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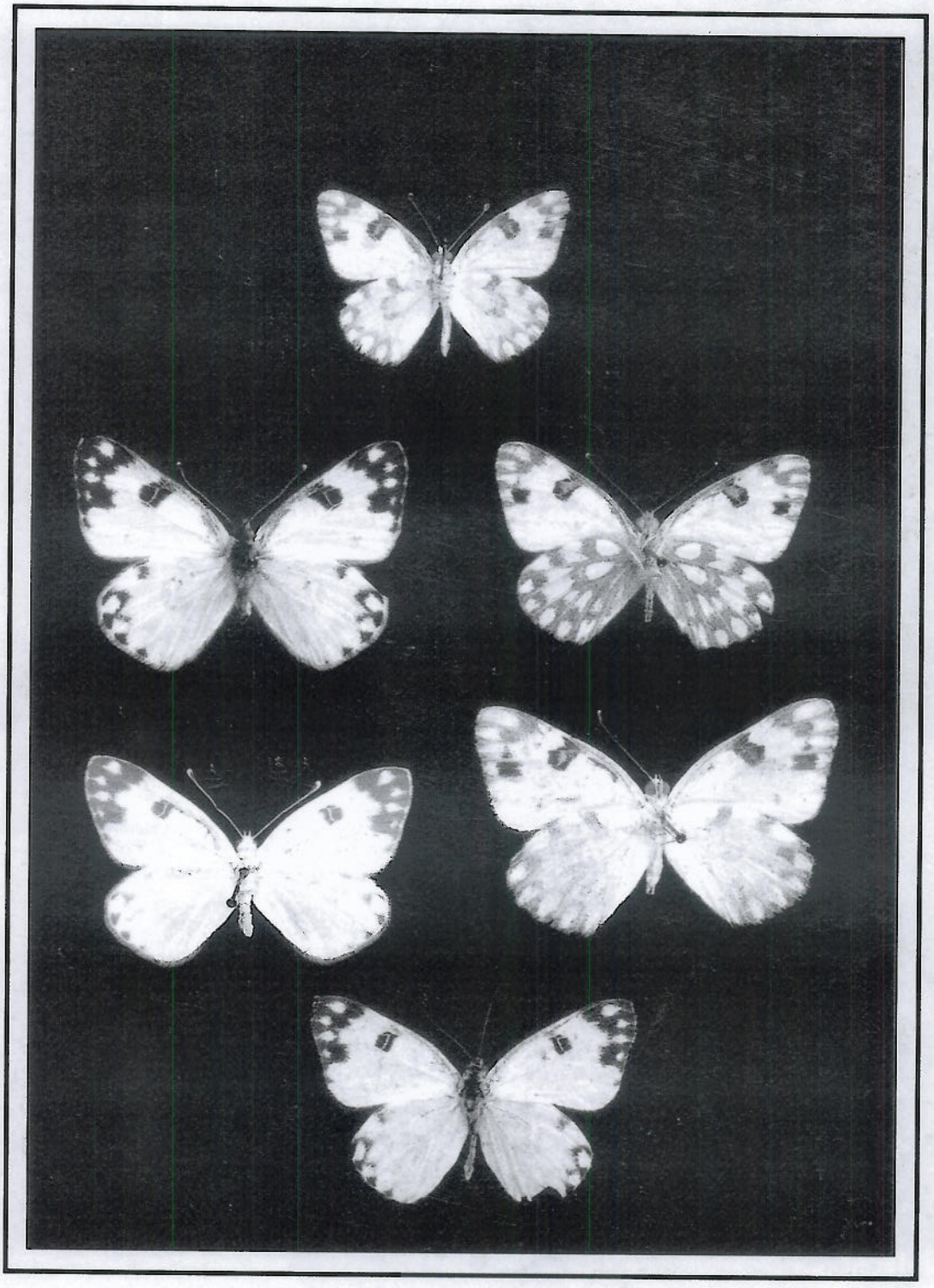

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Freshwater Snails of the UAE

by Gary R. Feulner and Stephen A. Green

Abstract

This paper lists the freshwater snails confirmed to occur in the United Arab Emirates, including the native species **Melanoides tuberculata, Lymnaea natalensis, Gyraulus piscinarum** and **Bulinus wrighti,** and the more probably introduced species **Thiara scabra, Physa cf. acuta** and **Biomphalaria arabica.** Brief descriptions are given for the benefit of non-specialists, along with photographs and salient basic information.

