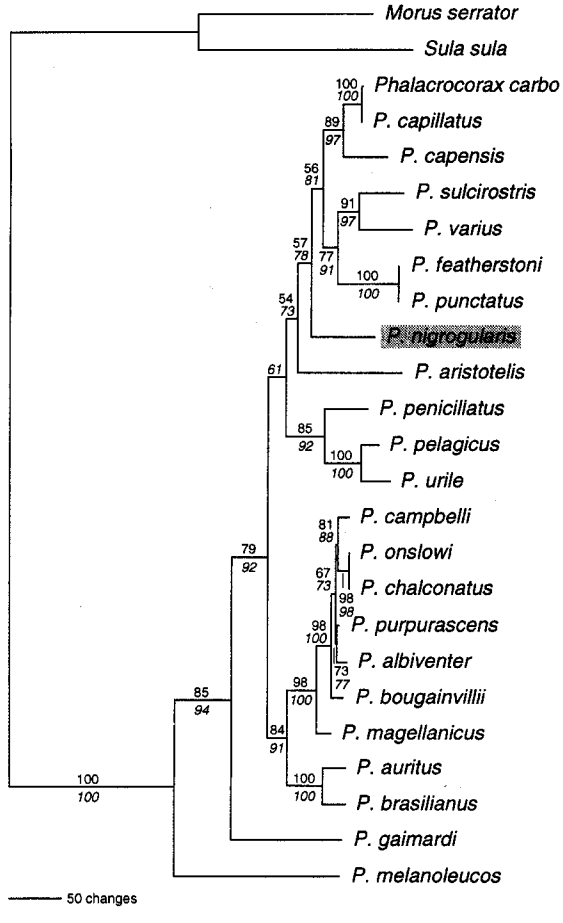


Figure 2 (*right*). The weighted parsimony phylogram (tree length = 1890, CI = 0.709, RI = 0.703) generated from the current sequence data-set. In this analysis transversions were weighted seven times transitions (this ratio is the same as found and used previous for the majority of this data-set, see Kennedy *et al.*, 2000). Bootstrap percentages (>50%) from 1000 replicates are shown uppermost. Jack-knife percentages (>50%, with 33% of characters deleted in each replicate) from 1000 replicates are shown in italics.

Notes on the distribution and ecology of the Dhofar toad, *Bufo dhufarensis* Parker 1931, in the Musandam Peninsula (Sultanate of Oman)

by Peter L. Cunningham and Gary R. Feulner

Abstract

This paper reviews and supplements the known distribution and comments on the ecology of the Dhofar toad, *Bufo dhufarensis,* within the arid carbonate mountains of the Musandam region of the UAE and Oman, adjacent to the Strait of Hormuz. The species is shown to exist there in numbers and over a range not previously suspected.
Dozens of *B. dhufarensis* were encountered mating during daylight hours in temporary pools in Wadi Shah, NE of Ra's al-Khaimah, UAE, two to three days after moderate rainfall in the area in January 2001, following extended drought. Five weeks later the same pools contained hundreds of tadpoles but no adult toads were observed by day. Small numbers of *B. dhufarensis* tadpoles were found elsewhere in the Musandam in two residual pools as late as mid-April. At least one adult and numerous tadpoles were found at an isolated permanent spring in June.
Only a very few earlier reports have indicated the presence of toads or tadpoles within the mountains of the Musandam, where permanent water is scarce. The authors' observations are consistent with prior published reports indicating that the Dhofar toad is able to aestivate for extended periods of time and may be active for only relatively short periods after rain, and/or that adult Dhofar toads are primarily nocturnal.
Two occurrences of the Arabian toad, *Bufo arabicus* Heyden 1827, are also reported in this paper, from peripheral areas of the Musandam. All previously published identifications from Musandam have been of the Dhofar toad.

Introduction

In mid-January 2001 in upper Wadi Shah, a lower tributary of the large Wadi Bih watershed in the mountains NE of Ra's al-Khaimah, the authors came upon a cacophony of Dhofar toads *Bufo dhufarensis* calling, coupling, and laying and fertilising eggs in temporary pools among boulders and gravel in the wadi bed *(Fig.* 1). The staccato *"kra-kra-kra"* breeding call of the Dhofar toad is readily distinguishable from the creaking *"krrraaaa"* of the Arabian toad *Bufo arabicus,* the only other toad so far known from the UAE and Oman.
The pools were the product of overnight rains two and three days before, after almost three years of drought. A dozen or more mating pairs of toads were observed in the first two downstream pools and it is estimated that many times that number were present in other pools, which stretched intermittently for half a kilometre upstream through an area of wadi-side agricultural

Fig. 1: Dhofar toads *Bufo dhufarensis* mating in a pool in Wadi Shah after rains. Note the large tympanum with a distinct outline, the backwards sloping profile of the snout and the black toe tips, all of which distinguish this species from the more commonly seen Arabian toad *B. arabicus.*

terraces known as Lahsah. The site is somewhat more than an hour's walk from the end of the vehicle track at an elevation of approximately 400 metres.

The presence of toads in the interior of the mountainous region came as a surprise since the Musandam, which is mainly composed of limestone and dolomite, is notorious for its lack of long term surface water. Despite years of experience afoot in the area, neither of the authors had ever seen toads in the Musandam before, although toads (mainly B. arabicus) are commonly observed in the generally wetter wadis in the Hajar Mountains, which begin immediately to the south of the Musandam but are geologically distinct, being composed primarily of basic and ultrabasic igneous rocks. The Lahsah site is, however, known to be relatively favourable for the retention of surface water, in comparison to other Musandam locations. The foregoing circumstances prompted further investigation and the present note.

The amphibian fauna of Arabia is limited in both distribution and diversity. It consists of nine Anuran species (i.e. frogs and toads), six of which belong to the genus Bufo and one each to the genera Hyla, Rana and Euphlyctis. Six species are endemic to the Arabian Peninsula and three occur in the Palaearctic region. Of these, all but one Bufo species are endemic to the Arabian Peninsula. Most of the species are concentrated in coastal areas and the mountains that fringe much of the peninsula, with the richest area being the relatively moist southwest (Yemen and SW Saudi Arabia), where all the recorded Arabian amphibians are present (Arnold 1980; Balletto et al. 1985)).

Bufo arabicus (the Arabian toad) and Bufo dhufarensis (the Dhofar toad) are the only two species so far recorded from the UAE and Oman (Balletto et al. 1985; Leviton et al. 1992; Hornby 1996; Jongbloed 2000). Both are relatively small species of Bufo endemic to the Arabian Peninsula (Balletto et al. 1985; Leviton et al. 1992; Schatti & Gasperetti 1994; Gardner 1999).

The Dhofar toad was first described and named on the basis of a specimen collected by the explorer Bertram Thomas from the Dhofar region of southern Oman.

Distribution

Bufo dhufarensis is limited to peripheral Arabia, ranging from western Saudi Arabia (Mecca) south to Yemen and, eastwards and northwards through Oman to the eastern UAE and the Musandam (Arnold & Gallagher 1977; Arnold 1980; Balletto et al. 1985; Leviton et al. 1992). In Dhofar, it is the only amphibian present (Balletto et al. 1985; Gardner 1998). Populations recorded from central Saudi Arabia are viewed as introduced (Balletto et al. 1985; Schatti & Gasperetti 1994).

In the Hajar Mountains of the eastern UAE and northern Oman, B. dhufarensis is present but is infrequently encountered and appears to be much less abundant than the Arabian toad, B. arabicus. This conclusion represents the experience of the present authors and others (Hornby 1996; Khan 1997; Jongbloed 2000). Hornby (1996) and Khan (1997) describe B. dhufarensis as rare in the UAE. Published records of B. dhufarensis from the northern Hajar Mountains include only the following sites (from south to north): Buraimi, Wadi Shawkah, Masafi, 'Asimah, Wadi Wurrayah, Wadi Ziqt and Digdagah (Arnold & Gallagher 1977; Balletto et al. 1985; Stuart & Stuart 1995), although Gallagher (pers. comm.) indicates that it is, in fact, known from many localities northwards from Dhofar to the UAE/Oman border at Al Ain/Buraimi. The Digdagah site is on the agricultural plains south of Ra's al-Khaimah, adjacent to the southern Musandam peaks. The authors have encountered small numbers of individual adult B. dhufarensis by day within this same range, along the mountain front north of Al Ain/Buraimi; near Hatta, UAE; and, five weeks after localised rain, in upper Wadi Diftah, near Masafi, UAE. The records of Animal Management Consultancy at the Breeding Centre for Endangered Arabian Wildlife in Sharjah also contain occasional Hajar Mountain sightings over the past five years (Wright, pers. comm.). It seems likely, however, that behavioural factors, discussed below, may cause B. dhufarensis to avoid routine observation.

Only four previous records of B. dhufarensis are known from the Musandam. Two were from at or near the principal coastal town of Khasab, being reports by M.D. Gallagher from a pool near a well in date gardens and by J.P. Mandaville from a dry cistern in a nearby gravel wadi (Balletto et al. 1985; Gallagher, pers. comm.) and specimens collected by M.D. Gallagher at the principal coastal town of Khasab and in a nearby gravel wadi (Balletto et al. 1985). In 1999, Gardner (pers. comm.) found B. dhufarensis abundant in date plantations at the coastal hamlet of Ghumdhah on the Arabian Gulf.

The fourth record of B. dhufarensis was more remarkable: in February 1999 a party of six hikers from the Emirates Natural History Group found two toads atop the summit ridge of Jebel Rahabah (Honey 1999), overlooking the Arabian Gulf coast NE of Ra's al-Khaimah at approximately 1550 metres elevation. There had been no significant rain in that area since November 1997, the wadi below was described as "dry, dry, dry" and the summit ridge itself was described as "barren." Nevertheless, not long after the group sat down to enjoy lunch, a cool wind and a shower blew in. The group leader, an experienced naturalist, elaborated: "There was no permanent water along the mountain (as you would expect) but there were a lot of large tufty grasses (species?) and it started to rain while we were up there & that's when we saw [the toads]. It was surprisingly damp up there with lots of low cloud covering the ridge. This in direct contrast to a few hundred feet lower, which was very dry." (James pers. comm.). He was able to identify the toads as B. dhufarensis, by reference to Gross (1996) (in which the descriptions of B. dhufarensis and B. arabicus are unfortunately reversed) and consultation with the authors.

The Jebel Rahabah account exemplifies two more general phenomena that can be observed locally. One is the potentially significant contribution of cloud and mist to moisture levels at higher elevations, especially on ridges adjacent to the coast. The second is the emergence of the local toads during or immediately after even modest rain. This has been witnessed by one of the authors (GRF) on two occasions in wadis in the Hajar Mountains, and in each case a dramatic increase in ambient toad numbers (mostly B. arabicus) was accompanied by the observation of a carpet viper Echis coloratus. The latter is normally seen only infrequently, but in this region it feeds primarily on toads.

A few other, anecdotal reports of Musandam toads exist, but do not indicate the species. Of these the most specific is Sawaf's mention of a single toad seen in the central Musandam in the course of his work on local carnivores, which involved monitoring waterholes (Sawaf pers. comm.). The Wadi Shah sighting reported in this paper confirms the continuing and even robust presence of B. dhufarensis in the mountains of the Musandam.

Three weeks after the Wadi Shah observations, one of the authors (GRF) inspected temporary pools in Wadi Wa'eeb, an upper tributary of the Wadi Bih watershed, and found a total of five tadpoles measuring 25-30 mm, which were identifiable as B. dhufarensis by reference to Balletto et al. (1985). Another two weeks later, or five weeks after the original observation of the mating toads, the same author returned to the Wadi Shah site in late morning. The lowest pools and the small stream below them had dried up and no adult toads were seen or heard anywhere, but the remaining pools further upstream contained an estimated aggregate of at least 600 tadpoles ranging in size from 25-40 mm. Again, these were identifiable as B. dhufarensis by reference to Balletto et al. (1985). In each case, identification of tadpoles was based in particular on the shape of the

mouth (viewed under magnification of 2x-10x), the colouration and point of attachment of the caudal fin, and the visibility of the intestines. The presence of a range of tadpole sizes in the same pools may indicate multiple episodes of breeding in response to local rains spaced at intervals from early November through mid-January.

In mid-April 2001, three months after the original Wadi Shah observations, the authors happened unexpectedly upon a residual pool at c. 650 metres in rugged Wadi Kharras in the southern Musandam, where they observed some two dozen tadpoles approximately 35 mm in length, which were once again identifiable as B. dhufarensis.

In addition, contemporary reports were received of tadpoles in two other tributaries of Wadi Bih: at a man-improved spring in Wadi 'Aini in mid-January 2001 and in natural rock pools in the forbidding gorge of Wadi Zibat in late December 2000 or early January 2001 (Couldrey pers. comm.). Both sites are located at approximately 400 metres and they are two of the very few places where permanent surface water can be found in the Musandam.

The authors paid an overnight visit to the spring in Wadi 'Aini in June 2001 and found tadpoles of various sizes and juvenile toads present in and around the spring. These were determined to be B. dhufarensis. No adult toads were seen by day or by night, but at least one adult male B. dhufarensis called intermittently from dusk to near dawn from within a damp crevice close to the source of the spring.

The presence of toads and tadpoles in different stages of development suggests that breeding may occur continuously at this site. A large wadi racer Coluber rhodorachis was present at the spring in early morning and was actively hunting despite the presence of human observers. The B. dhufarensis tadpoles and young toads here were presumed to make up a large portion of its diet, as B. arabicus tadpoles do elsewhere (Cunningham, in prep).

Figure 2 shows all of the sites in the Musandam from which B. dhufarensis has now been reported.

