Title: The 'lost caravan' of the Ma'den Ijafen revisited: re-appraising its cargo of cowries, a medieval global commodity.

Authors: Christie, A.C and Haour, A.

Affiliation: University of East Anglia

Main Author Email: <u>a.christie@uea.ac.uk</u>

Correspondence Address: Sainsbury Research Unit, Sainsbury Centre For Visual Arts, University of East Anglia, Norwich Research Park, Norwich, NR4 7TJ, United Kingdom

Abstract

The lost caravan of Ma'den Ijafen, Mauritania, with its cargo of cowries and brass, is widely discussed in African archaeology, providing significant insight into the nature of long distance trade in the medieval period. While the brass rods recovered by Théodore Monod during his expedition to the site in 1962 have received considerable attention, the cowrie shells described in his comprehensive publication of the assemblage in 1969 have received much less. This issue was addressed during a recent visit to the Institut Fondamental d'Afrique Noire (IFAN) in Dakar, Senegal in May 2017, when the authors re-examined, the shells. This was part of a wider project which also involved archaeological and environmental surveys in the Maldives, the oft-assumed source of these shells. Examinations of natural history collections of cowries, ethnographic interviews in the Maldives, and environmental surveys in East Africa were also carried out. Drawing on insights from the wider project, we systematically compared the Ma'den Ijafen cowrie assemblage to three others from the Maldives, focussing on four criteria: species composition and diversity, shell size and evidence of modifications. This analysis enabled us to shed new light on the nature of the Ma'den Ijafen cowries and their wider significance to West Africa.

Abstract – French

La caravane perdue du Ma'den Ijafen, en Mauritanie, avec son chargement de cauris et de laiton, a fait l'objet de beaucoup de discussions en archéologie africaine, car elle offre des données importantes sur la nature du commerce médiéval à longue distance. Si les barres de laiton découvertes par Théodore Monod lors de son expédition sur le site en 1962 ont attiré beaucoup d'attention, les cauris, dont il offre une description dans sa publication de 1969, n'en ont presque pas reçu. Cette lacune a été comblée lors d'une visite en mai 2017 à l'Institut Fondamental d'Afrique Noire (IFAN) de Dakar. Lors de cette étude, les auteurs ont pu réexaminer, compter et décrire les cauris. Ceci a été fait dans le cadre d'un projet plus vaste qui a aussi permis des prospections environnementales et archéologiques aux Maldives, la source présumée de ces coquillages. L'étude de collections de cauris dans des musées d'histoire naturelle, des entretiens ethnographiques aux Maldives, et des prospections environnementales en Afrique de l'Est ont aussi été conduites. Ces éléments nous ont fourni un précieux éclairage lors de notre comparaison systématique des cauris du Ma'den Ijafen avec trois collections de cauris retrouvées aux Maldives. Nous avons pris en compte les espèces présentes et leur diversité ; la taille des coquillages ; et les indications de modifications. Cette analyse nous permet de jeter un nouveau regard sur la nature des cauris du Ma'den Ijafen et leur signification pour l'Afrique de l'Ouest.

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Introduction

The 'lost caravan' of the Ma'den Ijafen in the Mauritanian Sahara, thought to date to between the tenth and thirteenth centuries AD, counts amongst the most evocative finds in African archaeology. Monod's fundamental publication of this assemblage (1969) is oft-cited; the hoard serves as a tangible witness to the medieval trans-Saharan trade (e.g. Mitchell 2005) and to the goods valued within it, such as brass (Garenne-Marot & Mille 2007). Yet the collection of artefacts, currently stored in the Institut Fondamental d'Afrique Noire (IFAN) in Dakar, Senegal, has only been patchily studied since it was recovered almost fifty years ago, and mainly with a focus on the brass bars which it included. In May 2017, we had the opportunity to revisit this assemblage, with a particular focus on the cowrie shells. We were able to count, size, and classify the shells according to the nature of any modifications (taphonomic or anthropogenic). This significantly expanded on the analysis carried out by Monod (1969: 309) – and demonstrated its soundness.

However, and crucially, our aim was not just to characterise a well-known West African hoard, but also to compare it to cowrie hoards which we studied in the Maldives – an Indian Ocean archipelago often assumed to be the source of these shells. Indeed, Monod (1969: 309) himself had noted "Il serait intéressant de connaître la composition des lots exportés des Maldives". Here, we can begin to answer this question, by presenting our analysis of over 9000 cowrie shells: 3433 from the Ma'den Ijafen and the remainder from three locations in the Maldives, two of which known to date to the medieval period.

People have used and traded cowries for millennia; a range of studies have examined the question (e.g. Egami 1974, Reese 1991, Kovács 2008, Yang 2011). West Africa is one of the regions where these shells were particularly popular. Their use is well attested in the earliest written sources (Levtzion & Hopkins 2000) and studies of the ways in which their use spread over time and their cultural and economic significance have been put forward by Hiskett

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(1966), Johnson (1970), Hogendorn & Johnson (1986), Iroko (1987), Ogundiran (2002) and Heath (2017) among others. The Maldives have been assumed to be the source of the earliest cowries to reach West Africa, as vividly expressed by ibn Battuta who saw cowries being used in both the Maldives and Mali, in the latter place worth 350 times more than in the former (Hogendorn & Johnson 1986: 25). A comprehensive study of the archaeological evidence for cowries in West Africa remains to be made, however. This is part of our ongoing work, and this paper presents the results of the logical first step in this endeavour: the re-examination of the Ma'den Ijafen assemblage, the earliest known cowrie hoard in West Africa.

Accordingly, this paper presents recent work on the Ma'den Ijafen cowries recovered by Monod, and compares this collection to assemblages from three locations across the Maldives: Utheemu Palace on Utheemu Island in the northern atoll of Haa Alifu, Sultans' Park in the capital city island, Male, and finally Maamigili, a resort island in Raa atoll (Figure 1). The assemblages recovered there provide a valuable point of comparison to the shells from Ma'den Ijafen. In this paper, we describe the context in which Maldivian hoards are reported to have been deposited. In addition, since the context in which the Ma'den Ijafen hoard – which includes not just cowrie shells, but brass bars, fragments of rope and woven bags – was collected is part of the story of this museological assemblage, we outline the history of its recovery, and present an overview of existing studies of the finds.

Figure 1 – Location of Maldivian Atolls and Islands discussed in the text. Redrawn by authors.

Research context

In March 1962, Théodore Monod, director of the Institut Fondamental d'Afrique Noire in Dakar, learnt during one of his trips in the Mauritanian Sahara that antelope hunters had found some copper bars and cowrie shells in Le Mreyyé, a vast, featureless and waterless part of the Sahara along what is now the Mali/Mauritania border (Figure 2).