Seven species of freshwater snails have so far been recognised in the UAE. Of these, two are common, but the other five have been observed and positively identified only within the past year. At least four species appear to be well established residents of UAE mountain wadis, where they seem to have adjusted to the overall aridity and the instability of the freshwater environments there. The others have been found infrequently and only in association with agriculture or in other artificial environments and are, therefore, thought likely to be more recent arrivals introduced by man. In most cases the different species are easy to distinguish, as shown by the accompanying photographs.

Native Species

Melanoides tuberculata (Muller, 1774)

The shell of Melanoides tuberculata (Family Thiaridae, Fig. 1a) is a long, narrow cone with a relatively small aperture that can be sealed by the snail with a separate lid (properly called an operculum). Successive spirals increase gradually in width and the surface varies from relatively smooth to moderately ribbed and grooved. The colour is pale to medium brown with a pattern of intermittent darker red-brown longitudinal stripes that is usually not very pronounced. The shell is fairly sturdy. Specimens as large as 35 mm in length have been observed, but a length of c.20 mm is more typical.

M. tuberculata is generally considered to be the most common freshwater snail in Arabia [3,4,6,10], and this appears true of the UAE as well. It feeds on algae and detritus and is typically found in relatively still, shallow water in small pools, where it can be found on rock, gravel, sand, in layers of organic detritus, or on algae. It can also be found in flowing streams and falaj channels. In fact it can often be found in falaj systems even though it is not in evidence in the associated wadis.

M. tuberculata has a widespread Old World tropical and subtropical distribution including southern Europe, Africa and the Indo-Pacific region [3]. It is viviparous (live-bearing) and reproduces primarily asexually by parthenogenesis, which facilitates rapid dissemination. It is tolerant of salinity and can be found in brackish water, khors or estuaries [3,5], but is said to be intolerant of prolonged desiccation [6].

Lymnaea natalensis (Krauss, 1848)

The shell of Lymnaea natalensis (Family Lymnaeidae, Fig.1b) is dominated by the large, bulbous final chamber, which has a correspondingly large aperture. It normally appears a uniform pale to dark brown in life, but occasional specimens show light or dark spots. The colour is actually that of the mantle within, and empty shells are seen to be translucent and relatively fragile. The largest may reach 25 mm, but typical specimens are c.15 mm.

L. natalensis ranks as the second most common freshwater snail in the UAE. Like M. tuberculata, it is typically found in still, shallow water in small pools. Despite the substantial differences in the form of these two species it is generally difficult to discern any consistent differences in their preferred habitats. In the falaj environment, however, L. natalensis has frequently been found at or just above the waterline on damp substrate, and only L. natalensis has so far been observed on underwater vegetation other than algae, or in situations in which any part of the shell was emergent. It is not uncommon to find both M. tuberculata and L. natalensis in the same pool or falaj, although one or the other is typically more abundant. Both may be present in numbers greater than commonly recognised. One of the authors (GRF) once witnessed a heavy shower over Wadi Asfani and its tributaries, after which the resulting muddy spate was found to carry sizeable numbers of floating shells (dead) of both species among its flotsam.

L. natalensis is an aquatic pulmonate snail, i.e., it belongs to the primarily aquatic branch (Basommatophora) of the group of snails called Pulmonata, whose members have a sort of air breathing lung rather than gills, lack an operculum, and are typically specialised for either freshwater or terrestrial environments. Aquatic pulmonates are hermaphroditic and lay their eggs in a firm, clear gelatinous mass deposited on rocks or foliage [7,8]. Small linear masses of this sort can sometimes be seen on the underside of rocks in wadi pools in the UAE and in most cases are believed to be eggs of L. natalensis. Of the remaining freshwater snails reported below from the UAE, all except Thiara scabra are also aquatic pulmonates.

