

**Emirates Heritage
Volume One**

**Proceedings of the 1st Annual Symposium on
Recent Palaeontological
and
Archaeological
Discoveries in the Emirates
Al Ain, 2003**

Edited by Peter Hellyer and Dr. Michele Ziolkowski

**Published by the Zayed Center for Heritage and History,
PO Box 23888, Al Ain, United Arab Emirates**

Emirates Heritage – Volume One

Published by:

Zayed Center for Heritage and History
P.O. Box 23888
Al Ain, United Arab Emirates
E-mail: zc4hh@zayedcenter.org.ae

Edited by: Peter Hellyer and Dr. Michele Ziolkowski

Text: Copyright Zayed Center for Heritage and History and Chapter Authors,
Photographs, and Illustrations: Copyright Authors

Design: Genedine dela Fuente

Set in: Helvetica

Printed by: Al Ghurair Printing & Publishing House

Published: 2005

All rights reserved. No part of this book may be reproduced, stored in a retrieval system or transmitted in any form or by any means: electronic, mechanical, photocopying, recording or otherwise, without the written permission of the Editors, the Zayed Center for Heritage and History, and the individual Chapter Authors.

ISBN: 9948-06-130-6

Opinions expressed in this book do not necessarily reflect those of the Zayed Centre

A New Late Miocene Fossil Site in Ruwais, Western Region of Abu Dhabi, United Arab Emirates

Mark Beech and Will Higgs

Abstract

In April 2002, the Abu Dhabi Islands Archaeological Survey (ADIAS) undertook a survey of an area located near the junction of the Ghayathi road and the Tarif-Sila'a highway in the Western Region of Abu Dhabi emirate. The area surveyed is to be developed by Takreer, the oil refinery arm of the Abu Dhabi National Oil Company, for its new Central Environment Protection Facilities Project (BeAAT) in Ruwais. Following the recognition that an extensive quantity of fossil material was present on the surface of the site, a further, more detailed survey was undertaken, with the support of Takreer, in October 2002. A rich collection of fossil material was collected from the surface of a total of 62 localities across an area of approximately 2 sq.km. To date, around 7500 fossil fragments have been collected, many of which are large enough and sufficiently well preserved for identification of the animals. The fossils all originate from the upper part of the Baynunah Formation which dates to the Late Miocene, ca. 6-8 million years ago. At that time the Western Region of Abu Dhabi was a forested savannah area with slow-moving rivers, like today's East Africa.

Systematic collections of surface fossil material were made by ADIAS in October and November 2002. This work collected a variety of fossils ranging from bones from primitive ancestors of elephants and hippopotami, to ancient bovids/antelopes, three-toed horses (*Hipparion* sp.), crocodiles, turtles and fish. Several rich localities were noted which required more detailed examination. Subsequently excavations were conducted at a number of these localities in December 2002 and between February-March 2003. One of these sites (RW44) proved to contain a quite remarkable 2.54 metre long tusk from the primitive elephant species, *Stegotetabelodon syrticus*. The conservation and transportation of this tusk back to Abu Dhabi from Ruwais in December 2002 proved to be a major undertaking! Recent fieldwork carried out in February-March 2003 successfully retrieved a pair of *Stegotetabelodon* mandibles (RW13 and a partial mandible (RW57), as well as a second 1.94 metre long tusk, with skull and rib fragments in its close vicinity (RW48).

Although part of the fossil site area will still be developed by Takreer, a large part of the site, covering several square kilometres, will now be protected, thanks to collaboration between Takreer, ADIAS and the Environmental Research and Wildlife Development Agency (ERWDA).

Keywords

Stegotetabelodon syrticus, *Proboscidea*, Fossils, Late Miocene, Baynunah formation, Ruwais, Abu Dhabi, United Arab Emirates

Introduction

This paper outlines the recent work carried out by the Abu Dhabi Islands Archaeological Survey (ADIAS) on a newly discovered Late Miocene fossiliferous site located at Ruwais near the junction of the Ghayathi road and the Tarif-Sila'a highway in the Western Region of Abu Dhabi emirate. The area surveyed is to be developed by Takreer, the oil refinery arm of the Abu Dhabi National Oil Company, for its new Central Environment Protection Facilities Project (BeAAT). A rich collection of fossil material has now been collected from a combination of surface collections and excavation. A total of 62 fossil concentrations have been located across an area of approximately 2 sq.km. To date, around 7500 fossil fragments have been collected, many of which are large enough and well preserved for identification of the animals. The fossils all originate from the upper part of the Baynunah formation which dates to the Late Miocene, ca. 6-8 million years ago. At that time the Western Region of Abu Dhabi was a forested savannah area with slow-moving rivers, like today's East Africa.

Discovery of the Fossil site

An initial survey was carried out by ADIAS on the site of the TAKREER Ruwais Industrial Hazardous Waste Facility in April 2002 (Hellyer and Aspinall 2002). The team comprised Peter Hellyer (Executive Director of ADIAS), Simon Aspinall (Director of ADIAS Environmental Studies) and Dan Hull (Resident Archaeologist). This survey showed that the area just immediately south of the Tarif to Sila'a highway and east of the Ghayathi junction was an area of very considerable palaeontological significance. This initial survey documented a total of 19 fossil clusters (RW1-RW19).