Figure 2 – Geological map of the Majâbat al-Koubrâ and, inset, copy of a map drawn in the sand by a Monod's informant Hafdhi O. el 'Abid. Redrawn after Monod (1996: figures on pp. 46-47 and 68-69). Note terms included are adopted from local usage; see Monod (1996) for further discussion.

Le Mreyyé lies itself within what Monod named the Majâbat al-Koubrâ¹, a name he borrowed from al-Bakri: literally, "the great solitude", "the great crossing", an empty quarter through which one merely passes. Al Bakri called it the 'Great Waste' (in Levtzion & Hopkins 2000: 70, 76), while ibn Battuta described it as a vast sand desert, the final and most dangerous stage of his trans-Saharan route, and he speaks of members of the caravan dying of thirst (in Levtzion & Hopkins 2000: 282-283). At present, the Ma'den Ijafen lies in an area of extremely limited rainfall. In past centuries, the Sahel-desert boundary has shifted on several occasions, most recently in the seventeenth century when the Ma'den Ijafen would have lain in, or close to the northern border of, the Sahelian cattle zone (S McIntosh in press, after Webb 1995). What situation prevailed at the time the caravan floundered remains unknown, but the testimony of al-Bakri, a near-contemporary writer, and the remarkable degree of preservation of the finds, would argue for extremely arid conditions.

¹ There existed no name for this region, prior to Monod's studies – apart for the term 'Djouf' coined by Heinrich Barth but which Monod (1996: 24) rejects as a generic name.

The Majâbat al-Koubrâ itself is an area of the Sahara about 1000x500km in size – half the size of France – with no humans or human constructions, vegetal or water (Monod & de Gouvenain 1996). This point is important in order to understand the difficulties involved in tracking down the site once it had been reported by the antelope hunters². A first attempt in January-February 1964 failed, and a second was launched in December of that year. Monod and his team walked 10 days, finally identifying the reported findspot on 17 December, a feat of his guide Salek ould Guejmoul that Monod (1969: 290) describes as "supéfiant". Most of the following day was devoted to a study of the site.

The site presented as a roughly round mound 6-7m in diameter and 60-70cm high, covered in metal bars, some twisted, some planted vertically in the sand (suggesting the passage of recent antelope hunters), with abundant cowrie shells both mixed in with the surface metal and within the surface sand (Monod 1969: 296). A metre-wide trench excavated into the southern part of the mound (Monod 1969: Figure 55c, d) revealed the presence in undisturbed sand of six bunches of brass bars, each containing about 200 bars, some wrapped in fibre mats (Monod 1969: Figure 56 c, d; Figure 57, d). Monod (1969) estimated the total at 2085 bars. Twenty-five of these were sampled and taken back to IFAN, together with a sample of cowries and fragments of fibre mats and ropes³ (Figure 3 – The Ma'den Ijafen assemblage of brass bars, cowries, fibre mats and ropes).

Figure 3 – The Ma'den Ijafen assemblage of brass bars, cowries, fibre mats and ropes. (IFAN: MAU 67-151).

 $^{^{2}}$ Indeed, the description of the search for the hoard, and the route followed, occupy the first few pages of Monod's (1969) paper, and see also his Fig. 53.

³ The collection was accessioned as MAU 71-71, later changed to MAU 67-151 to avoid duplication with another assemblage It is worth noting this because some of the brass bars are physically marked with the earlier number.

Monod (1969: 295)⁴ proposed two possible names for the site: "Ma'den Ijafen" – the Ijafen mine – or "Blad al-Wuda", "the place of the cowries". He interpreted the load as a cache, left behind by a caravan in difficulty. The caravan was, he supposes, heading from Morocco to the Tichitt-Walata area (Monod 1969: 314-317 and Fig. 54). Two radiocarbon dates were run on fragments of the mats: they yielded dates of 785 ± 110 bp [I-2769] and 860 ± 108 bp [IFAN Dak-1] (Monod 1969: 310, 312). These calibrate to AD 1024-1329 (86.8%)/1341-1396 (8.6%) and 971-1306 (94.3%) and 1363-1385 (1.1%) respectively.

As part of our re-examination of the hoard, we ran two additional dates, and obtained the following results: 900 ± 30 bp [Beta 466014] and 1030 ± 30 bp [Beta 466013]. These calibrate to AD 1039-1210 and AD 901-920 (2.8%)/962-1041 (91.9%)/1109-1116 (0.7%) respectively⁵. Beta 466014 was run on a fragment of a very damaged vegetal fibre, and Beta 466013 on a fragment of rope within the assemblage⁶. Unfortunately, due to 'wriggles' in the calibration curve for this period, it is not possible to narrow the date range further, but these dates are entirely consistent with Monod's earlier set, and a slight improvement in accuracy. On balance, the assemblage can likely be attributed to the eleventh or twelfth century, rather than the thirteenth century.

Monod (1969: 293) recommended a vehicle be dispatched to retrieve the remaining metal and cowries, and in his paper, he supplied the names of those who had accompanied him,

⁵ All dates calibrated using Oxcal 4.3 using the IntCal 13 calibration curve (Bronk Ramsey 2009).

⁴ Tellingly, it is under the former name that this site is now best known in the scholarly literature – reflecting the bias towards the metal finds.

⁶ The fragment of damaged vegetal fibre was probably part of the textile featuring on Monod (1969: Fig. 57d), but it cannot be identified with certainty as it has clearly deteriorated since its accession. On the other hand, the other textiles are in good condition and can be clearly recognised on the published photographs. Monod (1969: 310) described these as "probablement marocain". As for the second sample, we selected the most damaged of the fragments of rope within the assemblage. This was a piece of the fine rope called 'Type D' by Monod (1969: 310): 5-10mm in diameter, and which had been used to tie the brass bars in a bunch.

explaining that it would be impossible to locate the site again without one of the men who had seen the site. As far as is known, however, the site was never again seen by researchers.

As the sole known example of a medieval caravan wreck, the Ma'den Ijafen has proved hugely important in understanding the movement of goods into West Africa in the early part of the second millennium. The hoard illustrates the import into West Africa of items not available locally – cowries and brass – at a period when travel across the Sahara represented the only realistic route into West Africa. Al-Umari (in Levtzion & Hopkins 2000: 276) described Sijilmasa, in present-day Morocco, as the point from which merchants set out for sub-Saharan Africa, bearing salt, copper, and cowries and returning with gold. Several studies have therefore been made of the Ma'den Ijafen materials deposited at IFAN. The brass bars have generated most interest; Monod (1969)'s original paper included an analysis of a number of them, and they have since featured in wider treatments of West African brasses (e.g. Werner & Willett 1975, Craddock 1985, Craddock & Picton 1986, Garenne-Marot 1995, Garenne-Marot & Mille 2007, Fenn et al. 2009).