The genus Lymnaea is widespread and diversified in freshwater environments worldwide [7,10]. The proper taxonomic classification and the resulting nomenclature for the Lymnaea species (or subspecies or morph) found in the UAE and northern Oman has been the subject of disagreement. The morphology of shells from the Hajar Mountains is consistently somewhat thinner and more high-spired than the norm for either the Palearctic, L. auricularia, which is known from Saudi Arabia, or the pan-African L. natalensis [3,4,10]. As a result the name L. arabica (Smith, 1894) has sometimes been applied to specimens from the UAE and Oman [4,10].

The use of the name L. natalensis in this paper is not intended to express a definitive position on the question of taxonomy. Instead, it follows the usage of Brown and Gallagher [3], on the basis that the dimensions of UAE specimens collected by the authors fall within the range of bivariate dimensional ratios reported by Brown and Gallagher for their specimens from Oman, which they declined to distinguish from L. natalensis, and do not exhibit the extreme ratios of the type specimens of the so-called L. arabica series.

Gyraulus piscinarum (Bourguignat, 1852)

This tiny ramshorn snail (Family Planorbidae, Fig.1d) was first noticed and reported by one of the authors (SAG) in April 1998 in a rocky wadi near the town of Hatta. Specimens were collected and sent to The Natural History Museum, formerly the British Museum (Natural History), where Dr. David Brown kindly provided identification. The shell has the general form called a "ramshorn," i.e., a flat, disc-shaped spiral, resembling a coil of rope. However, in contrast to most of the more common European ramshorns, the aperture is slightly off

centre opening very obliquely to the direction of coiling, not perpendicularly, and the shell is not carried erect, but more horizontally. In life the snail appears dark brown, but the shell is actually a pale translucent brown and the darker colour is that of the animal within. Air spaces created as the body moves within the shell may give the superficial impression of golden streaks on the final whorl.

G. piscinarum was locally common in the wadi in which it was first observed in the UAE and has proved to be present in other wadis as well, including Wadi Maydaq, near Masafi, and Wadi Shi and Wadi Safad on the East Coast. It appears to be widespread. It may have heretofore escaped notice partly because of its small size and its habitat. The largest so far encountered is only 4.5 mm in diameter, most specimens being no more than 3 mm. In the wadi in which it was first seen, specimens were found only in isolated, still, shallow pools within the rocky wadi, never in pools constituting the main channel. Moreover, those specimens and others found since were normally found only on the underside of larger stream cobbles. This may not be their primary habitat, however. Instead the snail may be nocturnal, simply retiring during daylight hours. This possibility is considered likely, following observation at sunset when several specimens were seen on top of small stones in a likely pool. M. tuberculata and L. natalensis are also found in all of the wadis in which G. piscinarum has been found, but the relative abundance of the three varies widely. In a few instances all three species were found to share the same pool.

Brown and Wright [4] reported unpublished observations by I.S.Alio dating from 1967 of G. convexiusculus in "interrupted perennial streams" in the Manama-Masafi area of what was then Trucial Oman. The genus Gyraulus includes a complex of closely related forms in Arabia and the Levant [4], and, in view of the current authors' observations, it seems probable that these early reports record what is now recognised as G. piscinarum. The previously reported range of G. piscinarum is northern Oman, Lebanon and Turkey [3], but this seems almost certain to be a result of incomplete observation and/or identification.

All of the foregoing species, M. tuberculata, L. natalensis and G. piscinarum, are found in association with archaeological remains at the site of the Dilmun Temple at Saar, in Bahrain (c. 1700-2200 B.C.), attesting to their relative antiquity in the region [5].

Bulinus wrighti (Mandahl-Barth, 1965)

Bulinus wrighti (Family Planorbidae, Fig.1c) is endemic to central and southern Arabia and has previously been reported from wadis of the Jebel Akhdar region of northern Oman [3,4,10]. The genus Bulinus is a potential intermediate host for the blood fluke parasite that causes bilharzia (schistosomiasis) in humans and B. wrighti is known to play this role in southern Yemen [3,10]. Studies at The Natural History Museum and elsewhere suggest that B. wrighti may be among the most archaic members of the genus Bulinus, since, unlike many of its congeners, it appears to be compatible with all species of schistosome belonging to the S. haematobium group [3,9].