Two occurrences of the Arabian toad B. arabicus are also reported here, since there appear to be no prior published records of this toad from the Musandam, although, as noted above, it is relatively common in the mountains to the south. Gardner (pers. comm.) observed an unidentified toad and B. arabicus tadpoles in an irrigation pool among date gardens at Khasab in 1999. One of the authors (GRF) observed at least five adult B. arabicus in December 2001 in several small but apparently permanent pools in coarse wadi gravel among boulders at Sidqah, a refurbished pastoral settlement about a 45-minute walk above the end of the vehicle track in Wadi Khabb in the SE Musandam, at an elevation of c. 400 metres.

Significantly, Sidqah is situated within an area consisting of deep water sedimentary rocks of the Hawasina group sensu latu, an allochthonous tectonic unit that comprises the SE margin of the Musandam region. The Hawasina rocks comprise shales, cherts, calcareous turbidites, coarse conglomerates and occasional volcanics rather than the relatively uniform shallow water carbonate sequence of the rest of the Musandam.

This geological distinction is parallelled by a botanical distinction, inasmuch as the Hawasina rocks of the SE Musandam margin constitute the northernmost extent of a number of mountain plant species common in the Hajar Mountains to the south, but not found elsewhere in the Musandam. The same distinction is also recognised by local archaeologists, who recognise Wadi Khabb as being more similar to areas to the south than to the Musandam proper (Velde, pers. comm.). These distinctions are presumptively attributed to distinctive lithological and hydrological factors of the Hawasina rocks. The same factors may account for the otherwise anomalous presence of B. arabicus.

At Sidqah, however, another possibility exists and must be mentioned as a caution. The Arabian killifish Aphanius dispar is also present in the pools at Sidqah and local residents (the settlement is permanently occupied by expatriate labourers) confirm that it has been introduced by them for mosquito control. it is possible that B. arabicus has also' been introduced, although this is considered unlikely. The Arabian killifish

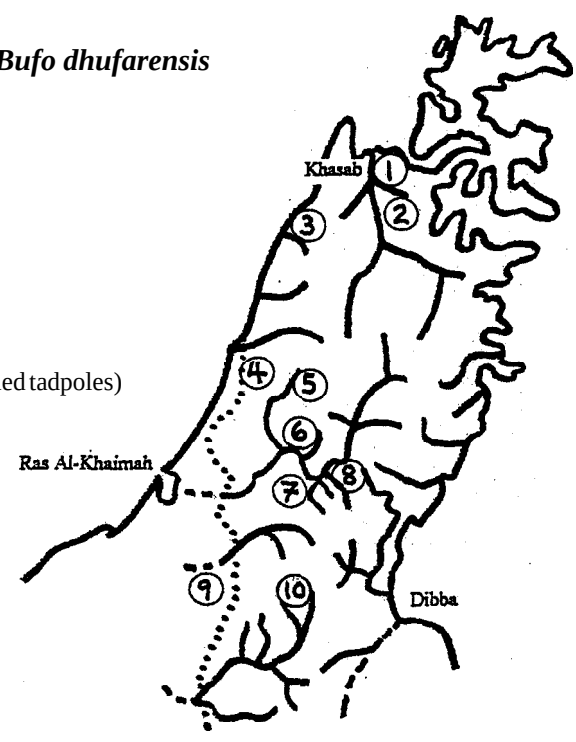
Pig. 2: Distribution of the Dhofar toad *Bufo dhufarensis* in the Musandam Peninsula.

Key

1. Khasab (Balletto et al. ***1985)***
2. Wadi al Jamat (Balletto et al. ***1985)***
3. Ghumdhah (Gardner, ***pers. comm.)***
4. Jebel Rahabah (James, ***pers. comm.)***
5. Wadi Shah
6. Wadi 'Aini
7. Wadi Zibat (Couldrey; ***pers. comm.,*** unidentified tadpoles)
8. Wadi Wa'eeb
9. Digadagah (Balletto et al. ***1985)***
10. Wadi Kharras

Wadi
Mountain front

10 km



is available for this purpose from local government sources, and has been introduced at various mountain localities in the UAE and Oman. At more accessible locations in lower Wadi Khabb, A. dispar is known to have been introduced by truck. In contrast, the authors are not aware of any history of introduction of toads.

Ecology

B. dhufarensis is an arid environment specialist able to aestivate underground for long periods of time, apparently up to two years or more (Balletto et al. 1985), while surface water is absent and/or ambient moisture is otherwise insufficient. It emerges rapidly after a downpour to mate but, at least in extreme environments, adults may be active (i.e. non-aestivating) for only a short time after rains (Balletto et al. 1985). According to Arnold & Gallagher (1977), Balletto et al. (1985), Hornby (1996) and the records of AMC at the Breeding Centre in Sharjah (Wright, pers. comm.), B. dhufarensis is almost exclusively nocturnal. Arnold (1980) paints a somewhat more complex picture of the species based on observations in the better-watered Dhofar region, where B. dhufarensis is the only toad:

"This toad occupies a very wide range of habitats from sea level to at least 860m and probably higher. It is often very abundant near water, either close to the sea or in irrigated areas and wet wadis. Here it is . . . often active by day as well as night in shaded places, although it does not enter water much. . . . Toads were also found well away from open water on the gravelly floors of wadis, in the grassland on the crest of Jebel Qara and on sandy and stony surfaces in semi-desert. In hot and arid habitats they were active only at night and were far less abundant than near water." (Arnold 1980 at p. 276).

Arnold contrasts this with observations of B. dhufarensis in the eastern UAE, where, he says, "non-breeding adults of this toad are usually encountered at night on gravelly plains and appear to be excluded from wet wadis and irrigated areas by the partly diurnal B. orientalis [a synonym of B. arabicus]. . . , not being so active by day or swimming so readily or so well." (Arnold 1980 at p. 276). This description is consistent with sightings from the records of AMC at the Breeding Centre in Sharjah, which are all nocturnal (including dawn and dusk) and of which by far the majority were made away from water (Wright, pers. comm.).

The frantic mating behaviour obqerved in Wadi Shah during January 2001 was initially observed in mid-morning and was still ongoing at sunset. At least a dozen pairs were observed. Male toads were highly vocal. Coupling was taking place in the water and some egg-laying was also in progress. Only two individual toads were encountered much further up the wadi, away from standing water. As this same area had been visited on more than half a dozen occasions over the preceding decade without any toads being noted, it was tentatively inferred that the toads had only recently emerged from aestivation. Balletto et al. (1985) recounted a similar unheralded mating frenzy observed in the vicinity of Mecca, Saudi Arabia, on a morning following "torrential rain."

It is likely that further targeted investigation, especially after rains, will confirm the presence of B. dhufarensis more widely throughout the Musandam. However, the observations reported here do not permit a conclusive explanation for the extreme rarity of sightings. The principal possibilities are that adult toads are nocturnal (in which case a concerted programme of night-time visual or possibly aural investigation should reveal their presence) or that the adult life cycle includes only very brief periods of activity after intermittent rain, interspersed with extended periods of torpor or aestivation. The latter lifestyle, suggested by Balletto et al. (1985), is perhaps the most likely throughout the arid Musandam generally. Such a lifestyle is exhibited by, inter alia, Breviceps spp. (B. macrops and B. namaquensis), Bufo vertebralis hoeschi, Phrynomerus annectans and Tomopterna delandei cryptotis, also known as "rain frogs," from in the dry western regions of Namibia and South Africa (Lovegrove 1993). On the other hand, it appears that B. dhufarensis may be active throughout the year in those few places where permanent surface water is available. Whatever its "normal" lifestyle, it seems apparent that this species is an opportunistic breeder that makes the utmost use of its time (day and night) during favourable conditions to mate and to ensure its survival.

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Fig. 3. An Arabian toad, *Bufo arabicus.* The distinctive white toe tips are just visible. *Picture: Simon Aspinall*

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The diet of Little Owl *Athene noctua* in the *UAE*, with notes on Barn Owl *Tyto alba* & Desert Eagle Owl *Bubo (b.) ascalaphus*

by Peter L. Cunningham & Simon Aspinall

Abstract

The diet of the Little Owl *Athene noctua* was studied from four different areas of Abu Dhabi Emirate in the UAE. Analysis of sixty-one pellets revealed the presence of at least six species of reptile belonging to four families (Agamidae, Boidae, Gekkonidae & Scincidae), at least five species of mammal representing the orders Rodentia (Cricetidae, Dipodidae & Muridae) and Chiroptera (unidentified), one or more species of bird, and, amongst Arthropods, at least eight beetles belonging to four families (Buprestidae, Carabidae, Scarabaeoidea & Tenebrionidae) and one species from each of the Orders Homoptera, Hymenoptera and Solifugae.
These findings suggest that the Little Owl is predominantlya nocturnal hunter and an opportunistic feeder foraging on a wide range of animals.

Introduction

Athena, the mythological Greek Goddess of Wisdom, gives her name to the genus of owl, Athene. The Little Owl *Athene noctua* is the only member of the genus to occur in Greece, and is, thus, presumably that portrayed as her personal emblem.
The natural range of the Little Owl includes much of North Africa, Eurasia and the Arabian Peninsula (Hollom *et al.* 1988). It is a common resident breeding species in the United Arab Emirates (Aspinall 1996, Richardson 1990), with an estimated population of 300-1000+ breeding pairs (Aspinall 1996). It is absent along the Gulf coast and from sandy desert areas which lack adequate breeding sites such as mesas and other rocky outcrops (Aspinall 1996, Osborne *et al.* 1996). According to Jennings (1995) it is a "widespread resident in desert areas" [of Arabia]. In the Sultanate of Oman it is classified as a "fairly common and widespread breeding resident" (Eriksen & Sargeant 2000). It is numerous in much of Saudi Arabia, also occurring in Qatar, but is absent from Bahrain.
Although common in the UAE, very little is known about the diet of this species. The only documented work on the diet of Little Owl from the UAE was published as an internal National Avian Research Center (NARC) report in 1994 (Griggs 1994), which determined the diet from pellets collected in just one locality.
Little Owl is "crepuscular and frequently abroad by day" (Aspinall 1998). Aspinall (1996) suggests that it is "much more nocturnal" in [sand desert in] the UAE "in accordance with the activity patterns of its prey". Little Owl pellets analysed by Aspinall (1998) from Jebel Hafit (the limestone mountain massif south of Al Ain and straddling the UAE-Oman border) indicated a diet primarily of lizards and beetles, with the occasional small passerine bird and rodent.
This paper attempts to determine further the diet and foraging behaviour of Little Owl in the UAE.

Methods

Altogether sixty-one Little Owl pellets were collected

from four different sites in Abu Dhabi Emirate. The sites included a limestone outcrop northwest of Al Ain (24 deg., 25 mins. 07 secs N, 55 deg., 35 mins. 1 sec. E, Elevation: 278m); two mesa sites west of Al Qua'a (Site 1: 23 deg., 12 min. 59 secs. N, 54 deg., 41 mins. 55 secs. E, Elevation: 102m & Site 2: 23 deg., 43 mins. 11 secs. N, 55 degs., 6 mins. 11 secs. N, Elevation: 116m) and the eastern foothills of Jebel Hafit (24 degs., 2 mins. 41 secs. N, 55 degs. 47 mins. 58 secs. E, Elevation: 360m). Each pellet was soaked and teased apart using a pair of forceps and a needle. Arthropod and bone material (especially skulls and jaws) were extracted and examined under a microscope. Reference samples of reptiles and small mammals were collected to facilitate identification.

For comparative purposes, 25 Barn Owl Tyto alba and 15 Desert Eagle Owl Bubo (bubo) ascalaphus pellets were also analysed (see Table 1). Barn Owl pellets were collected from Qusabi island, near Al Dabb'iya (16 pellets) and from Al AinIBuraimi, UAE/Oman (9 pellets), while Eagle Owl pellets were collected from Al Wathba (4 pellets), Bida bint Saud (10 pellets) and Jebel Hafit (1 pellet).

Results

Little Owl

At least five species of small mammal belonging to two orders (Chiroptera: unidentified bat remains & Rodentia: Acomyx cahirinus, Gerbillus sp., Jaculus jaculus and Rattus rattus), six reptiles. (Bunopus tuberculatus, Eryx jayakari, Pseudotrapelus sinaitus. Scincus mitranus, Stenodactylusdoriae and Uromastyx aegyptius), at least one bird (unidentified feathers and other remains found in five pellets) and at least eight beetle species belonging to four families were recovered from the Little Owl pellets.

Table 1 shows the frequency of each species or group found in the pellets. By frequency, arthropod remains were found in 88.5 % of the analysed pellets, compared to reptlies (47.3%), mammals (29.4%) and birds (8.2%). Note that pellets often contained more than one food item. Appendix 1 includes a list of the scientific and corresponding common names of species mentioned throughout this paper.

Barn Owl and Eagle Owl

Barn Owl and Eagle Owl had far fewer food items in the pellets analysed. Meriones crassus was dominant in Barn Owl pellets, while birds and both Rattus rattus and Gerbillus sp. were common in Eagle Owl pellets. Reptiles did not feature at all in the diet of either species. The limited number of pellets analysed for both species, however, especially Eagle Owl, could have influenced the apparent dietary preference.

Discussion

Little Owl proved to have a varied diet favouring Arthropods, Gerbillus sp. and large nocturnal geckoes of the genus Stenodactylus (S. doriae). This diet suggests that Little Owl is an opportunistic forager and, moreover, that it is predominantly nocturnal in the UAE. The extreme summer temperatures no doubt contribute to the nocturnal activity pattern of this species (and its prey) in the UAE.

The dominance of arthropod remains (90.1%), mainly Coleoptera, in the pellets analysed supports this finding, most Coleoptera being nocturnal and/or crepuscular in the UAE (Tigar 1996). According to Griggs (1994), invertebrate prey occurred in 82% of the analysed pellets from the one site studied in the Eastern Region of Abu Dhabi. This is very similar to the findings of the current study.

