Revolutions

THE NEOLITHISATION OF THE MEDITERRANEAN BASIN: THE TRANSITION TO FOOD-PRODUCING ECONOMIES IN NORTH AFRICA, SOUTHERN EUROPE, AND THE LEVANT

Joanne M. Rowland
Giulio Lucarini
(eds.)
Geoffrey J. Tassie

edition | topoi

BERLIN STUDIES OF THE ANCIENT WORLD

THE NEOLITHISATION OF THE MEDITERRANEAN BASIN involved a change from a procurement to a productive economy. Although the domestication of most of the plants and animals associated with the Old World Neolithic occurred in the Levantine Fertile Crescent, the Second Neolithic Revolution that resulted in elements of the Neolithic such as domesticates and objects occurring in North Africa and throughout Europe, is arguably just as important a process. Archaeological attention has been focused primarily on the initial domestication process, and only latterly on the spread of food producing economies.

In recent years, research into the Neolithisation of both Europe and North Africa has been increasing, notably so into the process by which varied communities adopted new food producing strategies. The implementation of new technology, methods, and theories have contributed to refinements in the timing of change in economies, analysis of the types of food eaten, and the reasons behind these transformations.

68 BERLIN STUDIES OF THE ANCIENT WORLD

BERLIN STUDIES OF THE ANCIENT WORLD · 68

EDITED BY TOPOI EXCELLENCE CLUSTER

Revolutions

THE NEOLITHISATION OF THE MEDITERRANEAN BASIN: THE TRANSITION TO FOOD PRODUCING ECONOMIES IN NORTH AFRICA, SOUTHERN EUROPE AND THE LEVANT

EDITED BY

Joanne M. Rowland (ed.)
Giulio Lucarini (ed.)
Geoffrey J. Tassie

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliographie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de.

Cover image: Bifacial arrowhead from the Wadi el Obeiyid (Farafra Oasis, Egypt). Drawing by Massimo Pennacchioni (Archive of the Italian Archaeological Project in the Farafra Oaais, Egypt).

Design concept: Stephan Fiedler

Distributed by
Westarp Verlagsservicegesellschaft mbH

Printed by
Druckerei Kühne & Partner GmbH & Co. KG

ISBN 978-3-9819685-6-9
ISSN (Print) 2366-6641
ISSN (Online) 2366-665X
DOI 10.17171/3-68
URN urn:nbn:de:kobv:188-refubium-29803-6

First published 2021

www.edition-topoi.org

CONTENTS

Geoffrey John Tassie 'Tass' † (17th April 1959 – 28th March 2019)

Geoffrey John Tassie ('Tass') was at the heart of the Revolutions' workshop as a postdoctoral fellow at Topoi. His fieldwork in Egypt remained tightly aligned with the transitions to the first settled communities and transitions to statehood. He worked in the Fayum, at Neolithic Sais, Merimde Beni Salama, and Kafr Hassan Dawood, and played a key part in a prehistoric heritage planning project at St Katherine's Protectorate, in the Sinai. Tass co-founded the Egyptian Cultural Heritage Organisation (ECHO) in the late 1990s and remained its driving force until his passing, co-editing *Managing Egypt's Heritage* and *The Management of Egypt's Heritage*. His determination and dedication led to the publication of *Prehistoric Egypt* and *Standards of Archaeological Excavation* and in 2018 Tass instigated the *Naqada Regional Archaeological Survey* and *Site Management Project*. Loved by his friends and colleagues of all countries, he made a huge impression on his new colleagues at the Grand Egyptian Museum, where he had worked since September 2018. A gentle man, Tass always had time to discuss research and offer advice and encouragement to colleagues and students. Tass worked tirelessly on the editing of this volume, and we all dedicate this book to his memory.

Giulio Lucarini and Anita Radini

A Disregarded Nobility: The Role and Exploitation of Wild Plants in North Africa during the Holocene, Analyzed through an Integrated Functional Analysis on Non-Knapped Stone Tools

Summary

The two case study areas presented in this paper – the Haua Fteah cave of Cyrenaica, Libya and the Farafra Oasis in the Egyptian Western Desert – have so far produced archaeobotanical assemblages exclusively made up of wild plants, among which several species of grasses are included. They have also yielded a number of grinding tools. The general assumption of a direct link between grinding tools and plant exploitation was tested, adopting an integrated approach of use-wear and plant micro-residue analysis of the stone tools. Results of this analysis confirmed that a variety of wild plants were processed in the two regions during the Mid-Holocene, showing how these local species represented a primary source of food even after Levantine domesticated animals and plants were introduced into North Africa.

Keywords: Farafra Oasis; Haua Fteah; Mid-Holocene; wild grasses; ground tools; use-wear analysis; starch analysis

Die Fundstellen der beiden hier vorgestellten Fallstudien – die Höhle Haua Fteah in der Kyrenaika, Libyen, und die Oase Farafra in der Westlichen Wüste, Ägypten – haben bislang archäobotanische Assemblagen ausschließlich aus Wildpflanzen erbracht, darunter mehrere Gräserarten. Darüber hinaus wurden etliche Schleifwerkzeuge gefunden. Die allgemeine Annahme eines direkten Zusammenhangs zwischen Mahlwerkzeugen und Pflanzennutzung wurde überprüft, indem in einem integrierten Ansatz Gebrauchsspuren und pflanzliche Mikroreste an den Steinwerkzeugen analysiert wurden. Die Ergebnisse dieser Analyse bestätigten, dass während des Mittelholozäns in beiden Regionen eine Vielzahl von Wildpflanzen verarbeitet wurde. Das zeigt, dass diese lokalen Arten auch nach der Einführung domestizierter Tiere und Pflanzen aus der Levante in Nordafrika eine primäre Nahrungsquelle darstellten.