B. wrighti was observed and specimens were collected and tentatively identified by one of the authors (GRF) in March 1997 from Wadi al-Ramthah in the area north of Mahdhah, Oman. Additional specimens were collected by the authors in May and November 1998 for identification, which was confirmed by Dr. David Brown, and for ongoing research use at The Natural History Museum. Subsequent exploration demonstrated the presence of B. wrighti in the UAE as well, in a tributary of Wadi Diftah near Masafi.

The shell of B. wrighti is small (maximum 10 mm), and its colour is a translucent pale blue-grey with dark grey apical whorls. It appears dark grey overall when the animal is alive within. Perhaps most distinctively, the shell is sinistral or left-handed[4] (i.e., the shell spirals in a counter-clockwise direction along the axis of coiling, so

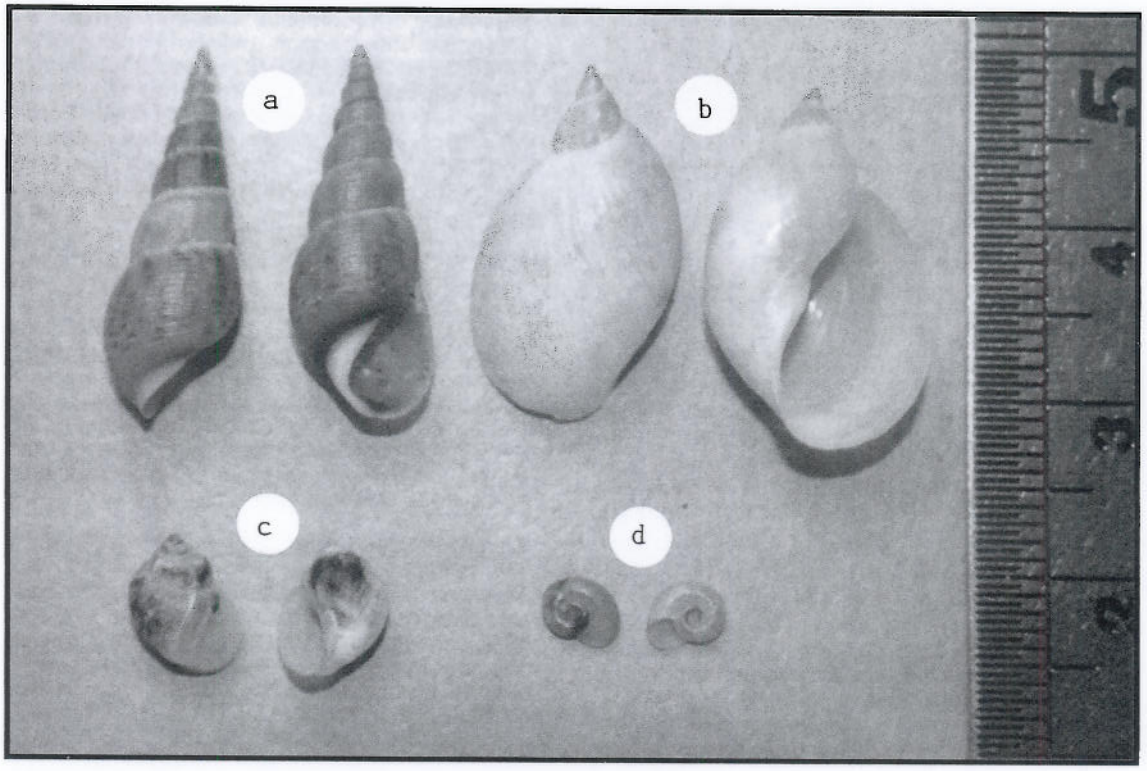

Figure 1: a, Melanoides tuberculata; **b,** Lymnaea natalensis; **c.** Bulinus wrighti; **d,** Gyraulus piscinarum