An extensive spread of fossils was noted on the lower slopes of the *barqat* to the east of the area and on the slopes of areas of raised relief to the north-west of the area as well as in the core zone destined for the first phase of the TAKREER development. This landscape is the remains of a geological stratum dating to the Late Miocene period, ca. 6-8 million years ago.



Figure 1. Satellite map showing fossil localities at the Takreer Central Environment Protection Facilities Project (BeAAT) site in Ruwais. The red square marks the total projected area for the Takreer development. The blue square marks the projected area of the initial Takreer development scheduled for May 2003. The dark line represents the Ghayathi road. Note that this map does not show all the fossil sites recorded within the entire Takreer development area, only those within the NW part of the site.

Previous palaeontological studies in the general area have shown that the formation, which has been given the scientific name of the Baynunah Formation (Whybrow 1989), has the most significant assemblage of Late Miocene terrestrial vertebrate fauna anywhere in the Arabian peninsula (Whybrow and Hill 1999; cf. ADIAS Miocene fossil website: <http://www.adias-uae.com/fossils>). Fossils collected from the work conducted by Whybrow and Hill included the remains of acacia-like trees, gastropods and bivalves, fishes, turtles, crocodiles, birds, small mammals, monkey, hyaenids, saber-toothed cats, elephants, horses, rhinos, suids, hippos, giraffids and various types of antelope.

On 18th June 2002, a further brief visit to the site area was undertaken by Simon Aspinall and Dr. Mark Beech (ADIAS Senior Resident Archaeologist and Honorary Research Fellow, University of York). An inspection of previously identified sites was undertaken and a strategy for further survey work and excavation was discussed.

Following agreement by TAKREER to sponsor further Investigations and the obtaining from TAKREER of further information on plans for the area, the second phase of the survey took place on 28th and 29th October 2002, involving Simon Aspinall, Dr. Mark Beech and Ingrid Barcelo (Field Assistant, ADIAS). Survey work in October began at the north-west corner of the proposed area for development by TAKREER, near the sign marked "TAKREER – Abu Dhabi Oil Refining Company – BeAAT (Central Environment Protection Facilities) Project No. 3430" (location: N 24.08189, E 52.75806, datum WGS84). Transects were made by 4-wheel drive car across the initial area marked for development of the hazardous waste treatment plant. This was an area of 694 X 632 metres (0.44 square km). Regular stops were made to check all likely deposits for fossil remains. The survey team then walked around fossiliferous deposits collecting all visible fossil remains, with the exception of very small fragments which were unlikely to be identifiable to species. A further 19 fossil concentrations were discovered (RW20-RW38).

The third phase of survey at the core zone of the TAKREER site took place on 21st and 22nd November 2002. A number of rich fossil-bearing sites discovered during the October survey were re-visited to search for further fossil specimens for collection. Other areas not previously examined were also visited, inspection being undertaken by walking transects. An additional 22 fossil concentrations were discovered (RW39-60). This work was done by a team comprising Dr. Mark Beech, Peter Hellyer, Dr. Geoffrey King (Academic Director, ADIAS) and Ingrid Barcelo, with the help of volunteers from the Emirates Natural History Group, Abu Dhabi, as well as John Newby, Director, Terrestrial Environment Research Centre, TERC, of the Environmental Research and Wildlife Development Agency, ERWDA. During this work, a fossil specimen of major international importance was discovered at the locality named RW44. This was an almost complete tusk of a proboscidean, an extinct form of elephant.

The fourth phase of fieldwork on the site took place on 16th to 18th December 2002 (Beech and Hellyer 2002). This work involved preliminary conservation of and lifting of the elephant tusk in order to bring it back to the ADIAS/ERWDA storage facility near Maqta bridge in Abu Dhabi. The team for this work consisted of Dr. Mark Beech, Will Higgs (Honorary Research Fellow, Department of Archaeology, University of York, U.K.), Simon Aspinall and Sarah Wood (School of World Art and Museology, University of East Anglia, U.K.)

The fifth and final phase of fieldwork on the site took place between the 11th-20th March 2003. This work involved the excavation and removal of three remaining major clusters of fossil specimens, and their transportation to Abu Dhabi. The team for this work consisted of Dr. Mark Beech and Will Higgs.

Methods

The locations of all fossil deposits were recorded using a hand-held Garmin GPS 12XL. Coordinates were taken using decimal degrees and minutes latitude and longitude, the datum being WGS84. The fossil site locations were then superimposed on a satellite image of the area (Figure 1).

Fossil material collected from the surface was placed in plastic finds bags with a site code being assigned to each locality, i.e. RW1, RW2, etc. A GPS reading was then taken for each locality in the above-described format. Where significant fossil clusters occurred, i.e. rich concentrations of well preserved material and/or large specimens, these were temporarily marked by fixing a steel rod into the ground with red tape on it as a marker post.

Four particular locations were subjected to more detailed examination by excavation. Here all fossils were excavated stratigraphically. Notes, photographs and, where necessary, samples, were taken during the excavation to ensure maximum retention of data about the position and sedimentary environment of each specimen. A series of unique specimen numbers were allocated to each major fossil, each large piece within the surface scatter, and to each group of small fragments closely associated with a larger fossil.