Jewel Beetle (Buprestid) elytra were present in 57% of all pellets from Eastern Abu Dhabi analysed by Griggs (1994). In comparison, the current study found only 3.3% of pellets (those collected from Jebel Hafit), to contain Jewel Beetle remains. It is possible that diet may vary not only seasonally, but also between areas.

Tigar (1996) states that the larger Tenebrionids, although conspicuous and abundant, are distasteful and thus avoided by vertebrate predators. This did not seem to apply to Little Owls. During this study, Tenebrionid remains were found in half (50.8%) of all pellets analysed. Data supplied to the Atlas of the Breeding Birds of Arabia, (ABBA), stated that most pellets from two localities in Saudi Arabia contained beetle remains (Jennings pers. comm.).

Almost 30% of the pellets analysed during this study contained small mammal remains. The species present confirm nocturnal foraging by Little Owl in the UAE. No complete mammal skulls were retrieved, in contrast to analysed pellets of Barn Owl and Eagle Owl. Some adult mammal prey may simply be too large for Little Owl to swallow whole. Crushed skulls made identification difficult, especially of the gerbil specimens, as the dentition of different species is very similar (Harrison & Bates 1991). However, Gerbillus cheesmani, Gerbillus dasyurus and Gerbillus nanus would all be expected due to their overlapping distributions (pers. obs.) and to the suitability (to them) of the areas where pellets were collected. The following observations confirm small nocturnal mammalian prey: Acomys cahirinus "...predominantly nocturnal and crepuscular"; Gerbillus cheesmani "...essentially nocturnal...occasionally observed by day"; Gerbillus nanus "... crepuscular and nocturnal" and Jaculus jaculus "...exclusively nocturnal" Harrison and Bates (1991). Gerbillus dasyurus is also nocturnal (pers.obs.), and Rattus rattus, "nocturnal" Skinner and Smithers (1990), although not exclusively so (pers. obs.).

Cape Hare Lepus capensis and Lesser Jerboa Jaculus jaculus were the dominant mammal remains from eastern Abu Dhabi, according to Griggs (1994), (the former presumably involving exclusively juveniles or erroneous). 21.8% of the diet from eastern Jordan constituted small, mainly nocturnal mammals (Al-Melhim et al. 1997). Cramp & Simmons (1985) and Thiollay (1968) report small, nocturnal voles dominating Little Owl diet in France and Germany, whereas in Spain, beetles were found to dominate in their diet (Manez 1983). Vertebrate remains (mostly mammalian) were present in over 80 per cent of pellets (n = 97) analysed from Kuwait, with 45 per cent holding Meriones sp. (Jird), 19 per cent Jaculus sp. (Jerboa), and 13 per cent Gerbillus sp. (Gerbil) respectively (Clayton 1991), while just 15% of pellets analysed from central Saudi Arabia contained bones of small mammals (Jennings pers. comm.).

According to Al-Melhim et al. (1997) and Rifai et al. (2000), Little Owls are diurnal foragers in eastern Jordan. Al-Melhim et al. (1997) states that 35.5% of the total diet items consisted of reptiles with the diurnal Uromastyx aegyptius microlepis, usually juveniles, constituting 11.4% of the reptilian component of their diet. Reptile remains represented at least six species and were found in almost half (47.3%) of the pellets analysed during this study. However, with the exception of the diurnal P.sinaitus, S.mitranus and U.a.microlepis (4.8% of the analysed pellets) as well as the unidentified remains (8.2%), all the species identified were nocturnal. The large nocturnal gecko, S.doriae, was present in 31.2% of the pellets analysed. Gardner (pers. comm.) supports Stenodactylus as being a favoured prey item in Prosopis cineraria (ghaf) woodland on the edge of the Wahiba Sands in Oman. 53% of pellets analysed by Griggs (1994) contained unidentified gecko remains. According to Sargeant (pers. comm.) only one of 310 records of Little Owl from Oman provided information on prey. This was from Jaaluni (Central Oman), where the observer reported Little Owl "feeding on geckos on

portacabins". According to Gardner (pers. comm.) the geckos in question are Hemidactylus turcicus.

Reptiles identified as prey in eastern Jordan by Al-Melhim et al. (1997) include Acanthodactylus sp., Stenodactylus grandiceps, Ptyodactylus puiseuxi, Pseudotrapelus sinaitus, Trapelus pallidus haasi and U.a.microlepis. Reptiles from the Family **Gekkonidae,** although not identified to genus and/or species level, were identified from Little Owl pellets in northern Egypt (Goodman 1988). Only 5% of pellets analysed from Kuwait contained gecko remains, although leaf-nosed snake Lytorhynchus diadema and Amphisbaenid were also included in the diet (Clayton 1991).

Little Owls are much less dependent on birds and small mammals than are Barn Owl and Eagle Owl. Bird remains were found in 8.2% (5) of the Little Owl pellets analysed, compared to 1.8% by Griggs (1994). Birds accounted for 7.3% of the diet from eastern Jordan (Al-Melhin et al. 1997). Ground-dwelling species of bird were recorded in pellets from Egypt (Goodman 1988), although the data were not quantified. Traces of bird remains are also documented from Kuwait (Jennings pers. comm.).

Barn Owl and Eagle Owl prey more heavily on birds (this study) with, respectively, 20% and 53% of their pellets containing bird remains. The small sample size does, however, have to be taken into consideration. **House Sparrows** Passer domesticus roosting communally in ghaf are known to be a favoured prey for some Eagle Owl pairs in Abu Dhabi (pers. obs.), while **Rock Dove** Columba livia are preyed on at Bida bint Saud (pers. obs.). It does, however, seem likely that individual variation would be found. An urban dwelling pair of Barn Owls in Abu Dhabi City regularly predates House Sparrows, but **Common Mynah** Acridotheres tristis has also appeared as a prey item (pers. obs.).

Rifai et al. (1998) state that bird prey contributes less than 4% in the majority of Barn Owl studies, except in data from Iraq (16%) and southern Turkey (23%). Birds made up 16.7% (by weight) of Eagle Owl diet in a Turkish study (Morgan 1983) compared to 3.3% and 14.6% respectively in eastern Jordan according to Rifai et al. (2000) and Amr et al. (1997). Barn Owl favours Meriones crassus (52%) and Gerbillus sp. (20%) in the UAE, [although Rattus sp. in the city of Abu Dhabi (pers.obs.)]. with similar preferences (e.g. Meriones tristrami being 55% of all food items) noted from northern Jordan (Rifai et al. 1998), while Kahila & Tchernov (1991) reported that 93-99% of Barn Owl diet consisted of rodents in Israel. More than 80% (by weight) of Eagle Owl's diet from eastern Turkey consisted of small mammals, especially **Golden Hamster** Mesocricetus auratus (Morgan 1983). By frequency, mammals accounted for 36.8% (Rifai et al. 2000) and 80.5% (Amr et al. 1997) of Eagle Owl's diet from eastern Jordan.

Study of the diet of Little Owl and other owl species in different seasons in differing locations would clearly be of interest, as would parallel studies of the activity patterns of prey. Prey selection in relation to availability and the relative importance in energy terms of different faunal groups also warrants examination.

Acknowledgements

Our appreciation goes to the following individuals and organisations for supplying us with owl pellets, relevant literature and other information: Dr. Zuhair Arnr (Jordan University of Science & Technology); Dr. Drew Gardner (Zayed University, UAE, formerly University of Lancaster); Dr. Brigitte Howarth (AAESS); Mike Jennings (ABBA); the National Avian Research Centre (part of ERWDA); Dave Sargeant (Oman Bird Records Committee) and John and Effie Warr (OSME).

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Appendix 1. List of the scientific and corresponding common names of species mentioned in text

Arthropods:

Adesmia cancellata	Darkling Beetle sp.
Androctonus crassicauda	Scorpion – (Family Buthidae)
Julodis euphratica	Jewel Beetle
Locusta migratoria	Migratory Locust
Ocnera hispida	Urchin Beetle
Pimelia sp.	Darkling Beetle sp.
Platypleura arabica	Arabian Cicada
Scarabaeus sacer	Dung/Scarab Beetle
Scarites guineensis	Ground Beetle
Tentyrina palmeri	Darkling Beetle sp.
Zophosis complanata	Darkling Beetle sp.

Birds:

Columba livia	Rock Dove
Acridotheres fristis	Common Mynah
Passer domesticus	House Sparrow

Mammals:

Acomys cahirinis	Egyptian Spiny Mouse
Gerbillus sp	Gerbil sp.
Gerbillus cheesmani	Cheesman's Gerbil
Gerbillus dasyurus	Wagner's Gerbil
Gerbillus nanus	Baluchistan Gerbil
Jaculus jaculus	Lesser Jerboa
Lepus capensis	Cape Hare
Meriones crassus	Sundevall's Jird
Meriones tristrami	Tristram's Jird
Mesocricetus auratus	Golden Hamster
Rattus rattus	Black Rat

Reptiles:

Acanthodactylus sp.	Fringe-toed Lizard sp.
Amphisbaenid	Worm Lizard (Zarudni's Worm Lizard)
Bunopus tuberculatus	Baluch Rock Gecko/Arabian Desert Gecko
Eryx jayakari	Jayakar's Sand Boa
Hemidactylus turcicus	Turkish Gecko
Lytorhynchus diadema	Awl-headed/Leaf-nosed Snake
Pseudotrapelus sinaitus	Sinai Agama/Blue Rock Agarna
Ptyodactylus puiseuxi	Fan-footed Gecko sp.
Scincus mitranus	Sand Skink/Sand Fish
Stenodactylus doriae	Dune Sand Gecko
Stenodactylus grandiceps	Big-headed Gecko sp.
Trapelus pallidus haasi	Blue-headed Agama sp.
Uromastyx aegyptius microlepis	Spiny-tail Lizard *(dhub)*

Wagner's Gerbil ***Gerbillus dasyurus*** -a prey species of rocky terrain, such habitat also being favoured by Little Owl. ***Picture: C. & T. Stuart***

Table 1: Little Owl, Barn Owl and Eagle Owl diet as determined by pellet analysis in Abu Dhabi Emirate, UAE. Values are presented as percentage occurrence in pellets analysed. The number of pellets containing a specific food item is indicated in parenthesis. Totals are also indicated as percentage occurrence.

	Little *Owl*	Barn Owl	Eagle Owl
Number of pellets	61	25	5
Total no. of different food items	42	12	6
ARTHROPODS (??excl. spiders)			
Coleoptera			
Adesmia cancellata	1.6 (1)		
Julodis euphratica	3.3 (2)		
Ocnera hispida	3.3 (2)		20 (1)
Pimelia spp.	9.8 (6)		
Scarabaeus sacer	6.6 (4)		20 (1)
Scarites guineensis	1.6 (1)		
Teniyrinqpalmeri	3.3 (2)		
Zophosis complanata	29.5 (18)		
Unidentified *beetle* remains	16.4 (10)	4 (1)	
Homoptera			
Platypleura arabica	1.6 (1)	4 (1)	
Hymenoptera			
Unidentified *ant* remains	3.3 (2)		
Orthoptera			
Locusta migratoria		4 (1)	
Solifugae			
Unidentified *camel* spider remains	8.2 (5)	8 (2)	
TOTAL	88.5%	20%	40%
ARACHNIDAE (Araneae)			
Unidentified spider remains	1.6 (1)		
AVES			
Unidentified bird remains	8.2 (5)	20 (5)	40 (2)
TOTAL	8.2%	20%	40%
MAMMALS			
Chiroptera			
Unidentified bat remains	1.6 (1)		
Rodentia			
Acomys dimidiatus	1.6 (1)		
Gerbillus sp.	18 (11)	20 (5)	40 (2)
Jaculus jaculus	3.3 (2)		
Meriones crassus		52 (13)	
Rattus rattus	4.9 (3)	4 (1)	60 (3)
Unidentified rodent remains	1.6 (1)	4 (1)	
TOTAL	29.4%	80%	100%
REPTILES			
Bunopus tuberculatus	1.6 (1)		
Eryx jayakari	1.6 (1)		
Pseudotrapelus sinaitus	1.6 (1)		
Scincus mitranus	1.6 (1)		
Stenodactylus doriae	31.1 (19)		
Uromastyx aegyptius	1.6 (1)		
Unidentified reptile remains	8.2 (5)		
TOTAL	47.3%		

Reflections on the Wind Tower House: Architectural Style and Historical Context on the Trucial Coast

by Ronald W. Hawker

Introduction

In ***Dubai and Its Architectural Heritage,*** Ahmed Hasan Al Rostomani refers to a historic Gulf architectural style that could be used as an antidote to the unwanted and uncontrolled flood of international motifs in modern Emirati buildings (Al Rostomani: 9). Shirley Kay and Dariush Zandi also note that this style is " 'very ancient, very appealing' and in danger of disappearing altogether" (Kay and Zandi: 4). Al Rostomani and Kay and Zandi are leaders in documenting and discussing this style based primarily on a common late nineteenth and early twentieth century house type, the courtyard wind tower house, found in the old neighbourhoods of Dubai, Sharjah, Umm al-Qaiwain, and Ra's al-Khaimah. The Dubai Municipality has implemented well-documented restoration programmes for these buildings (Omer 1998 & Dubai Municipality) and these efforts are increasingly paralleled in the other Emirates. The courtyard house has now come to symbolise the pre-oil past.

The pioneering work in documenting, promoting and preserving these buildings represents an invaluable contribution to the heritage of the United Arab Emirates and, indeed, of the Arabian Gulf region. Little survives from the last century in the way of written description and the architecture provides important insights into the conditions of its time.