that when the aperture is viewed with the axis held vertical and the apex uppermost, the aperture is to the left of the axis). This is a noteworthy characteristic because only about 10% of gastropod species are sinistral.
In Wadi al-Ramthah, B. wrighti was found only in the upper reaches of the wadi, above a stretch of more than a kilometre within which no surface water was observed. There the snails were relatively common in shaded, small to medium-sized pools in the ophiolite bedrock. Water depth was found to vary seasonally from about 150 cm in May to less than 30 cm in November. Snails were found on both bedrock walls and on coarse gravel within the pools. In one pool in particular, large numbers of small and presumed juvenile snails were found on bedrock walls. In Wadi Diftah, the shells of adult snails were found on coarse gravel at the edge of a "pothole" pool in the bedrock floor of a steep tributary at mid-wadi.
The foregoing distribution is consistent with prior observations that B. wrighti seems to have relatively narrow ecological requirements, being found in isolated small pools among rocks, filled mainly by rainwater and free of vegetation other than perhaps a very thin layer of algae [3,4]. The importance of B. wrighti as an intermediate host for disease may be limited by its restricted distribution and remote habitat [4]. Although it has been bred in the laboratory for many years in connection with public health research, the natural history of B. wrighti in the wild remains largely unknown.

Introduced Species

Thiara scabra (Muller, 1774)

This snail has only once been positively identified from the UAE. A single dead shell was collected from an irrigated terraced field in Wadi Maydaq by one of the authors (SAG) in June 1998 and identified by Mr. Fred Naggs of the (British) Natural History Museum (Fig. 2a).

T. scabra (Family Thiaridae) is a conical operculate species related to and similar in size and appearance to M. tuberculata. It is widespread in South Asia and the Indo-Pacific, including a few localities in East Africa[3]. In Arabia, however, it is known only from specimens collected at a few sites in northern and southern Oman and southern Yemen. All Omani specimens were associated with M. tuberculata and all live T. scabra were found in falaj systems [3]. On the basis of the foregoing, it seems best considered an introduced species.
The morphology of T. scabra is variable. Typical shells are "coronated," i.e., the suture at the top of each successive whorl is characterised by a distinct shoulder bearing vertical ribs which may project as short spines, making each whorl resemble a crown [3,4]. However, this tendency is less distinct in later whorls, and in specimens from northern Oman the entire shell may so closely resemble M. tuberculata as to make it extremely difficult to distinguish confidently in the field [3,10]. T. scabra exhibiting this morphology could therefore have been overlooked to date in the UAE. Among presumptive M. tuberculata seen by the authors at various UAE locations, local populations tend to be consistent. Those from natural wadi sites are typically moderately ribbed and have relatively deep sutures. Specimens from disparate locations may appear essentially identical in both form and colouration and none are so different as to actively suggest the possibility of a second species.

Physa cf. **acuta** (Draparnaud, 1805)
Specimens resembling Physa acuta (Family Physidae, Fig. 2b) were collected by the authors at the Za'beel Water Treatment Plant, Dubai (also known as the Dubai Fish Farm), in February 1998 and were tentatively identified by Dr. David Brown at The Natural History Museum. Better preserved specimens would resolve identification but access to the site has since been restricted. Human introduction is suspected. P. acuta is