Excavation normally proceeded in the following stages:

1. Location of a probable large fossil near the surface from the scatter of white fragments eroding on the surface.
2. Exposure of a small portion of the upper surface of the fossil by gentle brushing, followed by immediate consolidation of the exposed area. This normally allows tentative identification of the fossil and assessment of its quality and importance.
3. When a decision has been taken to excavate, the sediment layers are removed in stratigraphic order. Often it is necessary to clean an area around each fossil specimen to allow the excavator more room for working.
4. This operation leads to the fossil being exposed so that it eventually stands on a pedestal of sediment. The excavator then carefully exposes one side of the fossil, constantly consolidating exposed parts and supporting sediment until it is clear that the full depth of the bone has been exposed and partially undermined.
5. The fossil is then wrapped in conservation grade acid-free tissue paper, followed by aluminium foil, before a coating of gypsum plaster or two-part expanding polyurethane foam is applied to provide rigidity and protection. The same process is carried out along the other side to complete the protective coat before removal.

Miocene fossils in the Baynunah Formation of Abu Dhabi are nearly always extremely fragile, probably due to weathering and salt crystallisation during their sojourn near the desert surface. Consequently, it is necessary to excavate them with great care, immediately consolidating any exposed pieces and also consolidating surrounding sediment attached to the fossil with acrylic resin solution (Paraloid B72) diluted in acetone. This is normally applied in a concentration of about 5%. Subsequently this consolidant may be removed by reversing the process through the application of more acetone.

The Fossils

The seven and a half thousand fossils collected from the surface of the Ruwais site await detailed analysis and identification. A preliminary catalogue of the material was completed late in 2003 (Stewart 2003). The fauna represented is broadly similar to that discovered earlier by Whybrow and Hill (1999) at a number of other Late Miocene fossil localities in the Western Region of Abu Dhabi. Table 1 details a provisional list of the taxa which have been identified to date within this material. It should be noted that this is a provisional list and will almost certainly be subject to alteration once the full analysis has been completed of the assemblage. This can only be done at some future date in conjunction with specialists on the particular organisms in question.

The remains of fossil wood were found at a number of sites including a major cluster at site RW48 (see below). Molluscs are represented by two types of bivalves including a member of the swan mussel family, *Unionidae*. The fish remains include at least two species of catfish. At least three species of turtle and two species of crocodile are present. Fragments of ostrich eggshell, as well as two bird bones of indeterminate family were also noted. Mammalian remains include the remains of the proboscoid, *Stegotrabelodon syrticus*, as well as possibly a second as yet undetermined proboscoid. A number of fossil specimens belonged to *Hipparion* sp., the primitive three-toed horse. Artiodactyls noted in this initial examination of the Ruwais fossil material included suids, hippo (*Hexaprotodon* aff. *sahabiensis*) and several types of antelope.

Plantae	Leguminosae	<i>?Acacia</i> sp.
Mollusca	Bivalvia	
	Mutelidae	<i>Mutela</i> (?subgen. nov. aff. <i>Chelidonopsis</i>) sp.
	Unionidae	<i>Leguminaia</i> (<i>Leguminaia</i>) sp.
Pisces	Siluriformes	
	Clariidae	<i>Clarias</i> sp.
	Bagridae	<i>Bagrus shuwaiensis</i> Forey and Young, 1999
Reptilia	Chelonia	
	Trionychidae	<i>Trionyx</i> s.l. sp.
	Testudinidae	cf. <i>Mauremys</i> sp. <i>Geochelone</i> (<i>Centrochelys</i>) aff. <i>sulcata</i>
	Crocodylia	
	Crocodylidae	<i>Crocodylus</i> sp.
	Gavialidae	gen. et sp. indet.
Aves	Struthionidae	<i>Struthio</i> sp.
	Family indet.	gen. et sp. indet.
Mammalia	Proboscidea	
	Elephantidae	<i>Stegotetralodon syrticus</i>
	Family indet.	gen. et sp. indet.
	Perissodactyla	
	Equidae	<i>Hipparion</i> sp.
	Artiodactyla	
	Suidae	gen. et sp. indet.
	Hippopotamidae	<i>Hexaprotodon</i> aff. <i>sahabiensis</i>
	Bovidae	gen. et sp. indet.

Table 1. Provisional list of taxa identified at Ruwais.

Fossil Excavations

Four excavations were carried out where there were significant fossil specimens or dense clusters of well-preserved fossil material (Table 2).

Site Code	Location	Description
RW13	N 24.06964 E 52.76328	pair of mandibles from <i>Stegotrabelodon syrticus</i> .
RW44	N 24.07931 E 52.76452	a 2.54 metre long <i>Stegotrabelodon syrticus</i> tusk.
RW48	N 24.07886 E 52.76119	a cluster of <i>Stegotrabelodon syrticus</i> bones, which included a 1.94 metre long tusk, an incomplete cranium, a mandible fragment with associated tusk cast fragments, very fragmentary remains of two other tusks, one complete rib and four large rib fragments.
RW57	N 24.08010 E 52.76071	<i>Stegotrabelodon syrticus</i> mandible.

Table 2. Location and brief description of the four fossil site excavations

Excavation trenches were first delineated around each of the fossil clusters. These were oriented north-south/east-west, the GPS co-ordinates being recorded for the corners of each trench using decimal degrees and minutes latitude and longitude, the datum being WGS84. A temporary site datum for measuring the relative altitude of the fossil sites was established in each case (see below).