Keywords: Oase Farafra; Höhle Haua Fteah; Mittelholozän; Wildgräser; Mahlwerkzeuge; Gebrauchsspurenanalyse; Stärkeanalyse

The archaeological materials analyzed in this paper were excavated in the framework of the Farafra Oasis Archaeological Project, co-directed by G. Lucarini and B. E. Barich, and the Cyrenaican Prehistory Project, directed by G. Barker. This research is one of the outcomes of the MSCA Project FP7-People-2012-IEF 'AGRINA'. G. Lucarini carried out the excavation of the archaeological materials, the sampling for the plant residue analysis, and the use-wear analysis. Anita Radini undertook the plant residue analysis.

Joanne M. Rowland, Giulio Lucarini (eds.), Geoffrey J. Tassie | Revolutions. The Neolithisation of the Mediterranean Basin: the Transition to Food Producing Economies in North Africa, Southern Europe and the Levant | Berlin Studies of the Ancient World 68 (ISBN 978-3-9819685-6-9; DOI: 10.17171/3-68) | www.edition-topoi.org

1 Introduction

North Africa's potential contribution to the understanding of the food production process has often been considered limited, and the earliest occurrences of food production on the continent have been regarded as mainly derivative.[1] Scholars often put strong emphasis on the lack of a local process of plant and animal domestication; this approach has resulted in a paradigm of Africa's supposed cultural delay with respect to the Levantine regions where crops were first domesticated ca. 10 500 years ago.[2] The appropriateness of the term 'Neolithic' for North African Holocene contexts has long been questioned,[3] but recent research has contributed to shifting this debate by adding a more nuanced understanding of this process in the Eastern Sahara and the southern Mediterranean littoral.[4]

The earliest evidence for exploitation of domestic crops in North Africa can be dated to the 6th millennium BC. The Mid-Holocene contexts of the Egyptian and Sudanese Nile Valley and the northern coast of Morocco are the sole source from which remains of domestic crops have been retrieved so far. In the Faiyum Depression, charred macro-remains belonging to emmer wheat (*Triticum dicoccum*), two-row (*Hordeum vulgare* ssp. *distichon*), and six-row (*Hordeum vulgare* ssp. *vulgare*) have been dated to ca. 4700–4400 BC.[5] The site of Merimde, located on the western edge of the Nile Delta, has also yielded evidence of domestic wheat and barley dated to ca. 5000–4500 BC.[6] Einkorn/emmer (*Triticum monococcum/dicoccum*), free threshing wheat (*Triticum aestivum/durum*), and barley (*Hordeum vulgare*) macro-remains have been found in the Early Neolithic layers (ca. 5500–4700 BC) of the Moroccan sites of Kaf That el-Ghar, Khil, and Ifri Oudadane.[7] Domestic *Triticum* sp. and/or *Hordeum* sp. phytoliths and starches also come from the two Neolithic cemeteries of Ghaba and R12 in Sudan; these have been dated from ca. 5600 to 4500 BC.[8] A rapid diffusion of farming activities, evidenced by an increase in the size of the settlements and number of storage features, occurred at the end of the 5th millennium BC along the Nile Valley.[9] Differently, direct evidence for a dispersion of farming along the North African littoral remains substantially scarce before the 1st millennium BC.[10]

The Early and Mid-Holocene contexts of the North African littoral east of the Gulf of Sirte and the Eastern Sahara yielded strong evidence of an intensive exploitation of wild plants, mainly grasses and domestic caprines, but no macro-remains belonging to domestic crops have been identified so far.[11] The data coming from these regions are essential in order to understand how domestic animals and plants from the Levant diffused across the North African littoral and the Sahara, and how their use was added into a broad-spectrum economy, which still remained based primarily on the exploitation of wild resources.

This paper discusses the results of our previous work[12] on selected non-knapped stone tools from the Mid-Holocene deposits of the Haua Fteah Cave in Cyrenaica, Libya and Hidden Valley Village, Farafra Oasis, Egypt (Fig. 1) in order to provide new information on the role that wild taxa may have played in the ancient economy of the two regions. The data that has recently emerged from the analysis of macro and micro-wear analysis, combined with residue analysis, is here discussed and reviewed in a wider Northern African context.

2 Materials and methods

The Haua Fteah is a huge limestone karstic concavity located 10 km east of the ancient city of Apollonia, ca.20 km north of Cyrene and less than a kilometer from the Mediterranean shore. The site was first explored in the 50's by the University of Cambridge.[13] The same

1 A. B. Smith 1989.
2 Zohari, Hopf, and Weiss 2012.
3 Barich 1980; Barich 1984; Bishop and Clark 1967; Sinclair, Shaw, and Andah 1993.
4 Barich and Lucarini 2014; Barich, Lucarini, et al. 2014; Lucarini 2013; Lucarini, Radini, et al. 2016; Wendorf, Schild, and Associates 2001.
5 Wendrich, Taylor, and Southon 2010.
6 Hawass, Hassan, and Gautier 1988.
7 Morales, Pérez-Jordà, et al. 2013; Morales, Pérez Jordà, et al. 2016.
8 Madella, García-Granero, et al. 2014.
9 Wetterstrom 1993, 167.
10 Lucarini 2016; Broodbank and Lucarini 2019.
11 Barakat and Fahmy 1999; Barker, Antoniadou, Brooks, et al. 2009; Fahmy 2001; Fahmy 2014; Lucarini, Radini, et al. 2016; Thanheiser 2011; Wasylikowa 2001.
12 Lucarini, Radini, et al. 2016; Lucarini and Radini 2020.
13 McBurney 1967.