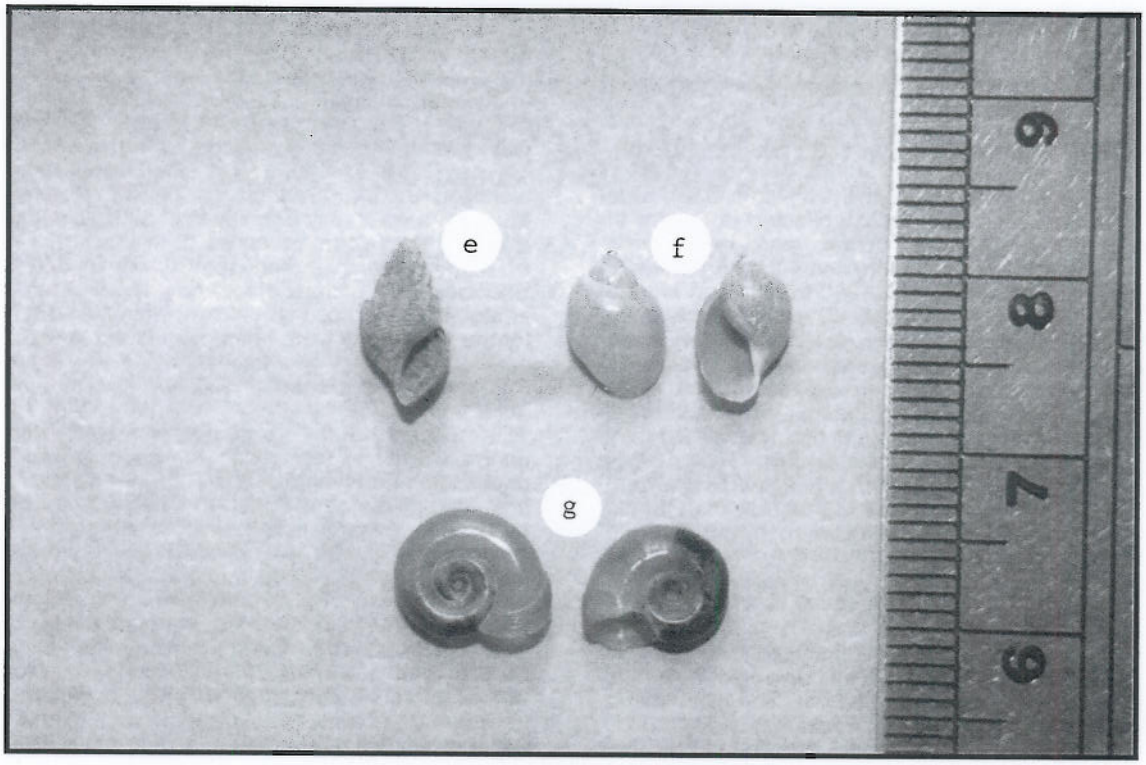

Fig 2: a, Thiara scabra; **b,** Physa cf. acuta; **c,** Biomphalaria arabica

widespread in ponds in Europe but has also been reported from scattered localities elsewhere, including Saudi Arabia and the Sinai Peninsula [4].
Adult shells typically measure 15 mm in height. They are smooth and have both a high, pointed spire and a high, elongated aperture. Like all members of the genus Physa (sometimes called bladder snails), P. acuta is sinistral [7].

Biomphalaria arabica (Melvill & Ponsonby, 1896)

Apart from Gyraulus piscinarum, discussed above, several other species of ramshorn snails, all belonging to the aquatic pulmonate Family Planorbidae, have previously been reported from Arabia [4,10]. One of the largest and most common of these is Biomphalaria arabica (Family Planorbidae, Fig. 2c), considered to be a possible intermediate host for the parasite that causes bilharzia (schistosomiasis) in humans [3,10]. B. arabica is widespread in Saudi Arabia and is also found in Yemen and in the Dhofar region of Oman, where it is associated with aquatic plant growth. It was not known in the UAE until its very recent introduction to a private pond with water plants collected from Dhofar. It remains to be seen whether it will become established. Typical adult B. arabica have a diameter of 10-15 mm.

Other species that may occur in the UAE

Indoplanorbis exustus (Deshayes, 1834)

This Indo-Pacific ramshorn snail (Family Planorbidae), another aquatic pulmonate, has been found at several locations along the coast and foothills of the eastern Hajar Mountains in Oman, southeast of Muscat [3,10] and could potentially be found on the East Coast of the UAE. It is very similar in size and appearance to Biomphalaria arabica, adult shells being somewhat larger than 10 mm in diameter and having a proportionately higher aperture than B. arabica. The two are depicted comparatively by Brown and Wright [4,10], but identification of soft parts is desirable in order to confirm identification.