RW13 – the *Stegotrabelodon syrticus* mandibles

Site RW13 is located to the south of the main core development area. The site was first noted by the ADIAS team in April 2002. Initially it was thought that a scatter of loose teeth fragments associated with a large metre long “figure of eight” shaped bone was a “hippo” (*Hexaprotodon* aff. *sahabiensis*) skull. Excavation carried out by the two authors subsequently proved otherwise (see below). A 3 x 3 metre sized trench was established at RW13 in March 2003. The GPS co-ordinates and relative heights of the corners of the trench were as follows:

- N 24.06957, E 52.76322 (NW corner, height = 99.88 metres)
- N 24.06958, E 52.76321 (NE corner, height = 99.88 metres)
- N 24.06961, E 52.76323 (SE corner, height = 99.81 metres)
- N 24.06961, E 52.76322 (SW corner, height = 99.81 metres)



Figure 2. The *Stegotrabelodon syrticus* mandibles from site RW13.

A site elevation datum level was established for RW13, a blue arrow and line being sprayed onto the northern leg of a nearby electricity pylon (location: N 24.06735, E 52.76013). This blue arrow was at the same height as a row of two rivets, ca. 1 metre below the barbed wire preventing access up the pylon. This pylon is located at a bearing of 229 degrees from RW13 at a distance of 410 metres. This benchmark level is now designated as 100 metres (N.B. this is not the actual height above sea level, but is simply a value attributed for local mapping purposes).

A temporary local site datum was established at N 24.06917, E 52.76290. A steel pole embedded in the ground was spray-painted blue and two large stones were placed next to it. This is located 60 metres from RW13 at a bearing of 211 degrees. This temporary site datum level is at a height of 99.49 metres.

The "hippopotamus skull" turned out to be a nearly complete pair of elephant mandibles, with traces of their lower tusks *in situ* (Figures 2-3). These specimens were successfully lifted, using the polyurethane foam method described above. They will require future careful conservation and cleaning before they are suitable for display. Preliminary examination suggests that they belong to *Stegotrabelodon syrticus*. They are very similar in appearance to the earlier specimens collected by the team led by Whybrow and Hill team from Shuwaihat site S6 (Tassy 1999; Whybrow and Hill 1999).

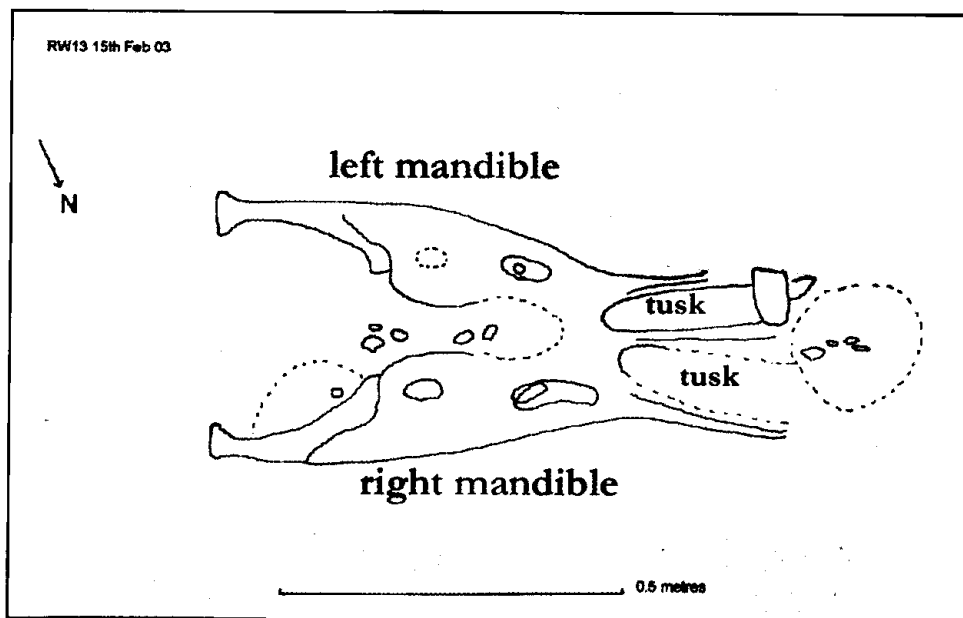


Figure 3. Plan of the *Stegotrabelodon syrticus* mandibles from site RW13.

RW44 – the big *Stegotrabelodon syrticus* tusk

Site RW44 was first noted by the ADIAS team in April 2002. An elongated spread of small bone fragments was noted which was assumed to be part of a large elephant limb bone (Figure 4). This site was further briefly investigated in November 2002, when it was discovered that the specimen was actually an almost complete tusk of *Stegotrabelodon syrticus*. This measured 2.54 metres from tip to base (Figure 5). After its initial discovery, the decision was made to rebury it so that a team could return at a later date with the necessary equipment for its safe excavation and conservation.