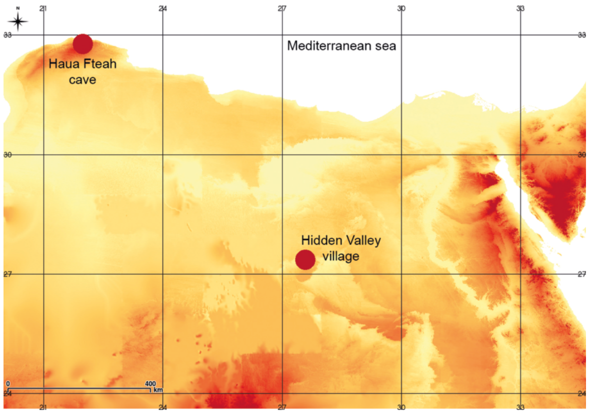

Fig. 1 Map with the location of the two sites mentioned in the text.

Fig. 2 The Haua Fteah cave, Cyrenaica, Libya.

university resumed the investigation of the site between 2007 and 2015 in the framework of the 'Cyrenaican Prehistory Project', which aimed to investigate the relationships between cultural and environmental change over the past ca. 200 000 years along the Libyan littoral (Fig. 2).[14]

The eleven dates for the Neolithic layers of the Upper Trench span approximately between ca. 5700 and 3500 BC.[15] The palaeobotanical analysis carried out from the Haua Fteah sample column by Morales and van der Veen[16] testifies to the presence of only wild species in the Neolithic layers – including Mediterranean shrubs or trees like myrtle (*Myrtus communis*), as well as grasses (the Poaceae family), and vetches (the *Vicia* genus). The groups populating the cave during the Holocene were practicing a mixed economy, combining an intensive exploitation of marine and terrestrial gastropods,[17] wild grasses consumption, associated with herding domestic caprines and, at a lower scale, cattle.[18] The Haua Fteah non-knapped tools assemblage is made up of 79 informal stone implements coming from the Neolithic levels of the cave. The artefacts were usually not manufactured; limestone pebbles, naturally available in the vicinity of the cave, were exploited as handstones. In the assemblages, only two handstones have been found that have proven to have been specifically manufactured. Only upper elements were found in the cave, which did not yield any lower items (e.g. saddle querns or palettes) (Fig. 3).

Considering this absence, we can assume that lower items may be still buried in the unexcavated deposit of the cave or that bedrock outcrops were utilized as the base-stones for grinding activities. Of the 79 implements found in the Haua Fteah Cave, only six handstones showed morphological characteristics that are consistent with a possible use as grinders. These tools were selected and underwent a combined use-wear and residue analysis.

Hidden Valley is a slab structure site located along the course of the Wadi el-Obeiyid, a large valley that opens between the Northern Limestone Plateau and the Quss Abu Said Plateau north of the Farafra Oasis (Fig. 4). The site, located on the shore of an ephemeral pool, was seasonally occupied from ca. 6600 to 5200 BC by human groups practicing a multi-spectrum exploitation of the environment; this included an intensive use of wild plants, hunting activities, exploitation of ostriches, and, starting from ca. 6100 BC, caprine herding.[19] The results from excavation of the site have highlighted the importance of wild grass exploitation for the Mid-Holocene groups settled in the region.[20] This site yielded a very rich assemblage of plant macro-remains that were analyzed by A.G. Fahmy;[21] among these, wild *Sorghum* and other species of grasses are prevalent. The Hidden Valley non-knapped tool assemblage consists of

14 Barker, Antoniadou, Brooks, et al. 2009, 90.
15 Barker, Antoniadou, Brooks, et al. 2009, 90; Douka et al. 2014, 46.
16 Barker, Brooks, et al. 2008; Barker, Antoniadou, Brooks, et al. 2009; Barker, Antoniadou, Armitage, et al. 2010.
17 Hill et al. 2015.
18 Stimpson, pers. comm. 2015.
19 Gautier 2014.
20 Lucarini 2014.
21 Fahmy 2001; Fahmy 2014.

Fig. 3 Haua Fteah Cave. Upper grinders from the Neolithic layers of the cave (a: HFT 1955/7 - HFT 399.00-55, Layer VI-VIII); b: HFT 1955/9 - HFT 160.02.2005, Layer VIII; c: HFT 1955/3 (1) - HFT 192.09, Layer VI; and d: HFT 1955/5 - HFT 193.14.2005, Layer VI-VII-IX-X.

37 items, including ground upper grinders and lower querns (Figs. 5 and 6). Use-wear and residue analyses were carried out on a sample of artefacts coming from the different stratigraphic layers of the site. The items found scattered on the surface within the gridded area of the site were not analyzed.

The presence of possible residues was observed on both assemblages as a first step, by means of a Leica M250C incident-light stereomicroscope at magnifications between 8x and 160x.

Once locations of interest had been identified, these were 'spot sampled' following established protocols for the extraction of microfossils.[22] Microfossils extracted from the samples were mounted on slides.[23] All slides were examined at magnifications of 200x, 400x, and 630x (oil immersion) using Olympus and Zeiss compound microscopes. Lighting conditions included brightfield and cross-polarized light. The extraction and mounting were conducted under controlled conditions in a clean lab.