One key point is that the bars are high in zinc (20%) and are, therefore, brass, an alloy which at the current state of knowledge was not produced in sub-Saharan West Africa before the colonial era. Werner & Willett (1975), in a study of Ife and Benin castings, proposed on the basis of composition that the origin of their brass may lie in twelfth/thirteenth century European brasses, noting the special interest of the Ma'den Ijafen hoard in this respect.

A series of more recent studies have focused on evidence from the Senegal Valley. The predominance of brass on sites in the Middle Senegal Valley, together with the data from the Ma'den Ijafen, indicates a geographically circumscribed source, likely Morocco (Garenne-Marot 1995: 48). "En effet, c'est du « beau » métal que la caravane de l'Ijâfen acheminait... Le métal du Ma'den Ijâfen représente surtout une qualité d'alliage particulier. Taux élevé de

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zinc, couleur franchement jaune doré, grande malléabilité, absence de plomb, c'est un alliage qui, dans d'autres contextes de même époque, paraît essentiellement réservé au travail de la dinanderie [brassmaking]... ". Garenne-Marot (1995) suggests that the Ma'den Ijafen testifies to a massive importation of copper and copper alloys from northern Africa, while Garenne-Marot & Mille (2007) hypothesise that high zinc brass was preferred because it combined the external aspect of gold with the protective properties ascribed to copper.

S. McIntosh (in press), making a general overview of Middle and Upper Senegal Valley connections with the wider world, notes that first millennium deposits prior to c. AD 800 contain no evidence of northern imports. Three pieces of pure copper were recovered from excavations at Cubalel sites, in levels dating between AD 800 and 950, while upriver, at Sincu Bara and Arondo, copper and brass appear at approximately the same date. Also at this time comes the first evidence of new architectural technologies, including banco and unfired mud brick, supplementing earlier wattle-and-daub. Shortly thereafter, cordoned pottery of a distinctive style documented at Tegdaoust and Kumbi Saleh appears at sites in the Cubalel region, at Sincu Bara, and at Arondo. All this suggests long-distance exchange and interaction, when copper, glass, new building technologies, and pottery styles linked to the southern Saharan trade entrepots appear (McIntosh in press). The Ma'den Ijafen load clearly fits into this general picture, at a slightly later date.

Therefore, the Ma'den Ijafen has offered fundamental insights into social and economic processes in West Africa. The cowries within the wreck had, however, been neglected since Monod's initial assessment. It was time to revisit them.

The cowries form a substantial part of the material culture recovered at the site. Describing the site, Monod (1969: 296) reported that "Mélangés aux baguettes dans certaines régions du bombement, sous celles-ci ailleurs, on note, en surface, d'abondants coquillages blancs, des

<u>Cypraea moneta</u> en particulier: il y en a beaucoup d'autres <u>dans</u> le sable superficiel" – see Monod (1969: Figures 50, 56b). Verdcourt (in Monod 1969: 309) suggests that this load "may well have represented several transactions with people who had obtained them from very diverse places". Monod recovered a sample of the assemblage, returning with 3.945 kg of shells to Dakar for analysis, which he estimated would represent approximately 3260 specimens. He reported that over 99% of the assemblage comprised *Cypraea moneta* with a further 8 species making up the remaining 1% (Monod 1969: 309). In our analysis, we reassessed the sample of shells collected by Monod in its entirety. We should add here on a technical note that the World Register of Marine Species has updated the taxonomic classification for *Cypraea moneta* since the time when Théodore Monod wrote. Hereafter this species is referred to as *Monetaria moneta* (Linnaeus 1758).

Archaeological cowries in the Maldives

Cowrie hoards and caches are frequently encountered across the Maldives during construction and farming. The earliest (and largest) of these from archaeological excavations was recovered from the Buddhist monastery site of Kaashidhoo. This hoard comprised a single deposit of over 62000 shells and a radiocarbon date returned a result of 1690 ± 65 which calibrated to AD 165 - 345. The shells were deposited close to the remains of Ruin II - a square stone platform located to the north of a structure interpreted as being the image house of the monastery (Mikkelsen 2000: 12). They are thought to represent "a sacrificial offer, or some other type of intentional deposit" (Mikkelsen 2000: 13). Other smaller cowrie caches were also recovered from other parts of the sites, in various contexts (Mikkelsen 2000:18). Amongst these were three discrete deposits containing 106, 109 and 218 shells respectively. In light of the small quantities, Mikkelsen (2000: 18) hypothesises that these could represent Buddhist rosaries, which reportedly comprise 108 beads. These deposits were dated to 1690 ± 40 bp (AD 220 - 330), 754 ± 75 (AD 1170 - 1300), and 660 ± 65 (AD 1260 - 1200) 1340) respectively. Shells have also been found in smaller numbers in carved coral stone boxes which have been found during construction or agricultural activities on several atolls across the country⁷.

It is important to note that cowries were, for best results, collected alive; beach washed specimens are typically worn, pitted and lacking in lustre, and thus "fragile, useless for ornamentation, and... often rejected for money use, or command[ing] a lower price" (Hogendorn & Johnson 1986: 80). Once collected, and prior to shipping, the shells required processing. One method was to bury them in the ground for a period of weeks to enable the

⁷ http://www.sun.mv/61019/,

https://www.facebook.com/media/set/?set=a.698595880223807.1073741827.117463275003740&type=3; Heritage Inventory; S. Jaufar, pers. comm.

flesh of the mollusc to putrefy and drain out – a practice attested by repeated observers since the time of ibn Battuta (Hogendorn and Johnson 1986: 25). In 1982, fieldwork in South Male (Kaafu) atoll allowed Hogendorn & Johnson (1986: 82) to witness the process in person. They report pits were dug inside the compound walls of a house to bury the shells. Once reexcavated, the shells were washed repeatedly; once clean, they were shipped to the capital Male and stored, some in warehouses, some underground. One late seventeenth-century source suggests that thousands of tonnes of shells lay buried in Male, while another thought that over 90% of the processed cowries were kept elsewhere to guard against pirate attacks (Hogendorn & Johnson 1986: 83). Our ethnographic enquiries in the Maldives confirmed that in the recent past cleaned shells were used in a local government shop or sent to Male in exchange for produce and goods.⁸