This subsequently took place in December 2002. Careful excavation followed by consolidation of the tusk and its underlying sediments using Paraloid B72 was carried out. This left the tusk standing on a pedestal of sediment. A series of small holes was then drilled into the



Figure 4. View of site RW44 prior to excavation.

sides of this pedestal, plastic pipettes being used to try and inject the Paraloid into the underlying sediments. A special steel and timber frame was pre-designed and assembled in Abu Dhabi, with the assistance of Kelly Brookes (Abu Dhabi Aviation). This was placed over the tusk so that it was surrounded by the frame. A series of adjacent timber planks were then placed under the tusk, which were then fixed to the timber frame, as each section of the underlying sediment was excavated (Figure 6). Additional support for the tusk was initially provided by plaster of Paris on either side of the tusk. Subsequently plaster was abandoned as it set too quickly and did not successfully flow under the tusk, leaving the middle part of the tusk weak and unsupported. Two-part expanding polyurethane foam proved to be far more successful and easy to manipulate. Pieces of cardboard wedged parallel to each side of the tusk helped to direct the foam around and under the tusk. The final result was that the tusk was completely encased in foam, which rested on its timber and steel frame (Figure 7).

A large vehicle with a crane for the lifting and subsequent transport of the tusk back to Abu Dhabi was kindly provided courtesy of Takreer, via CleanCo Trading, Importing and Services Est., Ruwais (Figure 8). Wheels were then bolted onto the underneath of the frame supporting the tusk, once it arrived in Abu Dhabi, so that it could more readily be transported, as it was estimated that the tusk and platform weighed in excess of 500 kg.



Figure 5. Site RW44 - the big *Stegotetrabelodon syrticus* tusk uncovered.

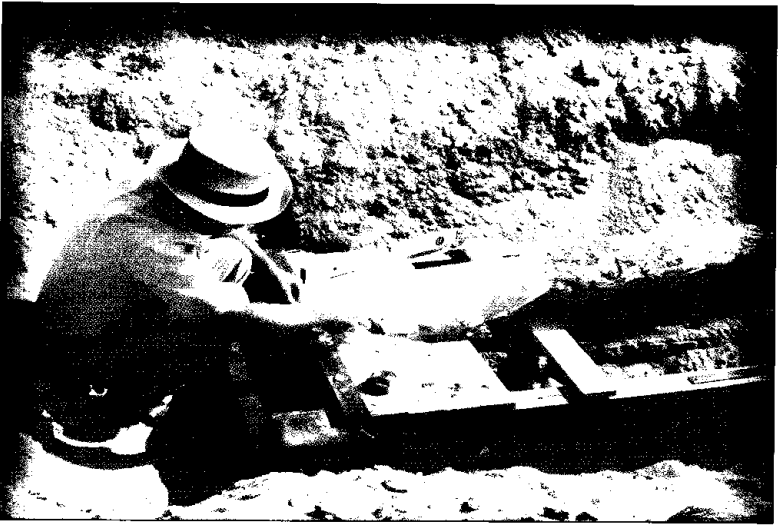


Figure 6. Site RW44 - during the excavation of the *Stegotrabelodon syrticus* tusk. Note the special timber and steel frame.

In late February 2003, the tusk was subsequently removed from its foam jacket, cleaned and consolidated further, but was left sitting on its underlying timber and steel trolley. Jesmonite resin was then used to strengthen and support the tusk, and further cosmetic work was carried out to repair fragile sections of the tusk (Larkin 2003; Figure 9).

Preliminary investigations suggest that the tusk appears to be an upper tusk from a *Stegotrabelodon syrticus*. A much smaller fragment of a right upper tusk (specimen AUH502) of this species was collected by the Whybrow and Hill team from Shuwaihat site S6 (Tassy 1999; Whybrow and Hill 1999). More research is required, however, on all the Ruwais proboscidean material in collaboration with external specialists, as some of the specimens collected may belong to another as yet undetermined species of Miocene elephant.



Figure 7. Site RW44 - the tusk encased in its polyurethane foam jacket on its platform.

RW48 – “Elephant Hill” (formerly known as “Bicycle Hill”)

Site RW48 was discovered by ADIAS during the survey carried out in late November 2002. An old abandoned rusty bicycle lay on the surface of a mound adjacent to what appeared to be a large scatter of elephant bones. Large fossil fragments were eroding out of the surface and sides of the mound. The site was originally given the nickname “Bicycle Hill”, although it was renamed “Elephant Hill” after excavations were initiated.

A trench 9 x 7 metres was established at RW48. The GPS co-ordinates of the corners of the trench were as follows:

N 24.07886, E 52.76119 (NW corner, height = 99.35 metres)
N 24.07890, E 52.76124 (NE corner, height = 99.37 metres)
N 24.07885, E 52.76129 (SE corner, height = 97.32 metres)
N 24.07881, E 52.76123 (SW corner, height = 98.80 metres)

A temporary local site datum level was established at GPS co-ordinates N 24.07865, E 52.76120. This is located SE of the trench at a bearing of 332 degrees from the left side of the power station, and at a bearing of 82 degrees from the Etisalat tower (N.B. from this datum level it was also possible to survey the level of the large elephant tusk at site RW44 excavated in December 2002. The heights of the corners of the trench at RW44 were as follows: NW corner = 98.16 metres, NE corner = 98.36 metres, SE corner = 98.16 metres, and SW corner = 97.96 metres).



Figure 8. Site RW44 – lifting the tusk with the crane.