22 Torrence and Barton 2006.

23 Lucarini, Radini, et al. 2016, 85.

As pointed out in our previous work,[24] due to the complex vegetation history of North Africa, which comprises species of both Mediterranean and tropical origin during the Holocene, the identification was conducted using a large reference collection made up of: 1) species of plants already identified among the macro remains by Morales and Van der Veen in Haua Fteah[25] and by Fahmy in Farafra[26]; 2) a wider variety of domesticated and wild plants known to produce starch granules that were collected by the authors during fieldwork in Egypt, Italy, Libya, and Sudan; and 3) published assemblages of starch granules and phytoliths were also considered as reference samples.[27]

After the residues were extracted, the artefacts were washed with water and washing-up liquid, before undergoing use-wear analysis. The identification and characterization of the use-wear was carried out both at low and high power observation. The low power approach was performed on both assemblages using the same Leica M250C stereomicroscope at magnifications between 8x and 160x. Features such as levelled (flattened) areas, fractures, edge rounding, and polish were recorded following the protocol developed by Adams and colleagues.[28] The high power approach was performed only on the Hidden Valley assemblage, using a Leica DM2700 free-arm metallographic microscope at magnifications between 50x and 200x. The micro-wears detected on the tool surfaces were compared with those present on modern examples produced via experiments, which are part of the reference collection of the Laboratory for Artefact Studies, University of Leiden.

3 Results

Tools from Haua Fteah that have been interpreted as grinders often show a flat irregular surface topography, which is levelled and polished.[29] Levelling affects high and low topographic points, creating a flat morphology and a smooth texture (Fig. 7a). A highly reflective polish is often spread all over the surface, affecting both high points and interstices. In the turtle-shell type grinders, a heavy polish is also present on the central area of the convex surface (Fig. 7c). Tools' grinding surfaces often show fractured or extracted quartz grains, possibly caused by rejuvenation activities such as repecking (Fig. 7b). In a few cases, siliceous fibrous plant residues were detected and visible inside the small cavities on the tool's surfaces (Fig. 8).[30]

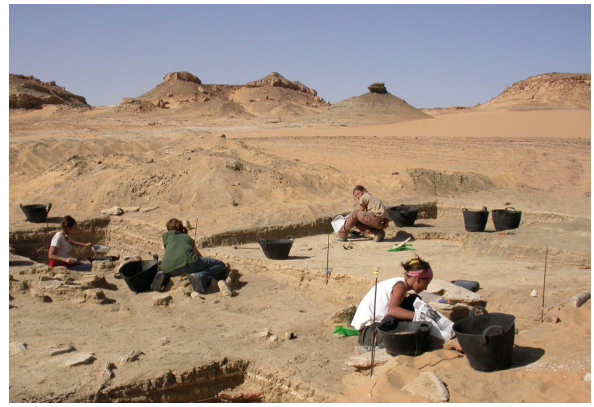

Fig. 4 Hidden Valley Village, Farafra Oasis, Egypt. Excavation of the site.

At a lower power of observation, upper grinders from Hidden Valley showed two grinding surfaces characterized by an irregularly flat micro-topography. The surfaces show very pronounced levelled areas (Fig. 9a). These were caused by a prolonged use of the tools, which lead to the smoothing of the rough surfaces and to the formation of a polish on the artefact's grinding surface. The most levelled areas are often associated with a very developed polish. Both quartz grain fracturing and extraction, sometimes quite deep, are also present, especially on the central area of the tools' surfaces (Fig. 9b). These were the effect of surface repecking. At the high power observation, polish appears granular and quite reflective. It is present in patches all over the tools' surfaces; it affects not only the high microtopography but also the grain's intermediate areas. It develops on the quartz grains' crests in an elongated way, in correspondence to a quite pronounced rounding of the grain's

24 Lucarini, Radini, et al. 2016, 86–87.
25 Barker, Brooks, et al. 2008; Barker, Antoniadou, Brooks, et al. 2009; Barker, Antoniadou, Armitage, et al. 2010.
26 Fahmy 2001; Fahmy 2014.
27 Henry, Hudson, and Piperno 2009; Leonard et al. 2015; Madella, Lancellotti, and García-Granero 2016; Tao et al. 2015; Torrence and Barton 2006; Wang et al. 2016; Yang, Zhang, et al. 2012; Yang, Ma, et al. 2014.
28 Adams et al. 2009.
29 Lucarini, Radini, et al. 2016, 81–82.
30 Lucarini, Radini, et al. 2016, 84.

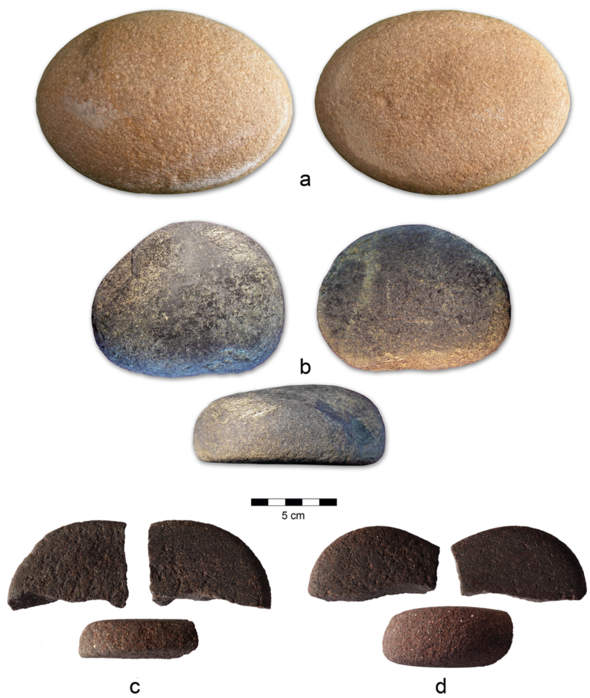

Fig. 5 Hidden Valley Village. Upper grinders from the site (a: Square I/3, Layer IIa; b: Square A/4b, Layer II; c: Square A/1b, Layer IIa, Feature 9; and d: Square G/4d1, Layer III).