Under these circumstances, it is understandable that buried shells are most frequently encountered as deposits not associated with other forms of material culture. Our interviews suggest that a day's collection typically accumulated 3-5kg (approximately 4000 - 4500 shells)⁹. Hogendorn & Johnson (1986: 81), for their part, mention that a good day's production for a group of 50 women and children was somewhat over 50kg. In view of all of this, we suggest that isolated assemblages of a few thousand shells can best be interpreted as

⁸ Hassan Gasin, 4/2/16; Faheema Ahmed, Aminath Saniyya/ Hawwa Ismail and Adam Hussein 5/2/16; Hariyya Ahmed 6/2/16; Ahmed Gasim 9/2/16; Samfa Mohammed 17/2/16; Mohammed Nizam 3/3/16; Sabiyya Dhonfuthu 4/3/16; Ahmed Mujhaba 5/3/16, Garmariyyath Adam10/3/16; Fathimath Yoosuf 11/3/16 Fathimath Rahman 12/3/16; Dhonfaru Mohame Yoosuf 17/03/16; Sakeena Ali 13/01/17; Zubair Hussein 24/01/17; Sanpaa Abdhulla and Umma Kulsoom 20/2/17; Mohammed Moosa, Fathimath Yoosuf and Mariyam Mohamed 22/2/17; Shareefa Ali 25/2/17; Moosa Aboobakuru 27/3/17; Mariyam Moosa and Fathimath Faiqa 1/3/17; Wafiyya Zakabiyya 2/3/17; Khadheeja Ismail/Abdulrahman Ibraim 5/3/17; Aisha Moosa 6/3/17; Ahmed Hassan 7/3/17.

⁹ Hassan Gasin, 4/2/16; Aminath Saniyya/ Hawwa Ismail and Faheema Ahmed 5/2/16, Sabiyya Dhonfuthu 4/3/16; Ahmed Mujhaba 5/3/16; Fathimath Yoosuf 11/3/16; Fathimath Rahman 12/3/16; Sakeena Ali 13/01/17; Sanpaa Abdhulla and Umma Kulsoom 20/2/17; Mariyam Mohamed 22/2/17; Shareefa Ali 25/2/17; Moosa Aboobakuru 27/3/17; Mariyam Moosa and Fathimath Faiqa 1/3/17; Wafiyya Zakabiyya and Mariyam Abdul Rahman 2/3/17; Ahmed Hassan 7/3/17.

caches. Larger assemblages, in the scale of tens of thousands of shells, can best be described as hoards, sometimes, as in the case of Kaashidhoo, with supposed votive intention.

As part of our research we were able to conduct an assessment of one potential cowrie cache and two cowrie hoards from the Maldives, all recovered from archaeological (if not systematically excavated) contexts. The scale of these deposits make them ideal candidates for comparison to the Ma'den Ijafen assemblage. A short description of these three deposits follows.

Sultan's Park, Male, North Male (Kaafu) atoll

Male is heavily built up, and the opportunity to excavate in this Sultans' Park, where once stood the sultan's palace, offered an excellent opportunity to improve knowledge of its history. Accordingly, we excavated several small test pits within the area (Figure 4). The Royal Palace, thought to have been built in the sixteenth century, was razed to the ground in 1968. The vast majority (over 80%) of the cowrie shells we recovered came from test pit N12 (1x1m) (Haour et al 2016: 74). It yielded 1445 cowries, 86% of which (n = 1242) were recovered from a single context, a loose, rich brown soil at a depth of 10 to 18 cm. We focus here on this assemblage of 1242 shells. Several fragments of modern debris such as plastic were found in this context, indicating substantial post-depositional disturbance. This is unsurprising in the context of a public space routinely swept by groundsmen. However, it is clear, given the dense concentration of the cowries within a small space, that this was a discrete deposit. We obtained two radiocarbon dates on materials from our work in Sultan's Park: one, from a charcoal concentration just under stone brick in Unit N2, was 470 ± 30 bp [Beta 438193] and the other, from discrete concentration within a cluster of stones in Unit E14, was 803 ± 30 bp [Beta 438195] (Haour et al. 2016: 74). Despite the unquestionably challenging nature of the Sultans' Park stratigraphy, these two dates are fairly consistent and

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suggest, we think, an occupation of the site falling between the twelfth and the fifteen century AD.

Figure 4 - Excavations underway at Sultans' Park.

Utheemu Palace, Utheemu, Haa Alifu atoll

Utheemu Island is home to one of the Maldives' significant surviving historical sites, the palace of sixteenth-century Sultan Mohamed Thakurufaanu. During excavations to lay an electricity cable a few years ago, two cowrie hoards were recovered from the northeast and south gates of the wall surrounding the palace courtyard. While the shells from the southern entrance were left in situ, those from the northeast entrance were retrieved and placed in storage by the local community (Haour et al. 2016: 70). We were able to assess this assemblage during a visit in 2016. The total assemblage – representing all the shells recovered by the local community excavations – weighed approximately 86 kg, which we estimate would represent about 67500 shells¹⁰. This number clearly points to a hoard, and the depositional context, in a liminal space, is intriguing. We assessed a subsample of 13250 shells (ie. approximately 20% of the assemblage), which we counted and identified to species level (Figure 5). Then 3511 shells (representing approximately 26% of the shells studied, and approximately 5% of the entire assemblage) were subjected to further detailed analysis.

¹⁰ During our analysis of the Monod hoard and the Maamigili sample we weighed over 5000 shells (in mixed size batches of known quantities). From this we were able to deduce that a dried, cleaned and intact *Monetaria moneta* has an average weight of 1.28g. This is comparable to Monod's estimate of approximately 1.21g per shell (Monod 1969: 309).

Figure 5 – Cowries from the Utheemu assemblage being sorted. Pile 1: Initial removal of other Cypraea species for subsequent identification; Piles 2 and 3: Different sizes of Monetaria moneta; Pile 4: Shells still to be sorted; Pile 5: Damaged Monetaria moneta; Pile 6: Non-shell fragments.

Unfortunately, our own work at the palace site, which involved the excavation of two units, failed to identify any in situ hoards. It did, however, allow us to situate the period of occupation. A sample from Unit 5, just above a human burial, was returned at 820 ± 30 bp (Beta 438870). Two other dates from this unit (Beta 438868 and 438869) fell between the late seventeenth century and the modern day and are interpreted as contaminations. Another trench (Unit 4), 1m x 3m in size, was laid out inside the palace next to the north entrance, and a sample returned the date of 450 ± 30 bp (Beta 438192). These dates are consistent with the historical evidence and the nature of the ceramic assemblage, and incidentally point to an occupation contemporary to that of Sultans' Park in Male.