Subsequently, a fence was erected to enclose site RW48. This consisted of angle iron embedded a metre or so into the ground at ca. 2 metre intervals around the fossil concentration. Yellow and orange nylon rope was then tied around the circuit of angle iron fence-posts to delineate the work area. GPS co-ordinates for a number of points along the perimeter of this fence are as follows:

N 24.07889, E 52.76113
N 24.07896, E 52.76118
N 24.07901, E 52.76128
N 24.07897, E 52.76132
N 24.07890, E 52.76130
N 24.07879, E 52.76126
N 24.07871, E 52.76122
N 24.07875, E 52.76120
N 24.07886, E 52.76117
N 24.07893, E 52.76116

At RW48, detailed mapping of the surface fossil material was undertaken (Figure 10). This mapping continued during the cleaning and subsequent excavation of the sub-surface fragments. The site consisted primarily of a varied collection of proboscoid fossils. The following specimens were identified:

- a) An incomplete cranium (See Fig.10, spec. no. 15-17, 29, 50-51).
- b) A fragment of mandible with associated tusk cast fragments including a cross-section (spec. no. 5 and 36). This resembled the *Stegotrabelodon syrticus* specimens from RW13.
- c) A 1.94cm long tusk (spec. no. 3). The tip of this was oriented WSW, the base ENE. This tusk is very similar to that excavated at RW44 in December 2002, however the tusk from RW48 has a much better preserved tip (Figure 11). The base end of the tusk contained a grey stone cast, which is very similar in appearance to the tusk excavated at RW44. This important specimen will require careful conservation prior to being displayed.
- d) Very fragmentary remains of two other tusks (specimen numbers 39 and 46).
- e) One large complete rib (spec. no. 45) and four large rib fragments (spec. no. 4, 27, 33 and 40) (Figure 12).



Figure 9. The *Stegotrabelodon syrticus* tusk after receiving conservation.

An interesting discovery at RW48 was a stone cast (fossil) of a freshwater bivalve (spec. no. 52). This was located resting up against the NE end of an elephant rib fragment (spec. no. 33). This cast belongs to a swan mussel, *Unionidae* (Figure 13). Such shells can only live in running freshwater, providing evidence that the deposits here were laid down by flowing water, i.e. a river.

A large cluster of fossil wood was found just ten metres to the north of the main cluster of fossils. This appeared to be a disintegrated trunk of an acacia-like tree.

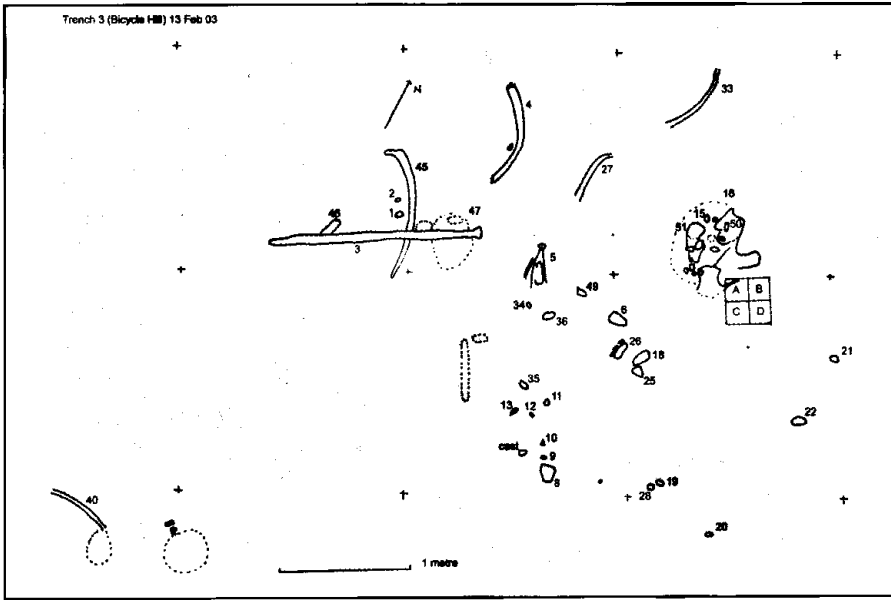


Figure 10. Plan of the distribution of fossils at site RW48.



Figure 11. Takreer staff Mohammed Yabhouni and Sulaiman Daoud Al Siksek discuss with Will Higgs (ADIAS) the 1.94cm long *Stegotetralodon syrticus* tusk at site RW48.

RW57 - the *Stegotrabeladon syrticus* mandible

Site RW57 was discovered by ADIAS during the work carried out in November 2002. It is located about 300 metres north of RW48. A cluster of elephant bone fragments was excavated from RW56 which was immediately adjacent to RW57. Site RW57 consisted of a partially complete elephant mandible. When it was first discovered, the decision was made to re-bury the specimen until adequate equipment and conservation chemicals could be acquired for its safe retrieval. This subsequently took place in March 2003, when a trench 9 x 3 metres was established at the site. The GPS co-ordinates of the corners of the trench were as follows:

N 24.08009, E 52.76067 (NW corner, height = 99.89 metres)

N 24.08011, E 52.76075 (NE corner, height = 99.87 metres)

N 24.08008, E 52.76075 (SE corner, height = 99.80 metres)

N 24.08006, E 52.76067 (SW corner, height = 99.86 metres)

(N.B. The height levels at this site were tied into the temporary local site datum level for RW48.)