Fig. 6 Hidden Valley Village. Fragment of lower quern (Square F/1, Layer II, Feature 48) from the site.

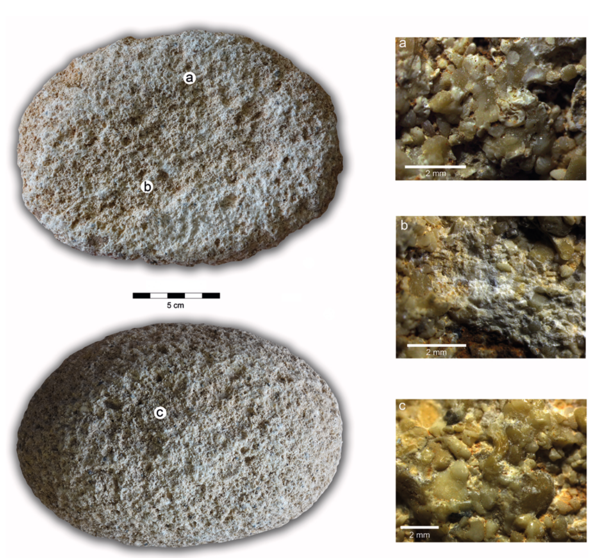

Fig. 7 Haua Fteah Cave. Ground turtle shell-type upper grinder HFT 1955/7 - HFT 399.00-55, Layer VI-VIII (a: levelled areas and slightly reflective polish; b: white crust-like areas resulting from grain fracturing; and c: highly reflective polish).

Fig. 8 Haua Fteah Cave. Turtle shell-type upper grinder HFT 1955/9 - HFT 160.02.2005, Layer VIII. Crevice containing fibrous plant residues.

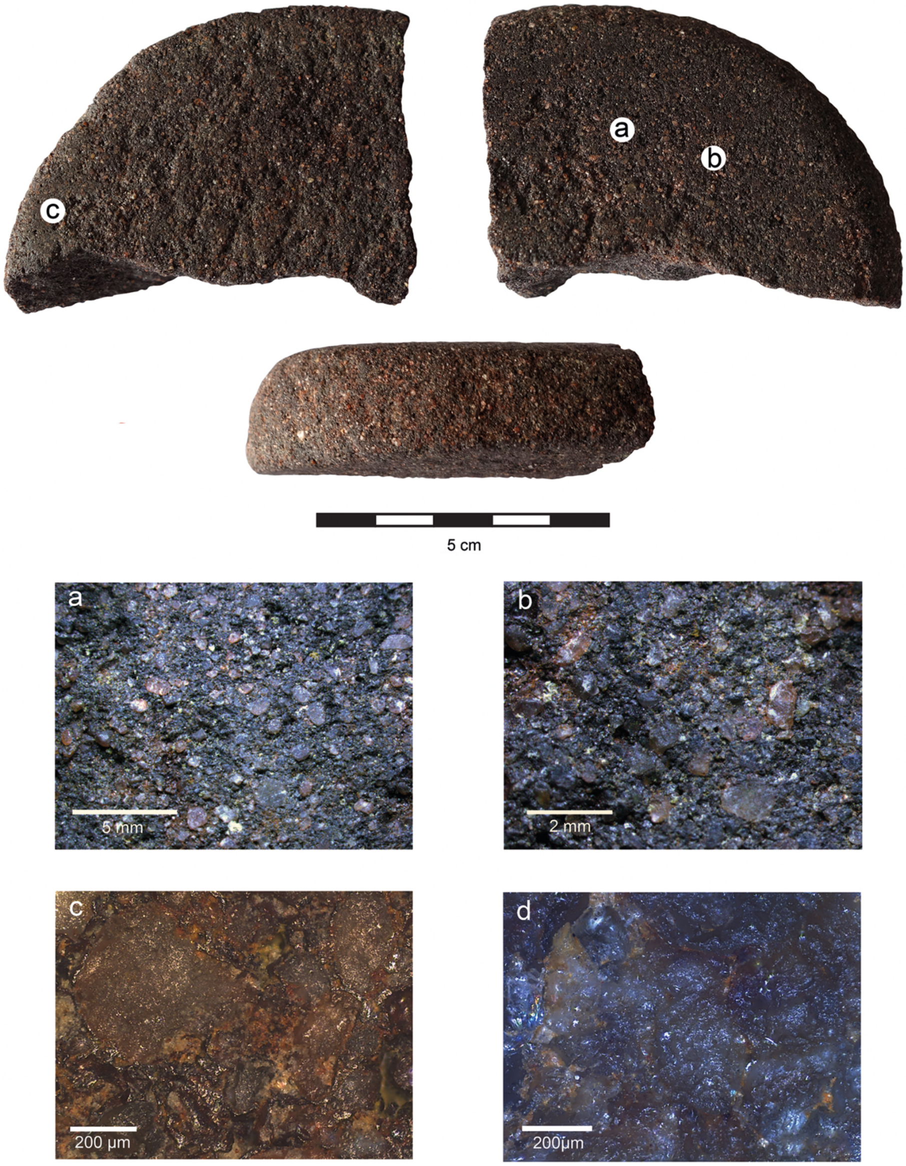

Fig. 9 Hidden Valley Village. Fragment of the upper grinder from Square A/1b, Layer IIa, Feature 9 (a: levelled areas; b: fractured and extracted grains; c: granular reflective polish resulting from plant processing; and d: granular reflective polish on experimental tool used for grinding dry einkorn wheat).