Loama, Maamigili, Raa atoll

A large assemblage of cowries was uncovered during the construction of a resort on the island of Maamigili, Raa Atoll. These were retained as part of a small museum which was set up to display the archaeological finds from the island in order to encourage cultural tourism. Upon invitation from the museum curator, we were able to conduct a brief assessment of a sample of the assemblage.

In order to display the cowries for visiting tourists, they were presented in two large pottery vessels. It was not possible to empty these during our visit, thus making a comprehensive assessment of the total assemblage impossible. The volume of shells does, however, suggest to us that this assemblage was comparable in size to that from Utheemu. Working within

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these constraints, we assessed a sample of 1000 shells in detail to document shell size, species and modification. As in the case of the shells from Utheemu hoard, the specimens were recovered in our absence and not as part of archaeological work. The date of occupation of the site, and thus of the hoard, is unknown. Because of these various limitations, we refer only occasionally to the Maamigili assemblage throughout this paper.

Studying the cowrie assemblages: Objectives

Our analysis of the assemblages focussed on four factors: species composition and diversity, shell size, and evidence for natural or anthropogenic modification. These variables were chosen because of the significance they hold in reconstructing past cowrie collecting and processing practices.

Shell species is a crucial consideration given the oft-repeated model presented by the historical and archaeological literature whereby the first cowries to arrive into West Africa were *Monetaria moneta* brought in from the Maldives while *Monetaria annulus* (Linneaus 1758) was brought from East Africa only from later periods, via European maritime trade routes. Monod (1969: 309) suggests that while East Africa was also a known source of cowrie shells, he would have expected that a caravan carrying shells from East Africa would evidence a greater dominance of *Monetaria annulus* in the assemblage. Our assessment of the species composition of the various assemblages aimed to test the validity of this hypothesis.

From the perspective of shell size, it is often thought that smaller shells were more highly valued in West Africa than larger varieties of the same or other species, perhaps because they were more cost-effective to transport (Johnson 1970: 36-37, Hogendorn & Johnson 1986: 96). Some corroborating historical indications exist; for instance, in AD 1723 a buyer for the Royal African Company speaks approvingly of the cowries at a sale being good and small (Hogendorn & Johnson 1986: 96). Our ethnographic interviews in the Maldives did suggest

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that in the recent past smaller *Monetaria moneta* were more highly valued when exchanged for produce in government shops or in Male, but that during collection little thought was given to species or size of shells¹¹. By documenting shell size, we aimed to assess a) whether smaller shells were indeed more common in an assemblage intended to supply West African markets; and b) whether different assemblages within the Maldives would evidence different degrees of variations in size, given that it is reported that shells were counted and sorted in Male for export.

Finally, the question of shell modification also formed an important consideration. It is known that cowries used in Africa were frequently pierced (backed) so as to facilitate stringing (Johnson 1970: 45, York 1972: 96). Our initial working hypothesis was that this operation was undertaken at the shells' source in the Maldives, but we quickly found this not to be the case. Our ethnographic enquiries and excavations in the Maldives make it clear that the shells were not being modified by the collectors or the exporters. Existing photographs of a small subset of the cowries recovered from the Ma'den Ijafen (Monod 1969: Figures 56b, 59c, 60) showed that they were unmodified, but it was not clear whether this was the case for the majority of the assemblage.

Methods used in our analysis

The analysis of the Ma'den Ijafen cowrie assemblage was derived from the approach that we had developed in the Maldives and which we outline below. We followed this approach systematically, except in the case of Maamigili for the reasons outlined above.

In the first instance, the assemblages were sorted. Shells were separated into two piles: *Monetaria moneta* and non-*Monetaria moneta* specimens. *Monetaria moneta* are most easily

¹¹ Hassan Gassin 4/2/16; Aminath Sanyaa/ Hawwa Ismail and Adam Hussein 5/2/16; Fathimath Yoosuf 11/3/16; Zubair Hussein 24/2/17; Sanpaa Abdhulla and Umma Kulsoom 20/2/17; Fathimath Yoosuf; Sakeena Ali 13/1/17; Moosa Aboobakuru 27/2/17.

identifiable on the basis of their rhomboidal shape and distinctive tubercules (Burgess 1970: 343, Lorenz & Hubert 2000: 205, Richmond 1997: 262). The non-*Monetaria moneta* shells were then further differentiated and identified using the guides in Lorenz & Hubert (2000: 505-539). The different species were further divided into intact specimens, fragments of specimens, pitted shells and potentially modified specimens, with the latter set aside for closer investigation.

The shells (within their species groups) were then sorted by size. All non-fragmented specimens were sized, irrespective of species. Shells were classified into one of four categories based on their length: extra small (less than 10mm), small (10 - 15mm), medium (15 - 20mm) and large (over 20mm). Shells with a missing dorsum were measured but more fragmentary shells were not, given that an accurate assessment of their overall length was not achievable. Such fragmentation is common in juvenile shells, as the animal has not yet laid down a sufficiently thick callus (Irie & Iwasa 2003: 1133) and so is unlikely to survive well in archaeological conditions.

The next stage of analysis was to conduct a more detailed assessment of potentially modified shells to determine whether natural or anthropogenic processes had been the cause. We noted the shells' overall condition (whether smooth, pitted, or burnt) in order to inform our understanding of depositional conditions and suggest whether the shell had been collected alive or dead. Live shells tend to be shinier or smoother, while those collected dead tend to be pitted (Johnson 1970: 19). It should also be noted that beach-washed specimens differ in appearance from those 'weathered' after deposition, as they are more deeply pitted. Burnt shells for their part can be golden brown, black or grey in colour, and can display evidence of severe cracking of the outer layer of shell.

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Finally, shells that were not fragmented but which were no longer intact (that is, where the dorsum was wholly or partially absent) were then examined in detail to record the nature and location of the perforation.

Results

We assessed a total of 9186 cowrie shells – 3433 from the Ma'den Ijafen caravan load, 3511 from the Utheemu hoard, 1242 from the Male N12 cache and 1000 from the Maamigili hoard.

Species representation

The great majority (about 95% in each case) of the shells within the Utheemu, Male and Ma'den Ijafen assemblages could be identified to species. The proportions of different species present showed some important variations (Figure 6). The two Maldivian assemblages featured a broader range of species and this is especially true in the case of Utheemu, where *Monetaria moneta* accounts for just under 97%. In all cases the proportion of *Monetaria annulus* shells in the assemblages is very low, at around 0.3 - 0.6%.