In this paper, I examine the courtyard wind tower house and its features and discuss its development specifically within the context of Gulf history. This analysis reveals two important, inter-related points. First, the courtyard wind tower house is not an ancient tradition indigenous to the Trucial Coast, the collection of individual emirates that, since 1971, have become the federation of the United Arab Emirates. Rather, it is an entirely new form that reflects the tremendous impact of the pearling industry on the coastal communities on the Trucial Coast. Furthermore, it is a syncretistic form resulting directly from the increasingly international commercial and social conditions of the late Nineteenth Century. The popularity of this form of house at the beginning of the Twentieth Century has been mentioned elsewhere and associated with the pearl industry (Kay: 33-34; Coles and Jackson), but there are certain details that illustrate the commercial entanglement that characterises Gulf history at the end of the nineteenth century and that are manifested in the style and features of this building type.

I first provide a sketch of the social and commercial changes that were stimulated by the heightened importance of the pearl industry in the last quarter of the Nineteenth Century and in the first quarter of the Twentieth. This is important because the prosperity that pearling brought re-shaped the economy and stimulated a flow of imported materials.

Because the economy previously balanced trade with fishing, pastoral herding, and date palm agriculture, the greater role of pearling also created new tribal and regional specialisations and affected settlement patterns. This led to the growth of population centres at the main pearling ports on the Arabian Gulf side of the peninsula. It also led to the increased popularity of coral, stone, gypsum and other permanent building materials now affordable for a greater portion of the population over the cheaper, lighter and more portable palm frond. With emigrant communities re-locating from Iran and India to take advantage of the pearl trade came new ideas and materials.

Examples of courtyard wind tower houses from Dubai and Sharjah demonstrate how the architecture reflects these historic events.

Background: Historical Context

Archaeological evidence and historic and ethnographic reports reveal that historic Emirati society depended on a varied range of economic activities across the region's geographic zones controlled and managed within the structure of the tribe and sub-tribe. Seasonal movements between differing locations over a large tribal territory, or dar, were timed to the rhythm of date cultivation, fishing, camel, goat, and sheep herding, and the farming of small mountain plots. Architecture varied in material and form according to the resources provided within each of the geographic zones (Heard-Bey 1996). Small palm frond ('arish) huts and tents, known as 'arishah or khaimah, were strung along date farms of the interior oases (Heard-Bey 1997: 260-261). In the mountains, were small stone built houses with a flat roof made from beams of the sidr tree (Heard-Bey 1997: 268). Towers and fortified houses of stone, mud brick, and sometimes coral, protected the resources and provided more permanent, larger and more prestigious housing for the ruling elites (Discussed in detail in Kennet 1995).

In the last two decades of the nineteenth century, pearls became the nineteenth century equivalent of oil. British correspondence and documentation of the economic and political circumstances of the early twentieth century stated unequivocally that "pearl fishing is the premier industry of the Gulf; it is, besides being the occupation most peculiar to that region, the principal or only source of wealth among the residents of the Arabian side. Were the supply of pearls to fail, the ports of Trucial Oman, which have no other resources, would practically cease to exist" (Tuson: 659). The money available through harvesting pearls created a new and wealthier merchant class. Tribes formed cooperatives to purchase boats and hired others to manage the palm gardens, choosing instead to spend more time on the boats and in the ports on the Arabian Gulf. Heard-Bey attributes the expanded importance of the pearl industry in the Gulf in the eighteenth and nineteenth centuries to neighbouring India, then prospering under Pax Britannica. "By the turn of the twentieth century," writes Heard-Bey, "about 1200 boats were based in ports on the Trucial Coast, manned by 22,000 men, mostly tribesmen, but with extra hands brought in from Baluchistan and elsewhere to augment the work force. The pearling industry had transformed the traditional economy of the tribal population" (Heard-Bey 1997: 262).

This transformation intensified in 1904, when the stringent tax policies of the central Persian government provoked the pearl merchants' abandonment of Lingah, which, along with Manama in Bahrain, was then the only organised pearl market town servicing the Gulf. The shift from Lingah to Dubai is clearly evident between the seasons of 1903-04, when the export of pearls from Lingah was recorded at a value of 4,905,000 pounds sterling, and 1904-05, when the export value, dropped to just over 600,000 pounds (Tuson: 683). Lingah's loss was Dubai's gain as Dubai expanded its status as one of the main pearl harvesting ports to include its new position as the main pearl export market for the lower Gulf. This also lowered business costs for all concerned, as the pearls no longer had to be re-transported across the Gulf.

Because pearling had become so lucrative, it provoked a number of important social changes. First of all, the balance of seasonal and cross-zonal resource exploitation was tipped in favor of expanded pearl

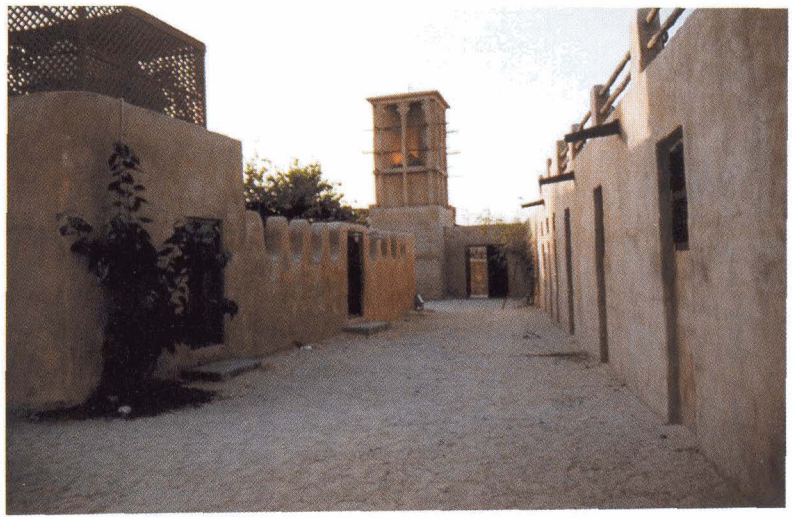

Fig. 1. Reconstructed wind-tower house, Dubai

harvesting. Two seasons of pearling, the *Ghaus a/-Barid* (Cold Diving), which began in April and lasted forty days, and the *Ghaus al-Kabir,* which began at the end of the *Shamal* season in June and lasted until September, was joined by the *Mujannah,* a shore operation carried out during the winter months. After 1889, when pearl harvesting off the Trucial Coast peaked, some of the pearlers also travelled to Sri Lanka during the winter, instead of devoting themselves to ordinary deep sea fishing at home (Tuson: 669).

This also shifted the geographic orientation of the tribal economic activities toward the coast, and probably, at least temporarily, from a more subsistence based economy to one more concerned with commodity markets. "Many of the Liwa-based sub-tribes of the Bani Yas formed cooperatives, which jointly owned a boat and shared the proceeds of the sale of the pearls according to an established arrangement," reports Heard-Bey. "It was due to pearling that, over several generations, some tribes became more specialised in one economic activity or another and became tied to particular locations. Thus, the Rumaithat and the Qubaisat [sub-tribes of the Bani Yas confederation] favored maritime activities and became attached to the coastal settlements and the islands, eventually giving up many of the date gardens they had in the Liwa" (Heard-Bey 1997: 268).

Secondary business thus accompanied the pearling industry. During the diving seasons, a small bazaar formed on Dalma Island "for the sale of supplies and *Tawwashes* or petty dealers and *Musaqqams* [fleet financiers] [came] there to buy pearls and recover debts" (Tuson: 671). This also led to the construction of permanent buildings catering to the new maritime traffic at Dalma (Al Azawi; *see also* King: 51-66).

Along the Gulf side of the Trucial Coast, the presence of Indian Hindu (Banian) merchants became more permanent, with enclaves developing at the major ports. Their impact on Gulf culture has not yet been fully investigated and is instead treated as cursory given the difference in religion and thus their cultural distance from local society. After 1904, they were accompanied by Farsi-speaking Sunni merchants from Lingah and other Persian towns who assimilated more easily because of their religion and the long historical kinship between the tribes of Arabistan in late Islamic Iran and the Arabian littoral. Together, they brought a wave of new products and ideas into the ports of the Trucial Coast.

The movement of people from Lingah to Dubai was accompanied by similar emigrations of kin-related tribes from the Persian side around the turn of the century. This does not necessarily indicate a sudden influx of "foreigners." There were more direct relations between the peoples on both sides of the Gulf than current political boundaries may suggest. Al Qasimi identifies a series of villages on the Iranian coast from Lingah to Bushehr with Arab populations drawn from the Banu Ma'in and Huwalah tribes as well as the Za'ab, who also lived on Jazirat al-Hamra in Ra's al-Khaimah and at Kalba on the UAE's east coast (Al Qasimi 1999: 48-65). Mohammed Al-Fahim adds the Al Ali "and others" to the list of Arab tribes living across the Gulf (Al-Fahim: 20). The neighbourhood of Bastakiya in Dubai is named after the originating settlement of its primarily Persian immigrants: Lingah's inland sister town of Bastak (Coles and Jackson: 2). The soaring sales values of the pearls, the market shift from Lingah to Dubai, and the movement of people across the Gulf attracted British authorities. British India steamships plied both sides of the coast, buoys and lighthouses were constructed in Dubai, and a British Agent was installed in Sharjah. All together, this resulted in the import of new building ideas, materials and forms to the Trucial Coast. What this meant in terms of settlement patterns was that the coastal towns grew in prominence, with those with large pearling fleets leading the way: Sharjah (Sharjah, Hamriya and Khan), Umm al-Qaiwain, Dubai and Abu Dhabi (including Dalma), with smaller fleets in Rams, Ra's al-Khaimah, Jazirat al-Hamra and Ajman. These towns, especially Dubai, Sharjah, Umm al-Qaiwain, and Jazirat al-Hamra in Ra's al-Khaimah, faced three simultaneous waves of emigration as people based in the interior oases and mountain villages moved permanently to the coast, and Persian and Indian merchant classes set up shop in Dubai and elsewhere. Coles and Jackson note that these merchant communities have "always been engaged in the entrepot trade - in the transhipment of goods between India and Iran and the Arab interior, notably Oman" (Coles and Jackson: 4). As the coastal towns grew and became more prosperous, the Trucial Coast became more closely linked commercially with the outside world and the new clusters of *'arish* buildings were replaced with much larger and more permanent structures.

The Architecture

This is the historical context in which the wind tower house dominated domestic architecture in Dubai and to a lesser extent Sharjah, Umm al-Qaiwain and Ra's al-Khaimah. Constructed of coral, gypsum, stone and an imported baked Iranian clay mixture called *saruj,* the appearance of the wind tower house coincides with the trans-Gulf movement of people. Its popularity continued

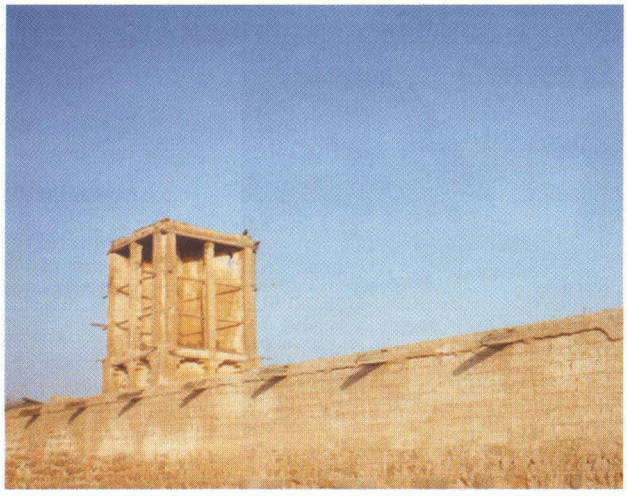

Fig. **2.** Wind-tower house, **Umm** al-Qaiwain

through the next three decades, waning (but not disappearing) in the 1930s after the collapse of the pearling industry with the 1929 advent of the global Great Depression and the Japanese invention of the cultured pearl.

The documented construction of a wind tower house is provided in Coles and Jackson and is traced to a Persian-emigre family in Dubai's Bastakiya and an emigre Persian craftsman titled *Ostad* (Master) Mohammed (Coles and Jackson: 4). The house, termed the Garden House, was constructed in phases, although in its maturity it consisted of four wings enclosing a courtyard garden - a form typical of Bastakiya and of the houses commissioned as well for Sheikh Sa'id al-Maktoum, Ruler of Dubai from 1912 to 1958, and other important local Arab Emirati families in the Shindagha neighbourhood and in Sharjah, Umm al-Qaiwain and Jazirat al-Hamra in Ra's al-Khaimah.

The original wing of the Garden House was a two storey building with a porch and reception area surrounded by a compound wall and storage sheds. Additional wings were added to provide extra living accommodation. The characteristic feature of the building is the wind tower, also known in Farsi as *bad'girr* (literally 'wind catcher') and in an Arabicised version of the Farsi as *barjil,* whose origin has been related to the central Iranian city of Yazd (Petherbridge: 189). The wind tower could rise up to 15 metres into the air where the wind travels at a much faster pace than at ground level. The tower was designed as a rectangle open on all four sides to catch and channel the slightest breeze through an interior X of masonry, textile or matted palm to a room below (Kay and Zandi: 20).

The wind tower re-appears in other venues, including Dubai's restored Grand Souq (Suq al-Kabir) (Omer: 16) and constructed from *'arish* at the Abu Dhabi *suq* captured only in historic photographs (Facey & Grant: 43). While the wind tower is Persian in origin, it is interpreted differently in Sharjah, where its shape and decoration takes on a more predominantly provincial Mughal flavour. In one occasion, the wind tower is round and domed. In another, it is simply capped with a rounded dome. In this way, the wind towers recall the columned cupolas typical of late Mughal architecture in India (Alfieri: 285).