At RW57, the elephant mandible fragment (Figure 14) was excavated and successfully removed. No other fossils were found in its immediate proximity.



Figure 12. Excavation of the elephant ribs at site RW48.

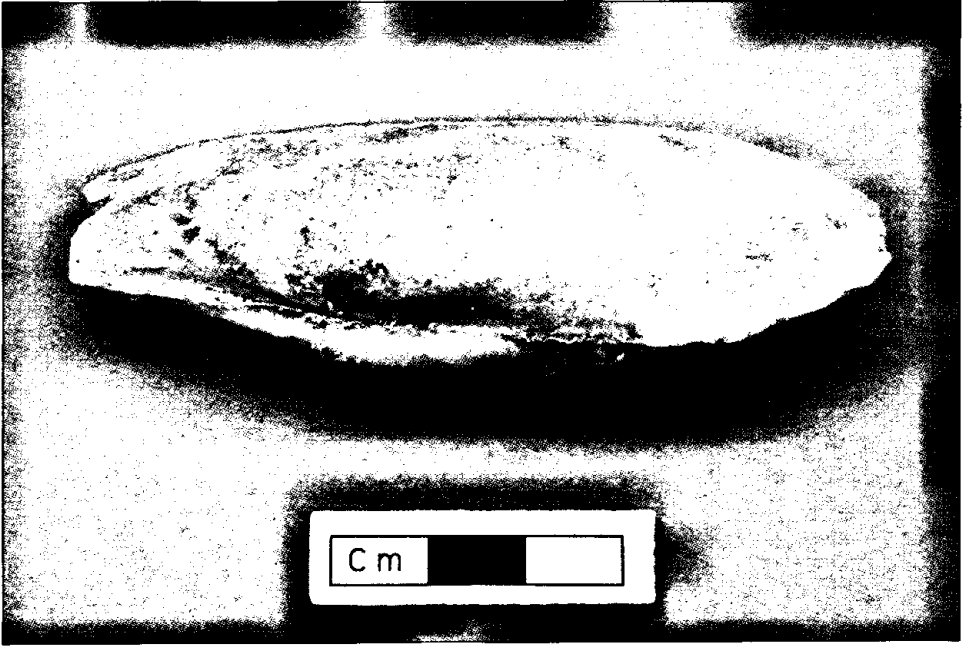


Figure 13. Stone cast of a swan mussel, a freshwater bivalve, *Unionidae*.



Figure 14. *Stegotetabelodon syrticus* mandible fragment from site RW57 (Scale: 0.5m intervals).

Concluding Statements and Recommendations

All the visible surface fossils have now been removed by ADIAS from within the core development area of the Takreer BeAAT project. Fossils recovered from the Ruwais sites are now stored in the ADIAS laboratories at Maqta in Abu Dhabi. The following recommendations are made concerning this important collection:

(1) Conservation – The large 2.54 metre long elephant tusk from site RW44, collected in December 2002, has already been carefully restored and prepared for display in February 2003 by Nigel Larkin, a palaeontological conservator from the UK. In October 2003 Nigel returned to Abu Dhabi and completed the stabilisation and preparation of the elephant mandibles from sites RW13 and RW57, and also the 1.94 metre long tusk from site RW48. The elephant ribs from site RW48 are all still encased in polyurethane foam jackets. These will need to be carefully removed and the specimens will require further chemical treatment to stabilise them prior to them being handled for further study or display.

(2) Catalogue/Database - There are around 7500 fossil specimens which have been collected from the Ruwais site. It is necessary to undertake a detailed examination of each piece so they can be properly identified and recorded in detail. A preliminary catalogue of the fossil specimens was completed late in 2003 (Stewart 2003). Further more detailed work is however required in collaboration with suitable specialists to finalise the identification of much of this material.

(3) Research and Publication - Further research is required, particularly on the new proboscoid remains uncovered at the Ruwais site. This would be best done in collaboration with an acknowledged expert on the palaeontology of Miocene proboscoids. It is hoped that Dr William Sanders of the Museum of Paleontology from the University of Michigan, U.S.A, will visit Abu Dhabi at some future date to undertake such a study in collaboration with the first author.

Investigations of the recently discovered proboscidean trackways at Mleisa, less than 70km from the fossil site may also prove to be worthwhile in providing further detailed information about Late Miocene proboscoids and their typical behaviour (Higgs *et al.* 2003; Kirkham *et al.* 2003). Further fieldwork and mapping of these sites is planned for late 2004.

(4) Display – In May 2005 a permanent display of the fossils from the Ruwais site, as well as of some of the Miocene fossils collected by Whybrow and Hill, will go on permanent display in the foyer of the Environmental Research and Wildlife Development Agency (ERWDA) building in Abu Dhabi. This display will be co-sponsored by TAKREER, ADIAS and ERWDA, as well as by ADCO, who funded the earlier research on Western Region fossils in the 1990s, and BP.

Within the display there will be a scale model of the late Miocene elephant *Stegotetralodon syrticus*. This has been created by Abdul Hafeez from the Private Department of H.H. the President.