Figure 6 - Distribution of cowrie species within three assemblages excluding un-speciated cowries. Total numbers are: Ma'den Ijafen – 3241 (94.4% of the sampled assemblage), Male N12 – 1188 (95.65% of the total assemblage) and Utheemu – 3356 (95.59% of the sampled assemblage).

This low number of *Monetaria annulus* shells contrasts significantly with similar assemblages from East Africa. For instance, 100% of the cowries reported at the site of Kizimkazi Dimbani on the island of Zanzibar in Tanzania were *Monetaria annulus* (van Neer 2001: 398). At Kua, in the Mafia archipelago of Tanzania, *Monetaria annulus* represented only 24% (n=54) of the cowrie assemblage; the remaining shells (n=164) were *Cypraea tigris*

(Christie 2013: 108). Similarly, the published photographs suggest that two cowrie assemblages recovered from a house courtyard at Shanga, on Pate Island in Kenya (Horton 1996: Plate 49) predominantly contained *Monetaria annulus*. Finally, our assessment of an assemblage of cowries recovered during excavations in 2016 at Songo Mnara, in the Kilwa archipelago of Tanzania, a site dating to the fourteenth to sixteenth centuries (Sulas et al 2016: 52), showed that *Monetaria annulus* accounted for over 95% of the assemblage (Figure 7).

The dominance of this species in archaeological contexts along the East African coast appears to mirror their natural abundance in the wider region (Hogendorn & Johnson 1986: 12, Newton et al. 1993: 242 -243, Evans et al. 1977: 483). We tested this fact by conducting ecological surveys in 2017, during which systematic sampling at eight locations around Zanzibar, Mafia, Kilwa and Songo Mnara yielded assemblages of which (97.1% (571 or 589 shells)) were *Monetaria annulus*. This lends strong support to Monod's suggestion (1969: 309) that the shells in the Ma'den Ijafen assemblage were unlikely to have been sourced from East Africa.

Figure 7 – Prevalence of Monetaria annulus, Monetaria moneta, and other identifiable cowrie species in four archaeological assemblages: Songo Mnara in Tanzania, Ma'den Ijafen in Mauritania, and Male and Utheemu in the Maldives.

As remarked on above, the Utheemu assemblage features the greatest variety of species. At least 8 different species were recognised, and several more identified which, though they could not be allocated to species, were definitely distinct and are referred to as *Cypraea* Sp.

Species	Habitat (after Lorenz and	Size Range	Ma'den Ijafen	Utheemu	Male
	Hubert 2000)	(After Lorenz			

		and Hubert 2000) (mm)			
Monetaria moneta (Figure 8a)	Inter-tidal rocks/coral	9-28	3224	3252	1173
Monetaria annulus (Figure 8b)	Inter-tidal rocks/coral/seagrass	8-25	5 reported (10 observed during our study) ¹²	17	7
Palmadusta asellus (Linnaeus, 1758) (Figure 8c)	Inter-tidal under coral slabs	10-20	13 reported (only 1 observed)	14	3
Palmadusta ziczac (Linnaeus, 1758) (Figure 8d)	Inter-tidal under coral slabs.	8-20	1 (reported)	0	0
Pustularia cicercula (Linnaeus, 1758) (Figure 8e)	In coral reef, inter- tidally	10-24		2	2
Naria helvola (Linnaeus, 1758) (Figure 8f)	Inter-tidal under coral	12-34	4	32	3
Monetaria caputserpentis (Linneaus, 1758) (Figure 8g)	Inter-tidally. Likes seaweed or rocky environments.	14-35	0	2	0
Naria erosa (Linneaus, 1758) (Figure 8h)	Intertidally, and shallow water habitats where cowries occur	14-75	2	2	0
Staphylaea staphylaea (Linnaeus, 1758) (Figure 8i)	In vital reef, inter- tidally.	7-29	2	0	0
Naria gangranosa (Dillwyn, 1817) (Figure 8j)	Inter-tidally amongst rubble	9-22	3	35	0
Other cowrie species	N/A	N/A	192	155	54

¹² Our work concerns only the shells present in the assemblage at the time we studied it. The numbers differ in some respects from those reported by Monod (1969: 309). It may be that some shells were stored separately from the main assemblage and were not found during our study.

Table 1 – Habitat preferences, size range and abundance of cowrie species identified in the studied assemblages

Figure 8 – Cowrie species identified in the studied assemblages: a) Monetaria moneta; b) Monetaria annulus; c) Palmadusta assellus; d) Palmadusta ziczac; e) Pustularia cicercula; f) Erosaria helvola; g) Monetaria caputserpentis; h) Erosaria erosa; i) Staphylaea staphylaea; j) Erosaria gangranosa.

The species identified (Figure 6, **Error! Reference source not found.**) all have a preference for inter-tidal areas which generally comprise rocks of coral rubble (Lorenz & Hubert 2000). Fewer species were represented in the Male assemblage, but they are still present in small numbers (Table 1). While what we saw of the assemblage from Maamigili consisted exclusively of *Monetaria moneta*, we think it likely that additional species were present in the wider assemblage.

Given the similarities in habitat preference of all the species identified in the archaeological assemblages, the likely scenario is that they were picked up in small numbers during collections. Most collectors we interviewed in the Maldives noted that while *Monetaria moneta* were worth more in terms of their exchange value, they would collect any cowrie species they encountered¹³. It is also clear that informants were able to recognise and differentiate between *Monetaria moneta, Monetaria annulus* and other cowrie species.

¹² Hassan Gassin 4/2/16; Aminath Sanyaa/ Hawwa Ismail 5/216; Adam Hussein 5/2/16; Samfa Mohammed 17/2/16; Sabiyya Dhonfuthu 4/3/16; Ahmed Mujhaba 5/3/16; Naseema Hussein 10/3/16; Fathimath Yoosuf 11/3/16; Zubair Hussein 24/2/17; Sanpaa Abdhulla 20/2/17; Umma Kulsoom 20/2/17; Fathimath Yoosuf 22/2/17; Shareefa Ali 25/2/17; Moosa Aboobakuru 27/2/17; Mariyam Moosa 1/3/17; Fathimath Faiqa 1/3/17; Wafiyya Zakabiyya 2/3/17; Aishath Moosa 6/3/17; Ahmed Hassan 7/3/17.

Indeed, while the species within archaeological assemblages are harder to differentiate to the untrained eye, when these shells are collected live they differ in shape, size, colouration and patterning (**Error! Reference source not found.**, Figure 8).