The masonry walls and floors in most wind tower houses are finished with hardwood beams, palm logs, or chandal wood, the latter usually imported from India and available in maximum lengths of four metres, which restricted the width of a room (Omer: 6). All the doors and windows are standard units in frames and were imported into Dubai complete. Many of the doors contain decorative elements that are Indian in content. An

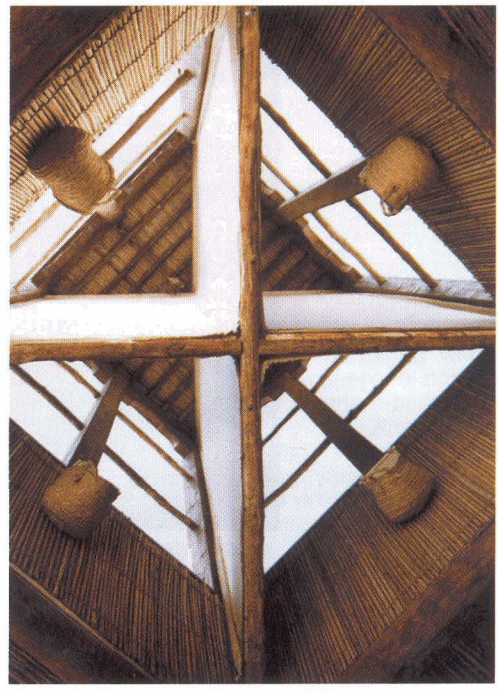

Fig. 3. Interior of a reconstructed wind-tower house, Abu Dhabi

example from Sharjah includes elephants and other royal Indian motifs. Some windows and balustrades were also fitted with plaster or timber lattice screens, sometimes referred to as modesty screens. These are the most recognisable decorative features of the house and are made from cast plaster (Coles and Jackson: 8; see also Dubai Municipality: section K).

Diverse in design, many are clearly imported from abroad, most likely from Bombay, and probably accompanied the standard frame units. Those with prominent European floral motifs (the common flowers and foliage arranged in a vase) appear to be based on Victorian pattern books. Other imported decorative items include decorative columns cylindrically cast in timber shuttering. A set of Corinthian-style composite columns for the Garden House were imported from Italy (Coles and Jackson: 8).

The flowers and foliage arranged in a vase motif shows up in a variety of forms: carved decorations on the door, pierced gypsum modesty screens, and carved decorative stucco patterns around the doors and along the frieze. The pervasiveness of the design in a variety of media suggest a common origin for all. Since the imported doors are Indian in origin, this brings up the question of whether some of the other work, notably decorative patterns around the doors, was done in *situ.* If so, then this is evidence for Indian crafts shops operating in the pearl towns during the height of the pearling period. It would also explain the common presence of cusped arches, another feature of late Mu hal architecture. With the documentation of Persian craftsmen operating in Dubai and historical references to a more permanent Indian presence generally in the Emirates during this period, there is no reason to doubt the presence of Indian craftsmen. It does, however, reflect on the varied flavour of the wind tower house style, which, in the end, is a synthesis of irrdigenous and imported materials, techniques and forms.

Discussion

The growth of pearling in the four decades straddling the turn of the century profoundly affected the material and economic growth of the tribes of the Trucial Coast. It

changed the pattern of economic activities and therefore re-shaped settlement patterns, and encouraged emigration from other parts of the region, including the interior of the Trucial Coast, Persia and the Indian subcontinent. Importantly, it also put Dubai and Sharjah on the steamer routes used by the British India company, thus introducing a flood of industrial products to southeastern Arabia. It was during this period that the courtyard wind tower house became an important form of domestic architecture, supplanting already established forms in the towns most dominant in the pearl trade. This is evident in comparing the wind tower-bedecked skylines of the pearling ports on the Gulf coast with the contemporaneous architecture of the main interior oasis town of Al Ain (El Mutwalli), of the non-pearling towns in Ra's al-Khaimah and on the east coast (for example, Fujairah and Wadi al-Hail (Hellyer 1992), and Falayya (Velde 2001) in Ra's al-Khaimah), and the mountain hamlets (King & Maren-Griesebach 1999). In the non-pearling towns, the construction techniques and building styles continued already established patterns and show little, if any, direct influence from outside. However, the many examples of the courtyard wind tower house incorporate stylistic attributes both foreign and indigenous to the Gulf at that time.

The house is based on an ancient plan common throughout the Mediterranean and Middle East. It is well known that the first mosque was in the courtyard of the Prophet Mohammed's (PBUH) house (Irwin: 58). Building complexes in Falayya and Fujairah are contained within walled enclosures that create interior complexes in which separate buildings are located, but the sense of space is significantly different in the typical courtyard wind tower house where the connected wings of the building form the internal courtyard. This internal garden space is thus more intimate. The individual features of the courtyard wind tower house are thus specific to the height of the Gulf's pearl dominated economy between 1890 and 1929. The courtyard design as we see it in areas like Bastakiya seems to have been more popular on the Red Sea coast of Arabia, Egypt and possibly Iran (Petherbridge: 184-185), from where it may have traveled in this form to the Trucial Coast.

The wind tower was a Persian import that accompanied the movement of people from Lingah and other Persian towns to Dubai and the other ports of the Trucial Coast after 1904. It is likely as well that Indian craftsmen were active in the pearl towns, especially Sharjah, and re-interpreted this imported form in new shapes and according to the needs of their patrons.

The construction of wind towers from *'arish* in the Abu Dhabi *suq* suggests that it was whole-heartedly embraced by local craftsmen as well, since palm frond was the most common of materials used for domestic architecture by local builders. Upon further investigation, the ways in which the wind towers were constructed differently in the various communities may reveal the specifics of more precise localised stylistic variations dependent on the economic status, ethnic and demographic make-up and external commercial connections of each individual pearling town. Furthermore, the presence of imported features and materials in the coast and their relative absence in the interior illuminates the economic patterns of the Trucial Coast prior to the Great Depression.

Indigenous and Persian masonry techniques were combined with Indian materials and stock-ordered decorative elements. Stock-ordered items included the modesty screens that seem to be derived from Victorian pattern books, Indian doors and windows, and the chandal wood beams that limited room sizes. This results directly from the Gulf's growing engagement in late Nineteenth and earlv Twentieth centurv international trade through the ArabianGulf and the Indian Ocean. In this way, products from Europe, particularly Britain and Italy, were used in these new buildings, giving them a decidedly classical European flair - an attribute they share with Indian architecture of the same period (Alfieri: 281). A similar combination of external sources is encountered in Red Sea architecture, at Jidda, Farasan and elsewhere.

The adaptation of imported European and other Asian forms supports Bianca Alfieri's assertion that industrialism provoked change in South Asian architecture. Alfieri writes: "From the end of the Eighteenth Century onwards Mughal art began to be substituted by new fashions introduced from Europe. Ancient crafts were threatened or even suppressed'by imports of modern industrial products wherever the newly built railways penetrated'the interior," or where, one might add, the steam ship stopped along the coast. This experience, argues Alfieri quoting H. Goetz, was

Fig. 4. Imported Indian door, Sharjah

Fig. 5. Round wind-tower, Sharjah

not limited to the centres of British commerce and administration. "The agony of the old world continued beyond the Nineteenth Century, and, departing from administrative and commercial centres, it pushed into even the most inaccessible district" (Alfieri: 295). While the courtyard wind tower house is mixed in origin and style, this does not diminish its historical importance. Indeed, the use of different materials and decorative features was the direct result of the Trucial Coast's turn-of-the-century prosperity and its engagement in the expanding international trade of the region in the late Victorian and early Edwardian periods. Although this economic state of well-being was fuelled by pearls, its secondary effects included an increasingly varied demography that infused indigenous architecture with new visions and motifs. Far from peripheral and isolated, this specific example of architectural form reveals a sophisticated mix of imported and indigenous materials, techniques and ideas. Too often the United Arab Emirates' pre-oil past is romanticised and conflated into a vaguely defined era of "Bedouin tradition," when, in fact, it was more dynamic and cosmopolitan, as the details of the wind tower house demonstrates. In fact, the survival and restoration of such architecture affords us an opportunity to examine and understand the complex historical conditions of the Trucial Coast. The wind tower house and other buildings from the pearling period stand as testimony to an otherwise undocumented history.

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An archaeological and architectural evaluation of a fort at Qurayyah, Emirate of Fujairah

by Gareth Longden and Salvatore Garfi

Introduction

In December 1999 archaeologists from Trinity College, Carmarthen, University of Wales continued their research project into the Late Islamic period remains of the Wadi Safad, Emirate of Fujairah, and in the vicinity thereof.

Attention focussed upon a Late Islamic husn to the north of the village of Qurayyah. Qurayyah is a small coastal village around 10 km north of Fujairah City, near the debouchment of the Wadis Safad and Thayb. The husn was first the subject of archaeological examination when de Cardi (1971) conducted a brief survey during a much more extensive analysis of the coastal region.

The husn was selected for detailed analysis for two reasons.

First, the opportunity to compare the husn at Qurayyah with insights derived from work previously conducted at a husn further up the Wadi Safad (Longden and Garfi, 2000). Preliminary observations suggested that whilst broadly contemporary, these two structures possessed very different architectural characteristics and social functions. The current research was designed to examine this issue in greater detail.

Second, it was recognised that the area around the husn at Qurayyah had recently been subject to considerable development pressure.

It was, therefore, considered appropriate to undertake this research in order to assess the impact upon the structure and its archaeological context.

The *husn*

The husn is located to the north-west of the old village of Qurayyah on a projecting spur from Jebel Thayb on the seaward side of the debouchment of the Wadi Thayb. The spur is immediately to the north-west of the village of Qurayyah and separates the plain upon which Qurayya is found from the plain to the north around the village of Qirath. Inland from Qurayyah the plain opens up into the Wadis Safad and Thayb.

The husn overlooks this plain and thus, ultimately, the entrance to both Wadis. The husn itself sits at the highest point of the spur, approximately 85 m above the surrounding coastal plain; its great size and the steepness of the slopes presents an imposing effect and provides an ideal defensive location (Plate *1;* Fig. *1).*

The ceramic evidence from the site has been examined on several occasions; first, by de Cardi (1971), then by Ziolkowski (pers comm.), the latter as part of a wider re-appraisal of the ceramics from Fujairah, and finally during the current project.

The assemblage is dominated by extensive spreads of locally produced Juifar red unglazed ware, incised white ware and by post-Julfar horizon wares. A small number of imported Persian turquoise glazed ware; mottled brown glazed ware and later Sgraffiato ware complete the assemblage, all of which are from disturbed surface deposits, there having been no recorded excavations on the site. The ceramic assemblage would suggest that the main period of occupation began during or after the 15th century AD, although earlier deposits may yet

Plate 1: The *husn* at Qurayyah, from west, showing curtain wall and palm gardens beyond

remain to be exposed.
The main feature of the *husn* is a curtain wall which encompasses the summit of the hill *(Plate 2)*. The space enclosed by the curtain wall has two distinct levels; a lower level immediately behind the wall and a second much higher area on the very summit of the hill. The area immediately behind the wall is narrow, rarely more than 2 metres in width; it is in this narrow area that the rooms within the *husn* are found. Behind this narrow stretch of level ground is a rock outcrop, approximately 3 metres higher, which forms the highest point of the hill. It is here that the cistern and the ephemeral remains of two other rooms are found.
The scale of the structure and the investment of labour in its construction is deceptive. The wall is approximately 240 metres in length and encloses an area that is approximately 3,500 sq.m. The wall in many places is over 3 m. high and is often over 1.5 m. wide. Some of the individual boulders incorporated within the wall are over 1 sq.m. and weigh several tons. The investment in labour involved in creating such a structure belies its apparent simplicity and emphasises the important role that the building fulfilled. The curtain wall itself is made of roughly coursed stones that were originally bonded with an earth mortar. In many places, however, this bonding has dried out and blown away to the detriment of the stability of the wall.
There appear to be two entrances into the complex, one on the north side of the hill and the other on its east side. The northern entrance is a complex arrangement of guardrooms, ramps and gateways. The entranceway to the complex begins on the coastal plain from where a winding route reaches up to the lower terrace where it is then directed through the remains of several small rooms that may originally have acted as guard-posts, and then finally up a steep ramp to enter the upper

Figure 1: Schematic plan of *Husn* Qurayyah

enclosure. This is a complex and highly ordered progression through a series of defended points which would have effectively controlled access to the enclosure. Again, the apparent simplicity of the structure is beguiling.

The second entrance to the enclosure is less clearly defined. This entrance on the east of the site faces the saddle and the mosque and an area of settlement. This entrance is less formal than that on the northern side and is less well provisioned with defensive elements. It may be that this is an adaptation of the structure to enable easier access to the area of settlement in the saddle during a period when defence was less of a priority. The curtain wall at this point decreases in height to form a ramp which leads up into the enclosure. There are no rooms or guard posts at this point and access to the interior would have been unhindered. This entrance and its defensive elements are quite different in character to that on the northern side of the hill, and it is quite likely that this variation is a reflection of the entrance on the east being a later and opportunistic addition.

The interior of the husn contains the remains of at least 8 rooms. The largest of these rooms is no greater than 3 m. by 2 m. and it is comparable in size with those which were likely to have been located on the terraces outside of the curtain wall to the north. The rooms are all small and are either revetted into the central outcrop or are abutted onto the curtain wall, as with the curtain wall itself the rooms are constructed from roughly coursed masonry with the residue of a earth bonding. The small number of these structures strongly suggests that the interior of the husn was not intended for large scale permanent occupation.

Instead it is tempting to suggest, that these structures may have been occupied by families who worked in the husn, perhaps as guards who were concerned with maintaining the water supply and the fabric of the structure. It is unlikely that the husn was an elite settlement, given the simplicity of the structure when compared with the much more elaborate structure at Safad (Longden & Garfi 2000; King & Maren-Griesebach, 2000).