Acknowledgements

Special thanks go from ADIAS to TAKREER for their continued support for this work. The personal interest and support of members of TAKREER Management, including, in particular, General Manager Ali Saeed al-Badi and Engineering and Projects Division Manager Ali Abdalla Abdelrazaq Al Fahim, has been of very great value. Day to day liaison has been undertaken with Ali Ismail Azzam (Projects Procurement Services Department Manager), Malcolm Bramfitt (Senior Procurement Engineer, Project Procurement Services Department), and Mohammed M. Al Sayyed (Administration Co-ordinator, Major Projects Division).

During the second major phase of the fieldwork (28th-29th October 2002), a 4-wheel drive vehicle was kindly loaned to the field team by H.E. Sheikh Nahyan bin Mubarak Al Nahyan, Minister of Higher Education and Scientific Research.

We would also like to thank the following volunteers from the Emirates Natural History Group, Abu Dhabi, for assisting us during the third phase of fieldwork (21st & 22nd November 2002): Kelly Brookes, Karen Cooper and Marc Dyer. Also providing help during this phase were Dr. Drew Gardner (Department of Natural and Quantitative Sciences, Zayed University), John Newby (Director, Terrestrial Environment Research Centre, Environmental Research and Wildlife Development Agency, ERWDA) and Mouna Newby.

The fourth phase of fieldwork when the elephant tusk was conserved, lifted and transported back to Abu Dhabi, was undertaken with the assistance of a number of organisations and individuals. Special thanks go to the following staff of TAKREER: Ali Ismail Azzam (Projects Procurement Services Department Manager) and to Malcolm Bramfitt (Senior Procurement Engineer, Project Procurement Services Department) for their valuable help with logistics and co-ordination. Mohammed M. Al-Sayyed (Administration Co-ordinator, Major Projects Division) assisted with the provision of an ADNOC Toyota Land Cruiser for the 16th –18th December 2002 fieldwork.

James N. Varghese (CleanCo Trading, Importing and Services Est., Ruwais) provided a large vehicle with a crane for the lifting and subsequent transport of the tusk back to Abu Dhabi. Kelly Brookes (Abu Dhabi Aviation) proved to be an invaluable assistant in the construction and purchase of all the equipment required for the safe lifting and transport of the elephant tusk back to Abu Dhabi. His detailed knowledge of Mussafah and its various engineering and carpentry workshops was of tremendous help to the ADIAS team.

Mohammed M. Al-Sayyed (Administration Co-ordinator, Major Projects Division) assisted with the provision of an ADNOC Toyota Land Cruiser for the 11th-20th March 2003 fieldwork. Valuable field assistance was also provided by Dr. Drew Gardner (Zayed University, Abu Dhabi). Initial cataloguing and quantification of the Ruwais fossil remains was undertaken by Dr. Mark Beech, with assistance from Ingrid Barcelo and Mohammed Hasan.

Authors' addresses:

Dr. Mark Beech, Abu Dhabi Islands Archaeological Survey, P.O. Box 45553, Abu Dhabi, UAE.
Email: adias@erwda.gov.ae

Will Higgs, Department of Archaeological Sciences, University of Bradford, West Yorkshire, BD7 1DP, UK.
Email: will@willhiggs.co.uk

References

Abu Dhabi Islands Archaeological Survey (ADIAS) Miocene fossil website
URL: <http://www.adias-uae.com/fossils>

Beech, M. and Hellyer, P. (2002). "Fossils Research at Ruwais. Report submitted to Takreer on 31st December 2002." Unpublished ADIAS report.

Higgs, W., Beech, M. and Gardner, A. (2004). "A Fossil Proboscidean Trackway at Mleisa, Western Region of Abu Dhabi, United Arab Emirates." In: P. Hellyer and M.C. Ziolkowski (eds.), *Emirates Cultural Heritage, Vol 1*. Zayed Centre for Heritage & History: Al Ain.

Hellyer, P. and Aspinall, S. (2002). "Ruwais Industrial Hazardous Waste Facility – Environmental Study (Archaeology, Palaeontology and Ecology) – April 2002." Unpublished ADIAS report.

Higgs, W., Kirkham, A., Evans, G. and Hull, D. (2003). "A Late Miocene Proboscidean Trackway from Mleisa, United Arab Emirates." *Tribulus* 13/2: 3-8.

Larkin, N. (2003). "Report on the conservation of a large *Stegotetralodon syrticus* tusk from the Ruwais area of Abu Dhabi." Unpublished ADIAS report.

Stewart, J.R. (2003). "Report on the Abu Dhabi Miocene Fossil Database."
Unpublished ADIAS report.

Tassy, P. (1999). "Miocene elephantids (Mammalia) from the Emirate of Abu Dhabi, United Arab Emirates: palaeobiogeographic implications." Chapter 18, Pages 209-233, In: P.J. Whybrow and A. Hill, *Fossil Vertebrates of Arabia*. Yale University Press: New Haven and London.

Whybrow, P.J. (1989). "New stratotype; the Baynunah Formation (Late Miocene), United Arab Emirates: lithology and palaeontology." *Newsletters on Stratigraphy* 21: 1–9.

Whybrow, P.J. and Hill, A. (1999). *Fossil Vertebrates of Arabia – With Emphasis on the Late Miocene Faunas, Geology, and Palaeoenvironments of the Emirate of Abu Dhabi, United Arab Emirates*. Yale University Press: New Haven and London.