As is reflected in the figures, the collection of other species is not that common – an observation supported by the environmental surveys which we conducted in the Maldives. Our cowrie collections at 23 sites across 7 atolls yielded an assemblage of which 84% (588 of 701 shells) were *Monetaria moneta*. *Monetaria annulus* represented just 13.4% (n=94) of the collections; these shells came from islands in Alifu Dhaalu, Laamu and Gaafu Alifu (Figure 1).

Our surveys in East Africa and the Maldives thus provided an opportunity to explore the habitat preferences of *Monetaria annulus* and *Monetaria moneta* in detail. The preferred habitat of *Monetaria moneta* – sandier areas with expanses of dead coral rubble – are more common in the Maldives, which likely accounts for their increased abundance.

As shown in **Error! Reference source not found.**, other *Cypraea* species were also present in the Ma'den Ijafen assemblage, albeit in smaller numbers. While this could suggest that other *Cypraea* species were being filtered out in Male in advance of export, it is also possible that their reduced presence in the Ma'den Ijafen remains is simply a result of the sampling strategy employed by Théodore Monod when he collected the cowries from the site.

Size

The distribution of different sizes in the Male, Utheemu and Ma'den Ijafen assemblages was quite similar (Figure 9). Small (10-15mm long) and medium (15 – 20mm long) shells make up over 90% of each case. Large shells (over 20mm long) were more common than the very small shells (less than 10mm long), which were only present in extremely small numbers.

Figure 9 – Proportion of different sized shells from the archaeological assemblages.

Figure 10 – Proportion of different size Monetaria moneta specimens from archaeological collections compared with Maldivian Monetaria moneta specimens in the Natural History Museum and those collected during our ecological surveys in the Maldives.

In order to evaluate whether the proportions of different sized *Monetaria moneta* specimens in the archaeological assemblages reflected natural size variability or deliberate selection of particular sized shells at various stages of the exchange process, we compared the archaeological remains to the size ranges present in two recent collections from the Maldives: our own ecological surveys, and a collection of shells held at the Natural History Museum, London.

Our observation that small and medium specimens are more common than the very small and large specimens in the archaeological assemblages is consistent with data from our ecological surveys. In contrast, the collection from the Natural History Museum features a more even mix of the different-sized shells than is present archaeologically (Figure 10). There, the proportion of large shells was also much higher than in both our ecological samples and the archaeological collections. This may be a factor of collectors' preferences, which are unfortunately not known to us. Our own systematic ecological collections probably give a better size profile for a natural population. These show that in a natural population one might expect to encounter more large shells than we did in the archaeological assemblages. It appears, then, that the archaeological collections might evidence a selection by past communities of small and medium shells.

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Returning now to the question of the archaeological shells, the Male assemblage features a higher proportion of shells that could not be sized (12% of the assemblage, compared to 2.8% and 5.8% from Utheemu and Ma'den Ijafen respectively) because of the high degree of fragmentation. The un-sized shells from Utheemu and Ma'den Ijafen are predominantly juveniles which have not yet fully formed, and being more susceptible to breakage they feature in our assemblage as fragments which cannot be measured.

A statistically significant ($P = <10^{-10}$ using the chi squared test) difference exists between the proportion of small and medium shells in the Maldivian assemblages and those in the Ma'den Ijafen caravan load sample, with the latter assemblage featuring a slightly higher proportion of smaller shells (10-15mm) (Figure 9). Although given the history of the site this may simply be a by-product of the ways in which the shells have dispersed in the centuries following the abandonment of the caravan load, or a ghost of the sampling strategy employed when the shells were collected from the site, it may also suggest that the shells are being sorted before being brought to West Africa. This would support Johnson's suggestion that smaller shells were preferable to larger specimens as they are lighter, more cost effective to transport and more profitable if sales were made by unit rather than by weight (Johnson 1970: 20, 27). Johnson surmises "the cowries of the trans-Saharan trade must have been almost exclusively small ones of Maldive[s] origin; heavier cowries would have been at a great disadvantage in the long and costly journey over the desert" (Johnson 1970: 27).

Within the Maldivian assemblages too we note some intriguing divergences. Most interesting is the statistically significant ($P = <10^{-10}$ using the chi squared test) difference in the proportions of different shells between the Utheemu assemblages compared with the Male assemblage, with the latter featuring a much higher proportion of larger specimens (Figure 9). The higher proportion of large shells in the Utheemu assemblage is partly influenced by the higher proportion of other (larger) *Cypraea* species in the assemblage more generally

(discussed below). As far as the Male assemblage is concerned, however, the distribution of sizes strongly suggests that this assemblage has not been sorted for smaller specimens, supporting our hypothesis that this was not a hoard awaiting export but rather a single individual's cache, buried for processing, or perhaps for safe storage for subsequent use. In contrast, as just stated the Ma'den Ijafen assemblage is quite different and indicative of a sorted shipment.

Natural and anthropogenic modifications

We classified alterations to the cowrie shells into four categories – shells that had been exposed to fire, those with no dorsa (backed), those that had been partially perforated, and peculiar to the Ma'den Ijafen assemblage, shells that had green discolouration (Figure 11).

Figure 11 – Proportion of modified shells showing the dominance of unmodified shells in the archaeological assemblages.

Very few of the shells in any of the assemblages evidenced perforation or backing. In the Maldivian assemblages these categories account for less than 1% of the total assemblage. This figure is marginally higher in the Ma'den Ijafen assemblage (4%). Over 90% of shells in the three assemblages were either completely unmodified or, in the case of the collection from Male, burnt but otherwise undamaged. These burnt shells are likely to reflect post-depositional damage, consistent with the history of Sultans' Park and the evidence for burning in the other material cultural remains we uncovered. The fact that these shells were otherwise totally intact, with no evidence of perforation or backing, is interesting. In combination with the near-exclusive presence of unmodified shells in the Utheemu

assemblage (only 3 of the 3511 shells were perforated and none were backed) this lends strong support to the idea that the shells were exported unmodified from the Maldives.

Fourteen of the shells the Ma'den Ijafen assemblages evidenced green discolouration of the shells' surfaces, often accompanied by damage to their structures (Figure 12). The discoloration is likely a result of having been in contact with the brass bars: the reconstruction proposed by Monod (1969: Fig. 51) of the Ma'den Ijafen load envisages bars ties into bundles topped by bags of cowrie shells.

Figure 12 – Discoloured shells: green patches probably influenced by their proximity to the brass bars.

Given the importance of the question of shell modification, we paid particular attention to the nature of the modifications the Ma'den Ijafen load, examining the 52 perforated and backed shells under a digital microscope¹⁴. This analysis suggests that the perforation and backing of the shells from Ma'den Ijafen is the result of natural, rather than anthropogenic, modification – likely a by-product of a harsh post-depositional context. As shown on

Figure 13, the edges of the perforations are typically rugged, and in in most cases the dorsum has not been completely removed. The hole often appears to have resulted from the natural expansion of a smaller perforation. The high proportion of unmodified shells (Figure 11) lends further support to the idea that this damage is accidental, since it seems unlikely that only a small part of the total assemblage would have been deliberately modified.