On the summit of the hill is a rock-cut mortar lined cistern *(Plate* 3). The cistern is approximately 4 metres by 2 metres and approximately 2 m. deep. When completely full it would have contained approximately 16,000 litres. There is evidence on the surface of a superstructure which surrounded the cistern and protected the water from the elements. A similar covered cistern has been described at the hill-fort of Shimal (de Cardi, 1971: 245). The water would have been collected from a *falaj* that de Cardi (ibid.) observed to the east of the hill; this area has since seen considerable development and it is no longer possible to identify this feature.

The extra-mural archaeological remains

The hill upon which the husn is located also contains other interesting archaeological remains; a mosque, a number of building platforms and a series of small terraces on the northern side of the hill.

The mosque *(Plate 4)* lies to the east of the husn in a saddle of the hill between the main summit and a lower outcrop. The mosque is now ruined and a few courses of stones are all that remain. It is likely that this was an open summer mosque which was originally 13 metres by 7 metres, it stood alongside the remains of two other rectangular buildings. Immediately to the east of the mosque the secondary summit provides an excellent location for a small watch station within a roughly circular area.

This group of buildings is reminiscent of the structures higher up the Wadi Safad, where the husn was surrounded by three watch stations with a mosque lying to the north of the site at a lower level of the hill.

The second area of archaeological interest on the hill at Qurayyah is the presence of a large number of small terraces on the northern face. There are approximately 30 of these small terraces (2 metres by 3 metres) built into the slope of the hill. It is unlikely that these terraces were used for agricultural purposes due to their restricted size and the difficulties associated with irrigating them; furthermore, the easy availability of better agricultural land on the coastal plain means that such a small agricultural enterprise would be unlikely.

A more likely suggestion would be that these terraces are the remains of an extra-mural settlement, perched on the side of the hill but near to the protection offered

Plate 2: The curtain wall on the west side of the *husn*

by the *husn*. The types of structure most likely to have been constructed on these small terraces are those described by Dostal (1983) and Costa (1991) which were found throughout the region, although no footings remain. The presence of such a precarious settlement is indicative of the context within which both the settlement and the *husn* were established. Such a defended settlement must surely reflect the political instability that was present. Such an argument has been advanced for the similar and broadly contemporary site at Safad.
Whilst the most likely suggestion is that these small terraces were intended for houses, it is also possible that at least some of them were produced as a by-product of the collection of stones that were to be used in the construction of the curtain wall. Alternatively some of the terraces may have been cleared to improve lines of sight along the direction of the entrance to the *husn*.

Discussion

It is interesting to compare the *husn* at Qurayyah with the *husn* higher up the Wadi Safad. The *husn* at Safad is a much smaller structure, yet it is also far more elaborate with many delicate and imaginative architectural details. It is protected by a complex series of defences including towers, curtain walls, parapet walkways and external 'watch stations'. The complex defensive features are matched by the complex residential provision within this small *husn*. A number of spacious rooms were built which would have provided elaborate and comfortable accommodation for a small number of people within a heavily defended residence. It is clear from the residential provision that the *husn* was intended to act as focus for permanent occupation for a small elite family group. This was fundamentally a private structure. The *husn* at Safad was surrounded by a large number of low status dwellings, the remains of a large and successful community from the 16th Century AD until it was abandoned around 40 years ago.
The political context within which the settlement at Qurayyah was established is illuminated by the obvious emphasis devoted to defence.

The large hilltop enclosure was designed to provide temporary protection for a relatively large number of people, it was not a structure which was designed to provide permanent occupation unlike the structure at Safad. The population that made use of the enclosure presumably lived on the eastern slope of the hill on the numerous small terraces and on the shoulder of the hill near to the mosque, retreating to the enclosure only at time of need. It might also be suggested that when these difficult times abated the population centre shifted from the hillside down onto the coastal plain.

Conclusions

The architectural and archaeological analysis of the *husn* at Qurayyah has revealed a structure'with a complex development with many subtle architectural devices employed in what is a deceptively simple structure. It is difficult to underestimate the investment in labour involved in not only the *husn* itself, but also the clearing of the site, the establishment of track-ways up to the site and the construction of the numerous terraces and ancillary buildings. The structure bears some close architectural similarities with the nearby structure at Safad but again there are subtle but significant differences in purpose and position within the local settlement hierarchy. Drawing upon analogies from similar sites in the area and from the ceramic assemblage, it is likely that the construction of the *husn* should be provisionally dated to the Late Islamic period of the 15th to 17th Centuries AD. Within this historical context of political uncertainties and the interplay of Portuguese, Omani, Persian and local tribal rivalries, a secure defensive retreat would have been of great value to the local population, and indeed may have been a necessity (King, 1997; d'Errico, 1983).
It is important to draw attention to the long term future of the monuments. Since 1995 considerable development has taken place in and around the Wadi Safad. Numerous cairns and buildings which were surveyed in 1994 (King & Maren-Griesebach, 2000; Garfi, 1995) on the wadi bottom have been destroyed due to the recent

Plate 3: The cistern at the highest point within the *husn*

construction of residential and educational complexes and water management systems.

Similarly, the building of a new road up the Wadi Safad has led to extensive destruction of archaeological features, including a Late Islamic settlement (Longden and Garfi, 2000). The *husn* at Qurayyah has only just escaped destruction following the erection of an electricity pylon to the west of the site. The outlying parts of the site have, however, been affected. The long term preservation of the *husn* must be in question, and unless some stabilisation of parts of the structure is undertaken more deterioration must be expected.

The continuing research programme has demonstrated that such defensive structures are complex elements of the historical settlement patterns of the Late Islamic period, and perhaps more complex than has been previously acknowledged. Further research is required to examine the more subtle relationships that existed between these defended hilltop structures and the nearby settlements and the exploitation of the surrounding environment and the wider social landscape.

In particular, the historical context which led to these structures being built needs to be more carefully examined through a combination of excavation, architectural survey and historical research.

Acknowledgements

We are grateful to His Highness Sheikh Hamad bin Mohammed Al Sharqi, Ruler of Fujairah, for giving approval for the work to be conducted. We thank Ahmed Khalifa Al Shamsi, Director of the Department of Antiquities and Heritage of the Government of Fujairah, for the generous support offered by his Department and Salah Ali Hassan, also of the Department, with whom we liased throughout our stay in the Emirate.

Peter Hellver, Executive Director of the Abu Dhabi Islands Aichaeological Survey, ADIAS, has provided continued assistance throuahout this proiect.Michele Ziolkowski of the University of Sydney gave helpful information on the ceramics from both the site at Qurayyah and from the Wadi Safad. We would also like to acknowledge the assistance we received from the Emirates Natural History Group in Abu Dhabi, which provided a grant to support our work, and from ADIAS. Finally, we would like to acknowledge the generous assistance provided by the School of Archaeology, Trinity College, Carmarthen.

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Longden, G. & Garfi, *S.* (in prep) **The evolution of a defended residence: Insights from recent archaeological and architectural fieldwork in the Wadi Safad, Emirate of Fujairah, United Arab Emirates.**

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Plate 4: Remains of the open air mosque at *Husn* Qurayyah, seen from the west

Spiny-tail Lizard *Uromastyx aegyptius microlepis* diet - a study in the United Arab Emirates

by Peter L. Cunningham

Spiny-tail Lizard Uromastyx aegyptius microlepis, (Blanford, 1874), better known by its Arabic name "Dhub," is mainly a herbivore, which forages on a wide variety of plant species (Cunningham 2000a, Foley et al. 1992, Jongbloed 1997 & 2000, Kevork & Al-Uthman 1972, Mandaville 1965, Robinson 1995). While adults are reported to be almost exclusively herbivorous (Arnold 1984, Cunningham 2000a, Gallagher 1971, Kevork & Al-Uthman 1972, Robinson 1995), juveniles also prey on insects (Arnold 1984, Brown 1982, Jongbloed 2000).

Although some studies have been conducted on the diet of U.a.microlepis by analysis of stomach contents (Foley et al. 1992, Mandaville 1965) very little work has focused on faecal analysis. The following results are presented from a Ph.D. research project by the author on the ecology of the species in a loose-knit population approximately 35km northwest of Al Ain in the Abu Dhabi Emirate, United Arab Emirates. The area, approximately 5 sq. km., is known locally as Qarn Qashash, and is comprised of inter-dunal gravel flats with scattered calcrete hills, bordered by extensive sand dunes and inland sabkha.

During this study, in addition to direct observations of foraging behaviour (Cunningham 2001), a total of 425 faecal pellets were gathered, teased apart and analysed to determine the diet. Pellets were collected from different individuals (different burrows) throughout the study area during the summers of 19991200012001 (255 pellets) and winters of I99912000 & 2000/2001 (170 pellets).

Vegetable remains consisting mainly of stem and leaves of favoured food plants (Cunningham 2001) dominate the pellets. Of the analysed pellets, 32% contained "other" material during summer (n=3yrs) compared to 20% during winter (n=2yrs). "Other" items increased from 19% (summer 1999) to 42% (summer 2001) and 18% (winter 199912000) to 22% (winter 200012001). The total absence of rain in the study area since May 1999 could have resulted in the observed increase of "other" items in the diet.

"Other" items include the following: •
Animal remains (other than Arthropod)
Arthropod remains
Camel droppings
Date kernels
Sheep droppings
Artefacts (Human objects)
Feathers
Stones

Arthropod remains (Tenebrionid beetle sp.) were only identified in one pellet (0.24%) of the total pellets analysed. This is consistent with the statement by Kevork & Al-Uthman (1972) that "the adult species of Uromastyx has a strictly vegetarian diet, though some adults and young ones in general may occasionally take animal matter as well". The same authors state that "insignificant amounts" (1-2%) of arthropod remains were found in stomach contents of juvenile lizards. The only other reference found quantifying insects in the diet of Uromastyx was by Highfield & Slimani (1998) for U. acanthinurus, from Morocco, who stated that 6% of the diet consisted of "ants and beetles". U. loricatus from Iraq have also been documented as occasionally preying on insects (Kevork & Al-Uthman 1972).

(1984), Brown (1982) and Jongbloed (2000) state that insects are included in the diet of juvenile U. a. microlepis, but they do not quantify this. Brown (1982) noted that adults took locusts at the time of swarming. Gallagher (1971) noted that the species is "almost entirely herbivorous, but will take beetles," this being recorded from observation of pellets, the age of the animal not being known.

The lack of insects in the diet could be because most insects, Tenebrionidae at least, are crepuscular or nocturnal (Tigar 1996), thus avoiding the lizards' main foraging period (Cunningham 2000a, b).

Other animal remains identified during this current study, thus far, included the toe and claw of another Spiny-tail Lizard. This was possibly ingested accidentally or erroneously during normal feeding activity, as old lizard carcasses (remains of raptor and off-road vehicle kills) are common throughout the study area. Feathers also occasionally appear in the lizards' faeces.

Sheep droppings were the most common "other" item identified. Pellets analysed during summer contained an average of 19% sheep droppings compared to 11% during winter. No goats were present in the study area.

Date kernels were the second most common "other" item with an average of 8% and 4% of analysed pellets containing kernels during summer and winter, respectively. Dates are routinely fed to camels as a food supplement and consequently appear in their faeces.

It is possible that the lizards accidentally ingest objects other than plant material during their routine foraging excursions or erroneously ingest these objects as arthropods.

Artefacts (Human objects) include plastic remains.

Sheep droppings and date kernels, which are usually dark in colour, could well be confused as arthropods resulting in erroneous ingestion. Brown (1982) suggested that sheep droppings are ingested to "extract undigested seeds", but this is doubtful as the sheep droppings are excreted in their original "shape."

Pellets analysed from juvenile lizards (n=13) also indicate a vegetarian diet in the UAE, although the small sample size should be taken into consideration and could affect the results. More juvenile faecal pellets should be analysed to confirm their diet preference. No differentation was made during the study between pellets from male and female individuals.

It is, therefore, suggested that adult U. a. microlepis are exclusively herbivorous and that most "other" objects are ingested accidentally andlor erroneously. This is important as it places the species in direct competition with domestic livestock (camels and sheep) in the study area. For the species to be protected effectively, it is imperative to determine the extent of the competition between the lizards and the domestic stock for the limited resources. It remains to be determined whether, and to what extent, domestic stock influence the survival and fitness of Spiny-tailed lizards in the UAE. It would be a tragedy if "locally common" domestic stock contributed to the demise, in certain areas at least, of this archaic true desert dweller.

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Short Notes

Michael Gallagher

The ***Tribulus*** Editorial Board is delighted to welcome Michael Gallagher as a member of the Advisory Panel. With 32 years experience in Arabia, including an early five years in the Gulf (1968-1973) and 21 years (1977-1998) on environmental work in the Sultanate of Oman, he has gained a wide understanding of the natural history of the region, which will now be available to contributors and editors.

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Two new species for the UAE

Savi's pygmy shrew *Suncus etruscus* was recently discovered in the UAE by a researcher working for Sharjah's Breeding Centre for Endangered Arabian Wildlife. Known previously from Bahrain, Oman (Dhofar), Yemen and also Socotra, its occurrence in the UAE was suspected, although not proven until an individual turned up live in a pitfall trap in Sharjah. This tiny insectivore is possibly the world's smallest mammal.

Source: ***Arabian Wildlife*** *(10:10) Spring 2001*

The second recent discovery concerns the archaic tadpole shrimp, *Triops sp.* These were again found by staff from the Sharjah Breeding Centre, this time whilst working together with the Pest Control Section of Dubai Municipality. The interest of the latter is clear, because *Triops* are native biological control agents which consume mosquito and midge larvae, themselves potential vectors of parasites and diseases. *Triops* has previously been found within the peninsula in Oman, Saudi Arabia and Yemen.