working edge. When the upper part of the quartz grain is levelled, the polish is spread not only on it, but also extends to the peripheral areas of the grain that are not levelled and lower in topography. Moreover, it also affects the surface of the small interstices and cavities that are present on top of the quartz grain's surface, thus confirming the very high degree of its development (Fig. 9c). The polish directionality varies from patch to patch; this is not surprising if we consider that the circular or sub-circular shape of the analyzed grinders could allow their use not only along one axis.[31]

The results of starch analysis at the two locations produced important results regarding the use of wild grasses (Tab. 1). At Hidden Valley, starch granules were retrieved in large numbers, often above 100 granules/sample. This is thought to be due to the presence of calcium carbonate sealing the remains from the surrounding deposit, thus protecting them from deterioration. Both Haua Fteah and Hidden Valley had remains of starch granules sufficiently preserved to be identified at least at the tribe level, but in some cases suggestions of sub-tribe or even genus were proposed based upon

31 Lucarini and Radini 2020.

Site	Sample	Tool	Context / Layer	Extraction point	St 1	St 2	St 3	St 4	St 5	OrSt
Hidden Valley village	F1	HV1	2001 A/4b Layer II	Surface 1	70		3	36	12	x
Hidden Valley village	F2	HV2	2001 A/4d Layer II	Surface 1	15					x
Hidden Valley village	F3	HV3	1999 A/1b Layer IIa feature 9	Surface 1	48	12	2	60	46	x
Hidden Valley village	F4	HV3	1999 A/1b Layer IIa feature 9	Surface 2	45	40	2			x
Hidden Valley village	F5	HV5	1999 F/3a Layer IIa	Surface 1	11	28	3	11	40	x
Hidden Valley village	F7	HV7	1999 I/2d Layer IIa feature 67	Surface 1	79	35	21		40	x
Hidden Valley village	F8	HV8	1998 I/3 Layer IIa Hearth feature 64	Surface 1	34		20	23	60	x
Hidden Valley village	F9	HV9	1998 I/3 Layer IIa	Surface 1	230	13	5		11	x
Hidden Valley village	F10	HV10	1998 I/3 Layer IIa Hearth feature 64	Surface 1	90		12		23	x
Hidden Valley village	F2015	HV2015	1998 G/4d1 Layer III	Surface 1	24		24	20	42	x
Hidden Valley village	F2016/1	HV2016	HV-VG96 E/4 II	Surface 1	34	23	45	12	32	x
Hidden Valley village	F2016/2	HV2016	HV-VG96 E/4 II	Surface 2		13	32		12	x
Haua Fteah cave	A6E6	HF6	AE6	Surface 1				8		x
Haua Fteah cave	A6E2	HF6	AE6	Surface 2				1		x

Tab. 1 Summary table of the starch granules retrieved from the Hidden Valley Village and Haua Fteah Cave grinding tools (St 1: Eragrostideae; St 2: Digitariineae; St 3: Andropogoneae; St 4: Cenchrineae; St 5: Setariineae; Or St: Other unidentified starch granules; x: present).

size and morphology. Starch granules of overall polyhedral shapes with a clear extinction cross were found at both sites, and it was possible to assign them to different sub-tribes of Paniceae based upon morphology. In Haua Fteah, intact starch granules are large, around and above 20 µm; sub-round to polyhedral in shape; and show a central fissured hilum with a high number of thin fissures radiating from it. Such fissures expand over almost the entire granule surface, giving the granules a distinctive stellate aspect and a very glossy appearance. The large granules retrieved were thought likely to be those of the sub-tribe Cenchrineae. Overall, the starch granules found have an extraordinary resemblance to species belonging to the genus *Cenchrus*, such as *Cenchrus biflorus* (Fig. 10 d2), which have starch granules sub-round to polyhedral and the sub-round granules show a high number of fissures radiating from the hilum.[32] Starch granules possibly belonging to the sub-tribe Cenchrineae have also been found in Hidden Valley (Fig. 10 d1); the presence of seeds belonging to the *Cenchrus* type was already reported in the macro-botanical assemblage.[33] Hidden Valley also yielded another type of starch granule belonging to the tribe Paniceae; these were found to be smaller and more angular than the others and likely consistent with those belonging to the sub-tribe Setariineae (Fig. 10 c1). *Setaria verticillata* (Fig. 10 c2) is one of the species found in the Hidden Valley macro-botanical assemblage. *Brachiaria* and *Urochloa*, which are both present in the Hidden Valley macro-botanical assemblage, also belong to the sub-tribe Setariineae, but considering the size of their starch granules, much larger than our archaeological micro-remains, they have been excluded.[34]

The large data set from Hidden Valley also allowed for the retrieval of starch granules of 3 tribes other than the Paniceae:[35]

32 Lucarini, Radini, et al. 2016, 88.
33 Fahmy 2014.
34 Lucarini and Radini 2020, 79.
35 Lucarini and Radini 2020, 76–79.