Paludestrina glaucovirens (Melvill & Ponsonby, 1896)

Paludestrina glaucovirens (Family Hydrobiidae) was described from three dead shells collected in Dhofar at the end of the last century. Three more dead shells assigned to this operculate taxon, some bearing areas of periostracum, were collected in 1980 from in and around the date groves of the coastal village of Qida, near Khasab on the Musandam Peninsula, where they were found in association with M. tuberculata [3]. Snails described as Paludestrina cf. glaucovirens have since been found alive and in abundance in Bahrain in slow-flowing irrigation ditches near springs, where they live in association with L. natalensis [5]. The shell is high-spired but with rounded contours. The Dhofar and Musandam specimens are all somewhat less than 5 mm, but it has been indicated that specimens of this size are immature [5].

Hydrobia lactea (Kuster, 1852)

This small operculate snail (Family Hydrobiidae) is known from Jordan, Iraq and eastern Saudi Arabia, where it is found in swampy areas, irrigation ditches and vegetable gardens [4]. It has been suggested that H. lactea may prove to be synonymous with congeneric and other species recognised from both North Africa and South Asia [4]. In particular, it has been suggested that it may be synonymous with Paludestrina glaucovirens, described above. The shell of H. lactea is high-spired but with rounded contours. Its small size (< 5 mm) makes it easy for all but determined collectors to overlook.
In view of the long history of irrigation and cultivation within the UAE and their expansion in the modern era, it is reasonable to foresee the eventual presence of H. lactea or related species, e.g., Paludestrina glaucovirens.

Melanoides sp. cf. **plicaria** (Born 1780)
Brown and Gallagher [3] described specimens collected in 1982 at "Al Khona" (Ghunah), within the Omani enclave of Madha on the East Coast of the UAE, which they assigned to this unconfirmed taxon (Family Thiaridae). The specimens were found 5 km inland, apparently in association with M. tuberculata, which they closely resemble. They are said to be similar to specimens from Huqf in southern Oman. In relation to the associated M. tuberculata they are said to be relatively broader and smoother (although with stronger ribs on earlier whorls), to increase whorl size more rapidly, and to have shallower sutures, a more elongated aperture, and a paler grey-brown ground colour without significant red-brown markings.
Brown and Gallagher noted a resemblance to M. plicaria, a Pacific island species, but concluded that a more definite identification would depend on a revision of the genus Melanoides throughout the Indo-Pacific region. The present authors cannot advance this discussion and have not knowingly encountered this species in the UAE. Although considerable variation has been noted in presumed M. tuberculata, this is understood to be normal for the latter species and has not been systematically recorded or analysed.

Additional possibilities

Pulmonate snails of the genus Succinea (Family Succineidae), commonly called amber snails, are considered terrestrial snails, but several species live exclusively on emergent aquatic reeds and other plants, just above the waterline [1,8]. They occasionally enter or fall into the water and because they very closely resemble Lymnaea natalensis in both shell morphology and certain behaviour, they may be mistaken for freshwater snails [1,2,8]. One of the authors (SAG) collected a dead shell, thought to be L. natalensis, from cultivation immediately adjacent to the wadi bed of Wadi Maydaq near Masafi. This shell was subsequently identified by Mr. Fred Naggs of The Natural History Museum as probably Succinea sensu lato, suggesting at least the occasional presence of this group in the UAE. In many instances, confident discrimination between Succinea and L. natalensis may require reference to anatomical features, particularly antennae [8], and the former group may have been overlooked to date.

Further observations

With respect to the distribution of UAE wadi snails generally, it is tempting to suggest an inverse relationship between the presence of snails of any kind and the presence of the endemic wadi fish Garra barreimiae, a specialised bottom-feeding member of the carp family. While perhaps not surprising, this hypothesis has not been rigorously tested and remains as yet unproven. For example, in Wadi al-Ramthah, no wadi fish were found in the upper wadi where B. wrighti was found, although G. barreimiae was found in the middle and lower wadi, increasing in abundance downstream. No other snails were observed in Wadi al-Ramthah except in association with a falaj system serving cultivated fields at the settlement of Al-Ramthah near the mountain front, where M. tuberculata was abundant and L. natalensis occasional. No fish were observed within the falaj system itself, although G.