Source: ***Arabian Wildlife*** *(11:11) Summer 2001*

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Echinoid website

The UAE is a happy hunting ground for fossil echinoid (sea urchins), with several newly described species having been found in the country, primarily in the Late Cretaceous exposures in the Hajar Mountains and outliers to be found from the Al Ain area northwards towards Dhaid.

Identification has usually been the domain of experts at the Natural History Museum in London - until now that is. The following website, produced by the NHM, is recommended viewing for all enthusiastic fossil echinoid hunters and should permit identification of those specimens already housed in your collection or help identify any new ones found.

(If anything looks like a new or rarely recorded species, though, *please* get it properly examined!)

www.nhm.ac.uk/palaeontology/echinoids

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Hare Loss Problems

During 2000 a recently imported population of Cape Hares *Lepus capensis* held captive in the UAE began to die-off from a mystery illness. Originating from Turkmenistan, these animals formed part of a captive-breeding programme and their progeny were ultimately intended for release and restocking of the UAE desert. Veterinary effort, although too late to save the hares, isolated the cause of the mortality as a staphylococcus infection. It was noted, however, that the source of the problem came from ticks ***(Ixodes*** sp.), infecting the native population of Arabian hares, also *Lepus capensis, i.e.* the same species. It appears that the 'exotic' hares had no natural immunity to the bacteria hosted by the ticks on the native subspecies of hare, and had all thus rapidly succumbed. An unfortunate lesson was learned the hard way.

It is fortunate that the disease worked the way it did rather than vice versa. Then aaain. without due monitoring would we know whether the wild population here had been affected in any way or not?

This event should serve as a salutary lesson, supporting opposition to the future unregulated import of any non-native species or subspecies, no matter what animal or plant is involved, as, quite clearly, we are generally not in a position to judge what the veterinary and ecological implications of any introduction might actually be.

compiled by Simon Aspinall

A first modern record of the Mangrove Crab *Scylla serrata* in the U.A.E. and south-eastern Arabian Gulf

by Peter Hogarth and Mark Beech

A recent meal in Ra's al-Khaimah led to an addition to the list of crab species recorded from the United Arab Emirates. This was a female of the mangrove or mud crab, Scylla serrata. The specimen, when identified, was badly damaged by preparation for the table, but had a carapace breadth of approximately 17.5 cm. This specimen was caught at UTM 393700 E 1 2850300 N near the Police Club, Ra's al-Khaimah, UAE, in April 2001. An example of a complete Scylla serrata is depicted in Figure ***1.***

Scylla serrata is a member of the family Portunidae, the swimming crabs, in which the tips of the last pair of legs are modified into flat paddles, and reaches a spectacular 22-23 cm in carapace breadth (Guinot 1966), and a weight of 1500-2000 gm (Apel & Spiridonov 1998). The Ras al-Khaimah specimen, although apparently mature, was not unusually large. The species has a strong association with mangroves, where it digs sizeable burrows.

In many parts of the world Scylla serrata is an important commercially caught food species, and in south-east Asia is the basis of a developing aquaculture industry (Guinot 1966; Overton & Macintosh 1997).

The species is widespread throughout the Indian Ocean and west Pacific, although there is some doubt about its exact distribution since a number of varieties have recently been reclassified as separate species (Keenan, Davie & Mann 1998). It is known to occur in the Western Indian Ocean, including the Arabian Sea and the Gulf of Oman (Apel & Spiridonov 1998). Until now, its presence in the south-eastern Arabian Gulf has been suspected from anecdotal sightings of large crabs – and there are few species remotely as big – and by occasional reports of burrows. Recent surveys of the Gulf coastline of the UAE failed to identify this species (Al-Ghais & Cooper 1997; Hornby 1997, Hogarth & Beech, in prep.). This record is the first confirmation of its occurrence within the Arabian Gulf.

This is somewhat surprising, as it is quite common in archaeological deposits in, for example, Iron Age deposits at Rafaq in the Wadi al-Qawr, in the Hajar Mountains, near Hatta, and Sasanian/Islamic levels at Kush north of Ra's al-Khaimah. At Rafaq the abundance of Scylla remains suggests that it was an important food species which was transported some distance into the interior from the coast (Beech 2001; Beech et al., in press). These Scylla however, are perhaps more likely to have been brought to Rafaq from the East Coast of the UAE, on the Gulf of Oman, to which it is closer, rather than from the Arabian Gulf coast.

Why should a once fairly common species have virtually disappeared from the Gulf? The usually reasons for a species' disappearance are over-exploitation, environmental change, or reduction in suitable habitat. Perhaps the most likely explanation in this case is the loss of much of the mangrove habitat. In past times mangroves were much more widespread. Their use as timber for architecture and boat-building severely depleted mangroves in the Gulf, reducing them in area and diversity to relatively small patches, almost exclusively of the grey mangrove, Avicennia marina. Possibly the deliberate replanting of mangroves, such as the extensive programme in Abu Dhabi, will be followed by a resurgence of this spectacular – and tasty – species in the area.

Any further records of Scylla serrata would be of considerable interest.

Acknowledgements

We would like to thank the following people for their assistance during the preparation of this article: Christian Velde (resident archaeologist, National Museum of Ras al-Khaimah) for providing the coordinates for the crab's location (before it arrived on the dinner table), and for hosting the visit of the second author to Ras al-Khaimah in April 2001, Michael Turkay for providing the picture, and Michael Apel for his useful comments.

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De Soyza, A. (ed.) 2001. ***Research and Management Options for Protected Areas,*** ERWDA, Abu Dhabi, pp. 354 (no ISBN number).

This book presents the papers from the First International Symposium and Workshop on Arid Zone Environments, which was held in Abu Dhabi in January 2000. The symposium was held under the auspices of Abu Dhabi's Environmental Research and Wildlife Development Agency (ERWDA), who also published the proceedings.

First, a comment on production: it should be pointed out that the book could have been half the size with a better design and lighter paper. More attention should also have been paid to editing and proof-reading. Perhaps stranger is that there is nothing in the book to tell the reader where or when the symposium took place. It is also regrettable, in my opinion, that the book has no overview or discussion of the present situation in relation to protected areas in the UAE, or, in particular, the Emirate of Abu Dhabi.

ERWDA convened the symposium to help them learn from the experience of other professionals involved with protected areas in the arid zone. There are particularly interesting papers on the Thar Desert in north-west India, marine reserves in Oman, wetlands in western Africa and plant diversity on Socotra Island. Lessons can certainly be learned from such experience, and it is very appropriate that such information should be shared between professionals in a relaxed atmosphere where ideas can be freely tossed around. The printed volume is perhaps most useful as an aide-memoire for the participants.

The contributors to the symposium were very diverse in their approach and there are huge disparities in the level of detail in the various contributions. The relevance of some could at best be considered marginal, e.g. the account of the work of the Wildfowl and Wetlands Trust in the UK (which is not known for its aridity), and the highly statistical experimental manipulation of ant communities in New Mexico. Overall, however, the volume contains a lot of useful information, but, without an index or any apparent structure to the organisation of the book, it mav not be easv for the reader to find what he wants.

ERWDA should be congratulated for having organised the event, invited manv excellent speakers and published the proceedings, but the lack of information about the UAE is disappointing. There are only two in-country papers, (see below), and these are somewhat specialised.

The UAE desperately needs a system of protected areas, both to safeguard a series of important ecosystems and to afford protection to endangered species. Most habitats are under threat and wildlife is being lost at an alarming rate as a result of over-grazing, development, and what appears to be an insatiable desire for more walls and fences. ERWDA has been given the responsibility for determining what protected areas are required and how they should be managed, and this book helps a little by describing experience from elsewhere.

The conclusions from the Workshops are ably but briefly pulled together by Amrita de Soyza in the final section of the book, but there is no attempt to apply the conclusions to the situation on the ground here. ERWDA is characteristically modest about its own achievements, and any outsiders picking up this book will be disappointed if they want to find out about progress in UAE. There is more than enough information to be able to identify the areas most urgently in need of protection in the UAE. This book could have been used to provide additional weight in overcoming the obstacles and inertia which are preventing action on the ground.

Some of the contributions, particularly those from India, Oman and Saudi Arabia, clearly demonstrate the need to involve local people so that they can benefit from the existence of protected areas. One wonders to what extent this is relevant to the deserts of Abu Dhabi.

Very few of the original inhabitants of the desert have remained in place during the recent period of economic growth. The desert is overgrazed not because of the hardship of subsistence pastoralism but because water can be taken almost anywhere by road tanker. The single most beneficial action to help wildlife in Abu Dhabi would be the selection of a suitable area and exclusion of grazing by goats and camels (not to mention protection from the ever-expanding irrigated plantations). In this amazing country where almost anything is possible, surely the establishment of one large protected area of desert should not be too difficult?

Unfortunately we cannot allow ourselves the luxury of further contemplation of the issues before practical steps are taken to establish protected areas. The desert continues to be overgrazed and divided into separate compartments, our most precious coastal sites are being degraded and destroyed, and our most spectacular mammals, such as the Arabian leopard and the tahr, are on the brink of extinction with no legal protection or practical management to save them. Let us hope that ERWDA and the other responsible agencies can gain inspiration from this book, and set up the long overdue system of national protected areas.

The papers specifically related to the Emirates are as follows:

Barwani, Q. & Al Janahi, A. UAE East Coast Marine Reserves, pp. 81-88.

Hellyer, P. & Beech, M. Protected Areas and Cultural Heritage: An Abu Dhabi Case Study, pp. 195-213.

Richard Hornby

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Haerinck, E. (2001). Excavations at ed-Dur (Umm al-Qaiwain, United Arab Emirates). Vol. **II:** The Tombs, 430 pp. (110 pp., 10 ill. tabl., 313 pl. & 8 col. pl.). ISBN 90-429-0997-8. Price: 99 Euros. Peeters Publishers, Bondgenotenlaan 153, B-3000 LEUVEN, Belgium. E-mail: **peeters@www.peeters-leuven.be.**

The late 1st Millennium BC /early 1st Millennium AD site of ed-Dur (Ad-Door) in Umm al-Qaiwain is one of the key archaeological sites in the UAE. Together with the inland site of Mileiha, south of Dhaid, with which it was closely associated, it has provided the bulk of our information of the Emirates during this important phase of the late pre-Islamic period.

Excavated over a nine year period, from 1986 to 1995, by Professor Ernie Haerinck, of Belgium's University of Ghent, and, for shorter periods, by teams from Denmark, France and Britain, ed-Dur has yielded substantial evidence of the material culture of the inhabitants of the UAE 2000 years ago, as well as, through a temple dedicated to the sun god Marashams, of their beliefs.

The process of publishing the results from the excavations is now well under way, with Volume **I** of this series, on the glass vessels, having been published in 1998. Ernie Haerinck now publishes in this Volume details of the 121 tombs that were excavated at the site, as well as all of the grave goods.

The tombs covered in this work are of several different types, from simple individual burials to rectangular cists

and large semi-subterranean multiple tombs with an entrance, while a large above-ground grave was also found. Although most of those excavated had been plundered in antiquity, several were undisturbed and produced numerous objects, including important metal and glass.
Examination of the finds has shown that the inhabitants of ed-Dur were actively engaged in international trade, with the Roman Empire to the west and India to the east, and a number of the objects illustrated in this work
testify to the important of luxury items from abroad. Many are now on display at Umm al-Qaiwain's museum, having re-emerged, after many years, from the storerooms, much to the relief of those who had feared that they had disappeared.
Ernie Haerinck deserves praise not only for having worked his way through the descriptions of the graves and the assemblage of grave goods, but also for seeing the work through to publication. One wishes some of the other archaeologists that have worked in the UAE were as scrupulous about ensuring that the results of their work were published!
This book, second in a special series on the ed-Dur excavations, will be much welcomed by all those working in, or interested in, Emirates archaeology. We look forward eagerly to the next volume.

Peter Hellyer

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Jongbloed, M., Western R.A. & Boer, B. [2000]. **Annotated Check-list for Plants in the U.A.E.** 92 pp. 16 colour photographs. Softback A5. Zodiac Publishing, Dubai.

Published in December 2000, this is a handy checklist of the more than 750 species of plant known to occur within the UAE's borders. There were very few contributors to the checklist, with the collecting dates for just fifteen persons, professional and amateur, being detailed in the introductory pages, although a number of other names appear alongside individual species' entries.
Liverworts, mosses, ferns and gymnosperms take up under four pages of the 77 pages of checklist proper, which, as would be expected, is dominated by the angiosperms, or flowering plants. Species unable to survive without irrigation are not included, thus the plethora of ornamentals and cultivated plants do not appear (although some may well have crept in).
A standard format is followed, with a bewildering array of abbreviations and acronyms that have to be deciphered by constant reference to the 'key' on page 5. Regular reference would, one hopes, soon dispense with this need. A sample entry reads as follows:

CYPERACEAE

Bolboschoenus maritima (L.) Palla
Syn. ***Scirpus maritimus***
Western148/SDP919
PL, W, rare. AD, RAK
Perennial, tuber root, inflorescence umbel up to 2.5 cm.
Prefers swampy ground.

What you have here is the family, the species' scientific name followed by any synonym, the reference specimen by collector/s and herbaria (SDP - Sharjah Desert Park) where any specimens are stored, favoured habitat (PL,W - plantations, gardens & wadi beds), frequency of occurrence, range and a brief description (some helpful, others almost superfluous). Overall, the layout is not that pleasing to the eye, but all the information you need is there.
It is not surprising, but excusable, that a number of proofing errors occur, although inconsistency among place-names could easily have been remedied *(e.g.* Sueihan or Sueyhan appear, but never Sweihan, which is correct). A map and gazetteer of place-names would have been useful, although an index of families and genera is included.
This checklist is certainly a good way to polish your knowledge of Latin, as, frustratingly, most species, even of the flowering plants, do not have common names. Now we have the checklist, all we really need is a field guide to go with it – and gossip suggests that too may not be that far away, perhaps even within a couple of years.
Finally, it has to be noted that publication of this useful work was under the combined sponsorship of the UAE's three Natural History Groups, of Abu Dhabi, Al Ain and Dubai, many of whose members past and present were inevitably among the contributors.