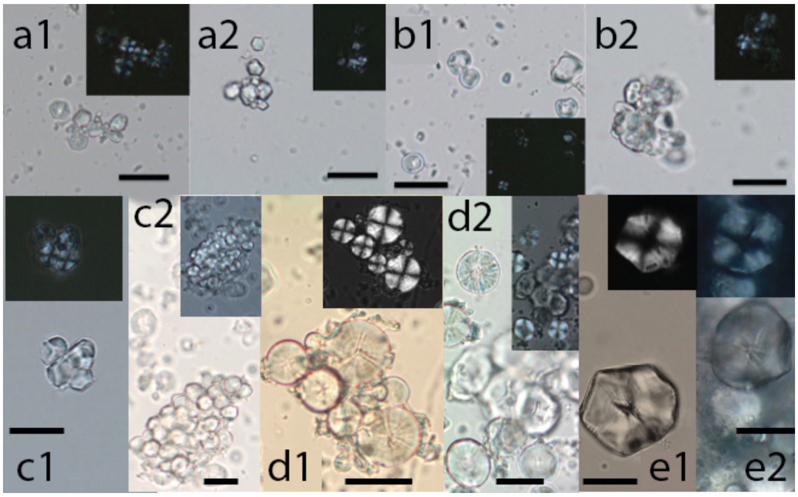

Fig. 10 Starch granules from archaeological tools compared with modern reference collection (a1: Eragrostidae from tool HV3; a2: Modern *Eragrostis cilianensis* from Egypt; b1: Digitariineae from tool HV9; b2: Modern *Digitaria sanguinalis* from Egypt; c1: Paniceae, sub-tribe Setariineae from tool HV1; c2: Modern *Setaria verticillata* from Italy; d1: Paniceae, sub-tribe Cenchrineae from tool HV1; d2: Modern *Cenchrus biflorus* from Niger; e1: Andropogoneae from tool HV3; and e2: Modern *Sorghum bicolor* from Libya. *All scale bars: 20 μm*).

- Tribe Eragrostideae (Fig. 10 a1): Polyhedral starch granules with angular and sharp facets and a hilum that is central and often sunken and fissured, ranging from 5 to 10 μm. Such starch granules are found in the tribe of Eragrostideae, sub-tribe Eleusininae, of which the species *Dactyloctenium aegyptium* and species of the genus *Eragrostis* spp. are widely represented in many North African macro-botanical assemblages. The starch granules in our analysis are very similar to those belonging to the genus *Eragrostis* (Fig. 10 a2), which was not found in the plant macro-remains assemblage.

- Tribe Digitariineae (Fig. 10 b1): Starch granules showing a more irregular but still polyhedral shape. Extinction cross is less sharp and appears somewhat smaller than the one belonging to the tribe Eragrostideae starch granules. In our reference collection, such starch granules are found in the tribe Digitariineae, of which *Digitaria sanguinalis* (Fig. 10 b2) has the closest similarity, and it has been found in the plant macro-remains record.

- Tribe Andropogoneae (Fig. 10 e1): Starch granules larger than the others, still polyhedral, often with a central, fissured, or stellate hilum, which appear very similarly to those of the tribe Andropogoneae, species *Sorghum bicolor* (Fig. 10 e2), and very likely belong to *Sorghum arundinaceum* as this dominates the archaeobotanical record.

None of the locations produced any starch granule consistent with barley or wheat or any of their wild ancestors, which are known to have starch granules characterized by a bimodal distribution of small round starch granules and large sub-oval ones.[36]

4 Discussion

At a lower power of observation, the upper grinders from Haua Fteah and Hidden Valley show traces of intensive use, evidenced by the presence of levelled areas and edge roundings often associated with developed polish. Various stages of tool use can be also detected from the clear evidence for rejuvenation activities, noted on the grinders' surfaces, such as repecking. An analysis of the micro wear on experimental grinders used to grind dry einkorn wheat showed their polish to be granular in appearance and similar to the granular/spider-web like appearance of the archaeological tools from Hidden Valley (Fig. 9 c–d). This similarity, together with the incidence of the polish on both high and low microtopography, its high reflectivity and patchy development in both the modern and archaeological samples, confirms that the Hidden Valley grinders must have been used to process plants at some point.

In terms of species composition, the results obtained from the plant micro-remains analysis at Hidden Valley are mainly consistent with the ones from the macro-

36 Henry, Hudson, and Piperno 2009; Yang, Zhang, et al. 2012.

remains assemblage. However, from both locations, some types of starch granules provided new data and did not match any of the species present among the macrobotanical remains: at Hidden Valley starch granules from the tribe Eragrostideae, likely the sub-tribe Eleusininae and very similar to the starch granules belonging to the genus Eragrostis,[37] and at Haua Fteah, starch granules from the Paniceae tribe, sub-tribe Cenchrineae, whose species are also not present in the macro-remain assemblage.[38] Species of the sub-tribe Cenchrineae that are common in the desert are those belonging to the genus *Cenchrus* and *Pennisetum*, both of which would need the bristles removed. Overall, the analysis of the starch granules extracted from the Hidden Valley and Haua Fteah tools has confirmed the absence of domesticated crops and their relatives at both these sites.

Both in Hidden Valley and Haua Fteah, the lack of farming activities is also consistent with a lack of harvesting tools, such as sickle blades. Only two small gloss-banded blades, interpreted as possible sickle elements, were found during the 1950s excavations of Haua Fteah.[39] All this considered, the idea that wild plants may have been gathered with peoples' bare hands or using unhafted and unretouched tools, which may have been used as opportunistic knives/sickles, cannot be ruled out, as already evidenced by the findings from Farafra.[40]