barreimiae was common in the collecting pool.
Both M. tuberculata and L. natalensis are demonstrably abundant in at least two of the few wadis in which Aphanius dispar, the Arabian killifish, is present but G. barreimiae is absent. A. dispar is primarily a surface feeder and therefore may not be a regular predator on snails or snail eggs. In contrast, G. barreimiae, the most common wadi fish, is a specialised bottom feeder that in the typical nutrient-poor wadi environment is likely to be highly opportunistic and might be a significant predator on snail eggs and/or young snails. In a few instances, in pools where wadi fish were present, adult M. tuberculata and L. natalensis have been found in small numbers only under rocks, although this is not their typical habitat. In view of the limitations of current knowledge, readers are encouraged to be attentive to local freshwater snails, and the authors welcome further observations or information. In particular, the continuing "greening" of the country makes additional introductions likely.
The authors wish to express their appreciation for the cooperation and encouragement of professionals at The Natural History Museum, and in particular Fred Naggs, David S. Brown and Vaughan Southgate.

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[Authors' note: Readers are also referred to E. Neubert, [1998] "Annotated checklist of the terrestrial and freshwater molluscs of the Arabian Peninsula", in Fauna of Saudi Arabia, vol. 17, pp. 333-461, published after submission of this paper, which reviews the reported freshwater and land molluscan fauna of Arabia generally. Neubert's checklist contains 70 species of terrestrial molluscs and 27 freshwater molluscs. His sources and discussion mention the UAE only three times, but this includes records of the presence in the UAE of shells of two additional "freshwater" snails not mentioned above. These are **Iravadia quadrasi**, actually a brackish water to fully marine species well known from the Indo-Pacific, and **Stenothyra arabica**, a newly designated species, both collected by M. Apel in 1995 from "excavations at the sea shore" south of Rams, Ras Al-Khaimah.

Gary R. Feulner
P. O. Box 9342, Dubai, U.A.E.
Stephen A. Green
Al-Futtaim Willis Faber
P.O. Box 152, Dubai, U.A.E.

An AMS radiocarbon chronology for the late Umm an-Nar type tomb at Tell Abraq

by D.T. Potts and Lloyd Weeks

Abstract

A series of accelerator mass spectrometry (AMS) radiocarbon dates from charcoal samples suggests a date at the end of the third millennium B.C. for the tomb of Umm an-Nar type at Tell Abraq.

During the seasons of 1993 and 1997/98 at Tell Abraq, an archaeological site on the border between the emirates of Sharjah and Umm al-Qaiwain, a circular tomb of Umm an-Nar type was excavated just 10 metres to the west of the massive fortification tower which dominated the site at the end of the Third Millennium BC. The material from the tomb was sufficiently characteristic to suggest that it must have been in use near the very end of the Umm an-Nar period, named after the type site on the island of Umm an-Nar, adjacent to Abu Dhabi.
For example, instead of the 'classic,' high-shuldered, fine orange vessels with black-painted geometric decoration known from most Umm an-Nar tombs in the region, the tomb yielded short, squat vessels with very simplified geometric decoration, and in every case the base of the vessel showed tell-tale signs of having been string-cut. This was a characteristic of the following Wadi Suq period, not of the Umm an-Nar period. In addition, there was little of the 'classic' Umm an-Nar softstone. Finally, we recovered nearly two dozen socketed bronze spearheads, long considered one of the type fossils of the Wadi Suq period. Observations such as these and others strongly suggested that the tomb at Tell Abraq must date to the very end of the Umm an-Nar period, perhaps to the very beginning of the Wadi Suq era. In other words, it seemed in every way, apart from its stone structure, to represent a transition between the better known Umm an-Nar and Wadi Suq periods.
In order to obtain confirmation for this view we applied to the Australian Institute of Nuclear Science and Engineering (AINSE) for a grant to undertake accelerator mass spectrometry (AMS) dating of carbon samples from the tomb. The application was successful and we were able to submit five samples. These were all chosen from within the eastern side of the two-chambered tomb, and derived from levels extending from an elevation of