Simon Aspinall

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Aspinall, S. (comp.).[2001]. **Birds of Abu Dhabi - Checklist.** 24 pp, 14 colour ill. Published by ***Twitchers' Guide,*** PO Box 45553, Abu Dhabi. Dh 15 inc. p & p. inside UAE, UK pounds 3.50 inc. p. & p. in Europe.

The "Birds of Abu Dhabi – Checklist", recently published under the sponsorship of BP, lists all the bird species recorded on Abu Dhabi Island since records began.
Compiled by Simon Aspinall, the checklist has an ample, interesting introduction in both English and Arabic, giving particulars on the geography, "greenification" of Abu Dhab and the importance of Abu Dhabi Island as a bird migration staging post, along with other useful facts and figures.
The list is clearly laid out, in bold rounded print, with "tick" boxes alongside each species. Three boxes per species make an entry in the form of a date convenient. Species of bird recorded elsewhere in the Emirate, but not yet on Abu Dhabi Island are also listed, but without adjoining tick boxes. The taxonomic listing is easy to follow with the key terminology being distinctive: passage migrant, migrant breeder, winter visitor etc.
Some pleasing photographs accompany the text, most of which were shot in Abu Dhabi or nearby.
This slim lightweight volume is ideal for slipping into a briefcase or the car glove compartment. The paper quality is deliberately intended for ink or pencil entries. A simple, straightforward map of Abu Dhabi Island, indicating the key birding sites is also included.
This little volume is clearly a "must", not only the dedicated bird "twitcher", but for any Abu Dhabi resident or visitor who has a love of the natural environment of this region.

Andrew Twyman

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Other published papers

Copies, or details, have been received of the following other publications relating to the UAE.

Cunningham, P.L. [2001]. *Notes on some aspects of the ecology of* ***Acanthodactylus opheodurus*** Arnold 1980, *from the U.A.E.* **Herpetozoa 14** (112): 15-20.

Cunningham, P.L. [2001]. *On the distribution and status of the Arabian tahr* (Hemitragus jayakari) *in the UAE and northern Oman.* **Zoology in the Middle East. 23,** 2001: 13-16.

Proceedings of the Seminar for Arabian Studies, PSAS, Vol. 31 (2000) contains the following papers relating to the UAE.

Elders, J. The lost churches of the Arabian Gulf: recent discoveries on the islands of Sir Bani Yas and Marawah, Abu Dhabi Emirate, United Arab Emirates. pp. 47-58:
Magee, P., with Thompson, E. Excavations at Muweilah **1997-2000.** pp. 115-130.
Mery, S., Rouquet, J., McSweeney, K., Basset, G., Saliege, J.-F. & Al Tikriti, W.Y. Re-excavation of the early Bronze Age collective Hili N pit-grave (Emirate of Abu Dhabi, UAE): results of the first two campaigns of the Emirati-French Project. pp. 161-178.
Uerpmann, M. Remarks on the animal economy of Tell Abraq (Emirates of Sharjah and Umm al-Qaywayn, UAE). pp. 227-234.

The Proceedings also contain, as usual, a number of papers on Oman, Yemen and Bahrain. Of particular interest for the UAE are
Charpentier, V. Les industries lithiques de Ra's al-Hadd. pp. 31-46
and
Olijdam, E. Exploitation of sea turtles in the early Dilmin period (c. **2100-1900** BC). pp. 195-202.
There is also a note In Memoriam of the archaeologist Geoffrey Bibby, who died in early 2000. Well known for his work elsewhere in the Gulf, in Bahrain in particular, Bibby was also a co-director, with P.V. Glob, on the Danish team which carried out the first archaeological excavations in the UAE, at Umm al-Nar, in 1959, later moving on excavate the Hili Tomb.

Other publications on Gulf archaeology

Bahrain

Crawford, Harriet [2001]. Early Dilmun Seals from Saar: Art & Commerce in Bronze Age Bahrain. Hdbk, 112 pp., 222 colour photographs, 176 black-and-white drawings. ISBN 0-9539561-0-5. Price £45 or $63. (p. & p. extra). Archaeology International Ltd. Upper House, Stoke Saint Milborough, Ludlow, Shropshire SY8 2EJ UK. email: **rk@archaeology-international.co.uk**

The excavations at the archaeological site of Saar produced the largest single corpus of Bronze Age seals and sealings found so far in Bahrain, the centre of the Dilmun civilisation. The material forms a unique record of the art of the period and provides valuable information on the commercial activities of the inhabitants of Saar.
An introductory text describes the study of seals and sealings and is followed by a comprehensive analysis of the stylistic and functional attributes of the Saar material. The accompanying catalogue contains full details of over two hundred seals and sealings, and is lavishly illustrated with colour photographs.
This volume is the second in the series of reports on the excavations at Saar, carried out by the London-Bahrain Archaeological Expedition between 1990 and 1999.
Although only a few Dilmun seals have yet been recorded in the Emirates, not all of which have yet been published, this book will also serve as a useful introduction to UAE-based readers.

Oman

Two new publications from the Oriental Department of the German Institute of Archaeology dealing with aspects of Omani archaeology have been announced. Summary details adapted from information supplied by the publishers follow. Further information can be obtained from the author / co-author, Dr. Paul Yule, at paul.yule@t-online.de

Yule, Paul [2001] Die Graberfelder in Samad al Shan (Sultanat Oman) Materialien zu einer Kulturgeschichte. *Orient-Archaologie* 4. 514 pp., 47 text figures, 64 tables, 611 plates, in German with English and Arabic summaries. 295.00 DM.
ISBN 3-89646-634-8; ISSN 1434-162x
Verlag Marie Leidorf, Rahden. Website: www.vml.de

Following years of preparation, the publication on the research undertaken by the German Mission centering in Oman's Sharqiyah area has finally appeared. This work focusses on the Samad Period, from post 300 B.C. to 1000 A.D. In order to define this period/culture, those chronologically adjacent to it must also be defined in terms of finds and contexts.
This project began in 1980 and was in full swing from 1987 to 1992. Some 300 sites were studied, mostly of the Bronze and Iron Ages. 361 graves and their finds provide the main body of this work, although other material handed in to the Department of Antiquities is also reviewed. Over 20 different kinds of grave structures are recorded, while 500 different clases of finds are noted, including different types of weapons, pottery vessels, stone vessels, animal bones, jewellery, seals, and 157 classes of beads.
The publication is based on the author's Habilitation from the Faculty for Ancient Oriental Languages and Ancient Studies of the University of Heidelberg.

Paul Yule & Gerd Weisgerber (with a contribution by Michael Prange and Andreas Hauptmann). The Metal Hoard from 'Ibri/Selme, Sultanate of Oman. Published in the series *Prahistorische Bronzefunde,* volume 20:7. Franz Steiner Verlag Stuttgart 2001. Hdbk, ix & 106 pp. 52 plates, 25 figs. & 9 tables. 140.00 DM.
ISBN 3-515-07153-9

After eighteen years of preparation and several postponements this monograph on the largest Early Iron Age hoard ever found in the Middle East has finally appeared.
The large hoard of vessels, bangles and other metal implements, totalling 504 artefacts, was accidentally discovered in 1979. A working group of archaeologists, archaeometallurgists, and restorers was put together to tackle the publication and preservation of the find.
The majority of the hoard finds are metal implements of the Early Iron Age. They were hidden in a tomb of the second half of the 3rd millennium BC, presumably having been collected together by grave robbers who may have used the tomb as a depot. This interpretation does not, however, explain the presence of all of the artefacts, some of which seem to have belonged to the tomb.

Recent Research and Theses

Dr. Mark Beech, Environmental Archaeology and IT Director for the Abu Dhabi Islands Archaeological Survey (ADIAS), received his PhD from the University of York in July. The title of his doctoral thesis was:
"In the Land of the Ichthyophagi: Modelling fish exploitation in the Arabian Gulf and Gulf of Oman from the 5th millennium BC to the Late Islamic Period."

His thesis abstract was as follows:

This study addresses a number of key issues relating to the coastal archaeology of southeast Arabia. Namely, what role did chronological developments play in the characterisation of fisheries exploitation patterns? What

was the influence of the environment in this region? Are there any modern fisheries or archaeological data to support the notion that the inhabitants of this region practised a transhumant and seasonally based existence, occupying the coast or interior during particular seasons? Is it possible to identify traces of fish processing, dried fish or possible evidence for fish storage and trade in the archaeological record of the area?

The primary data forming the basis for this study are 23 archaeological fish bone assemblages from sites located in the Arabian Gulf and Gulf of Oman, with a particular focus on the southern Gulf region and the present day coastline of the United Arab Emirates. The chronological focus of this study is from the 5th millennium BC to the Late Islamic period.

Various techniques were used to model regional variability in archaeological fish bone assemblages. These included standard zooarchaeological quantification techniques as well as percentage sample presence, measures of ecological diversity (Shannon-Wiener and Simpson diversity indices), cluster analysis and Renkonens percentage similarity. The study highlighted three main types of assemblages, sites with shallow water and reef species, sites with numerous remains of Chondrichthyes, and sites with higher numbers of pelagic fish, particularly tuna and mackerel. Sites clustered according to similar regions or environments rather than according to any chronological principle.

A pilot study on Lethrinid otoliths questioned some of the currently adopted models relating to transhumance and seasonality. It is suggested that further studies should be carried out in conjunction with other researchers working in the region to critically evaluate the validity of these models.

The following report titles have been supplied by the Breeding Centre for Endangered Arabian Wildlife, Sharjah, UAE, from whom further information can be obtained.

Conservation assessment and management plan (CAMP) for Arabian carnivores and Population Habitat and Viability assessment (PHVA) for the Arabian Leopard and Tahr. Briefing book (2000). Breeding Centre for Endangered Arabian Wildlife in collaboration with IUCNISSC Conservation Breeding Specialist Group. Sharjah.

Conservation assessment and management plan (CAMP) for Arabian carnivores and Population Habitat and Viability assessment (PHVA) for the Arabian Leopard and Tahr. Final report (2000). Breeding Centre for Endangered Arabian Wildlife, in collaboration with IUCNISSC CBSG, Apple Valley. Min. USA.

Conservation assessment and management plan (CAMP) for the Arabian leopard and Arabian ungulates. Briefing book (2001) Breeding Centre for Endangered Arabian Wildlife, in collaboration with IUCNISSC Conservation Breeding Specialist Group. Sharjah.

Conservation assessment and management plan (CAMP) for the Arabian Leopard and Arabian Ungulates with Population and Habitat Viability Assessments (PHVA) for the Arabian Leopard, Arabian *Oryx* and Tahr. Final report (2001). Breeding Centre for Endangered Arabian Wildlife, in collaboration with IUCNISSC CBSG, Apple Valley. Min. USA.

Regional Studbook for the Arabian leopard Panthera pardus nimr (2001). Data current through 30 April 2001. Breeding Centre for Endangered Arabian Wildlife, Sharjah.

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Crackdown on illegal trade in wildlife promised

A continued flow of illegally-traded species of wildlife into the Emirates has prompted the Secretariat of the Convention on International Trade in Endangered Species of Flora and Fauna, CITES to recommend to its members a suspension of all wildlife trade to and from the UAE.

The move followed rising concern among other CITES members, and in the UAE itself, about the inability of the national authority responsible, the Ministry of Agriculture and Fisheries, to clamp down on the trade. The Ministry has cited its inability to obtain proper co-operation from airports, ports and custom authorities as being to blame.

The UAE joined CITES in 1974, but withdrew in the early 1980s, as part of Government financial cutbacks at a period of low oil prices. It rejoined at the end of the 1980s, but the Ministry of Agriculture and Fisheries has never been given adequate staffing to permit it to implement the CITES rules effectively. Local authorities have also been reluctant in some cases to clamp down on the illegal trade.

Warning of a possible suspension was first issued in June 2001, following which a CITES delegation visited the UAE in October to review the local situation on the ground. Prior to its arrival, a ministerial decree from the Minister of Agriculture and Fisheries was issued on 24th October, forbidding the importation of endangered species or products made from them unless a special CITES import permit has been issued by the Ministry. The decree specifically singled out all species of bustards, including houbara. It also banned the import of all live falcons of species on the CITES list during the period from 1st September to 31st March.

Although this and other steps indicated that steps were under way to tighten up controls, the CITES mission decided that insufficient action had been taken.

Further study is now under way by the relevant authorities to ensure that the UAE is able to comply fully with the Convention, so that the suspension may be lifted. One move likely to be taken appears to be a transferral of responsibility for CITES matters from the Ministry of Agriculture to the Federal Environmental Agency, FEA, with authority then being devolved, where appropriate, to local Departments and Agencies.

One important step that can be taken is the implementation of seizures of imported wildlife brought to the country in contravention of international regulations.

Under the terms of the decree establishing Abu Dhabi's Environmental Research and Wildlife Development Agency, ERWDA, the Agency has the powers, in association with the police, to seize wildlife on sale in the local 'pet shops,' if the presence of individual species of animals is deemed to be in contravention of international agreements. Action by ERWDA to utilise these powers is likely to be one of the first indications of a tougher new Government line.

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تريبيلوس

جمعية الامارات للتاريخ الطبيعي

المجلد ١١،٢ خريف/ شتاء ٢٠٠١