¹⁴ A similar analysis was not conducted on the Maldivian shells as these were in too few a quantity (only 5 shells from Utheemu, and 10 shells from Male N12).

Figure 13 – Microscopic assessment of perforated shell from Ma'den Ijafen.

The dominance of unmodified shells within the Ma'den Ijafen assemblage would suggest, perhaps counter-intuitively, that shells were being brought into West Africa un-backed, and that cowrie modification to facilitate stringing or sewing onto objects, clothing or for adornment was conducted at the destination.

Figure 14 – Shells from Ma'den Ijafen with perforated dorsa.

Conclusion

The study of the cowrie shells from the Ma'den Ijafen offers a unique glimpse into a medieval caravan heading across the Sahara. Although a range of studies had considered a sample of the brass bars within the load, no detailed work had been undertaken on the cowrie shells. Monod (1969: 309) had made some important remarks. He wondered whether there existed populations of cowries in which *Monetaria moneta* represent the near-totality of catches; observed that *Monetaria annulus* cowries would likely be more common in an East African hoard than they are in the Ma'den Ijafen collection; and remarked that it would be interesting to know the composition of a Maldivian assemblage destined for export. Our analysis has shown the prescience of these comments and demonstrated that careful typological analysis can allow us to address them.

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Location			
Sample size	3511	1242	3433 cowries
(shells)			
Fragmentation	< 1%	12%	1%
Species	11	5	8
Represented			
Shell Size	90% small/medium	84% small/medium	92% small/medium;
	7% large	4% large	1.5% large
	3% indeterminate	12% indeterminate	5% indeterminate
Modification/	99% unmodified	40% unmodified, 46%	94% unmodified
Damage		unmodified but burnt	

Table 2 – Comparison of assemblages

In this paper we re-examined the cowrie shells recovered from Ma'den Ijafen, comparing these to three similar assemblages excavated in the Maldives from the perspective of species composition and diversity, shell size and modification. This analysis aimed to evaluate the likely source of the shells in the Ma'den Ijafen assemblage, to examine whether smaller shells, which are reportedly more valuable across West Africa, were more dominant in assemblages being brought into the region, and to explore at what stage in the exchange modifications such as perforation and dorsum removal were made.

The species composition of the assemblages indicated a strong dominance of *Monetaria moneta*, with other *Cypraea* species comprising less than 3% of any of the assemblages. These species share similar habitat preferences and are likely to have been picked up in small numbers when the *Monetaria moneta* shells were collected. The dominance of *Monetaria moneta* in the Ma'den Ijafen load is consistent with the nature of the Maldivian samples, lending strong support to the interpretation that these shells were being brought in from the Maldives rather than East Africa. The East African assemblages which we have studied indicate a strong dominance of *Monetaria annulus* which were only present in extremely small numbers in the Ma'den Ijafen hoard. The size range of the shells is also consistent with those in Maldivian assemblages, with small (10-15mm) and medium (15-20mm) shells dominating the samples. There is a statistically significant difference in the proportion of small (10 - 15 mm) shells in the Ma'den Ijafen load. While this could support the interpretation that shells being brought into the region were being sorted to favour smaller specimens, it is also possible that this is a by-product of the ways in which the shells have dispersed at the site in the centuries following the abandonment of the caravan.

The majority of the cowries we studied were unmodified, or burnt but otherwise unmodified. This indicates that the shells were being brought into West Africa unmodified, and that the alterations we observe on archaeological specimens from sites in the wider region were therefore made once the shells have arrived in West Africa. This raises several questions, on which our future work will be focusing: who was responsible for modifying the shells, how was this achieved and where was this procedure undertaken? It is as yet unclear as to whether these modifications were being made by the user at the end of the exchange or whether they were being modified at a central location within West Africa before being distributed.

Our detailed analysis of the Ma'den Ijafen assemblage, paired with the same analysis of Maldivian hoards, has enabled us to make significant progress on the question of the origin of these shells. The dominance of *Monetaria moneta* in the Ma'den Ijafen assemblage, the similarities in shell size and species representation, and the high proportion of unmodified remains (Table 2) constitute notable parallels between the assemblage from the Ma'den Ijafen and the three assemblages from the Maldives (two of which broadly contemporary with Ma'den Ijafen) (Table 2). Furthermore, significant differences exist between the Ma'den Ijafen assemblage and comparable material in East Africa. These elements strongly suggest that the origin of the shells in the Ma'den Ijafen hoard was the Maldives. Careful analysis of the species composition, size and modifications of the Ma'den Ijafen cowries in comparison to similar assemblages from the Maldives has enabled us to finally address some of Monod's questions about the hoard, suggesting that these shells were indeed sourced from the Maldives.

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Captions

Figure 1 – Location of Maldivian Atolls and Islands discussed in the text. Redrawn by authors
Figure 2 – Geological map of the Majâbat al-Koubrâ and, inset, copy of a map drawn in the sand by a Monod's informant Hafdhi O. el 'Abid. Redrawn after Monod (1996: figures on pp. 46-47 and 68-69). Note terms included are adopted from local usage; see Monod (1996) for further discussion
Figure 3 – The Ma'den Ijafen assemblage of brass bars, cowries, fibre mats and ropes. (IFAN: MAU 67-151)
Figure 4 - Excavations underway at Sultans' Park
6: Non-shell fragments
N12 – 1188 (95.65% of the total assemblage) and Utheemu – 3356 (95.59% of the sampled assemblage)
species in four archaeological assemblages: Songo Mnara in Tanzania, Ma'den Ijafen in Mauritania, and Male and Utheemu in the Maldives
Monetaria annulus; c) Palmadusta assellus; d) Palmadusta ziczac; e) Pustularia cicercula; f) Erosaria helvola; g) Monetaria caputserpentis; h) Erosaria erosa; i) Staphylaea staphylaea; j) Erosaria gangranosa
Figure 9 – Proportion of different sized shells from the archaeological assemblages
Museum and those collected during our ecological surveys in the Maldives
Figure 12 – Discoloured shells: green patches probably influenced by their proximity to the brass bars
Figure 15 – Microscopic assessment of perforated shell from Ma'den Ijafen

Table 1- Habitat preferences, size range and abundance of cowrie species identified in the studied assemblages

Table 2 – Comparison of assemblages



