Although the majority of North African archaeological contexts have yielded clear evidence of an intense exploitation of wild resources during the Mid-Holocene, the role of these non-domesticated taxa has often been underestimated. The general assumption is that when domesticates were first imported into the region, the legacy represented by thousands of years' worth of wild resource exploitation fell into oblivion. Although it is already clear that this model is not appropriate to understand the Mid-Holocene sites of the Eastern Sahara and the Cyrenaican coast, can it be used in the study of the North African littoral and other regions along the Nile Valley? In light of recent research, it is clear that even for the contexts that yielded the earliest evidence of domesticated crop processing in Egypt (e.g. Faiyum and the early Merimdian occupation at Merimde), cultivation of domestic crops was only a marginal component of a mixed economy based on the combined exploitation of wild and domestic resources.[41] The marginal use of domesticated plants is also attested in the Moroccan region where they represent only a very small part of the palaeobotanical assemblage, for example, at the site of Ifri Oudadane. They range from 0.2% in the Early Neolithic A (5600–5300 BC) through to 0.9% in the Early Neolithic B (5100–4700 BC), to 1.7% in the Early Neolithic C (4600–4400 BC).[42] A much stronger reliance on domestic plants is, on the contrary, attested from the Early Neolithic layers of Kaf That el-Ghar (5500–5200 BC) and Khil (5300–5000 BC) in the Tangier region.[43]

Given the capacity of wild plants to adapt easily to adverse environmental conditions, North African groups relied on wild resources, mainly plants, to face food shortages. The exploitation of wild plants is a low cost and easily reversible strategy requiring little productive capacity on the part of human groups. It, therefore, tends to represent the most immediate response to a food shortage.[44] It was under this framework that the human-plant relationship became stronger, with the wild species gaining more and more importance for the human groups settled in the Sahara and along the North African coast during this period. During times of severe food shortages, a number of these plant species may have been chosen based on their nutritional properties, even if they were inefficient in terms of the time and energy required to process them. Take, for example, the case of *Cenchrus biflorus*. Its grains are found in a 'spiny' envelope comprised of modified leaves; this thorny package, therefore, makes gathering and processing this particular species quite time consuming. This is why *Cenchrus*, despite its high nutritional yield, is at present only made use of during times of extreme famine, as noted in studies on the Tuaregh and Zagawa communities.[45] Other studies have also shown that when food shortages are recurrent, human diets begin to rely more heavily on wild foods, to the point that these continue to be a primary

37 Fahmy 2001; Fahmy 2014.

38 Barker, Brooks, et al. 2008; Barker, Antoniadou, Brooks, et al. 2009; Barker, Antoniadou, Armitage, et al. 2010.

39 McBurney 1967, 298.

40 Lucarini 2014.

41 Holdaway, Wendrich, and Phillipps 2010; Tassie 2014, 204–205.

42 Morales, Pérez-Jordà, et al. 2013; Morales, Pérez Jordà, et al. 2016.

43 Morales, Pérez Jordà, et al. 2016.

44 Watts 1983; Watts 1988.

45 M.-J. Tubiana and J. Tubiana 1977.

component even when food supplies return to normal and environmental conditions improve.[46] Studies carried out by Harlan have confirmed that even today more than 60 wild grass species continue to be collected and used in many parts of Africa.[47] Although these are generally only employed during periods of food shortages or extreme famines, some of them are a primary food source for a number of modern African groups. For example, collecting a range of wild grains for consumption is still today observed in a number of areas in the Saharan, Sahelian, and Near Eastern regions. *Kasha/kréb*, a mixture of about 12 different kinds of wild grasses that grow in the savannah and ripen at the same time, is at present one of the most important food sources of the Sahelian regions.[48] It is, therefore, not surprising to find that the species comprising the modern *kréb* – *Panicum, Eragrostis, Digitaria, Dactyloctenium aegyptiacum, Brachiaria deflexa, Latipes senegalensis,* and others – have also been identified among the residues extracted from the grinding equipment recovered from the Hidden Valley.

5 Conclusions

The importance of wild plants in the economy of North African prehistoric groups has often been underestimated, especially after the Levantine domesticated crops, the so-called 'noble grains', were imported into North Africa. Data from the archaeological contexts investigated here showed, on the contrary, how North African wild plants represented a primary source of food for people during the Neolithic. Despite being located in two different eco-zones and being characterized by contrasting past environments, the Holocene deposits of the Haua Fteah Cave (Cyrenaica), Libya, and Hidden Valley, Farafra Oasis (Egyptian Western Desert), have so far produced archaeobotanical assemblages exclusively made up of wild plants, among which are several species of grasses.[49] The situation presented by the other North African regions during the Early and Mid-Holocene is also a complex one, showing a high degree of variability due to different ecosystems, giving rise to different adaptations, but all with a common feature: their heavy reliance on wild resources.[50] The economies of North African groups at this time entailed low-risk subsistence strategies centered around the hunting, gathering, and fishing of wild resources. Local wild foods, however, were not replaced with the introduction of domestic species from the Levant around 6200 BC; they instead, supplemented these wild resource-centered strategies, providing a greater degree of predictability, but not necessarily increased productivity.

Wild grasses, especially *Sorghum*, were heavily exploited and the only evidence of domestic wheat and barley during the 6th and 5th millennia available so far (dated between ca. 5600 and 4400 BC) is from the Nile Valley and the northern coast of Morocco;[51] even in these contexts, the exploitation of domesticated crops was undertaken alongside foraging activities, and it was only after some time, and along the Nile only, that these groups became more fully committed to agriculture. For these reasons, the use of definitions such as 'low-level food producers' today seems much more appropriate as a way to describe this kind of adaptation to the environment.[52] Investigating and better characterizing the 'middle ground', as defined by Smith,[53] seems today the only way to better understand the role played by wild resources in the process of North African Neolithisation and to give wild plants back the noble status they so richly deserve and which has been disregarded for far too long.

46 Huss-Ashmore and Johnston 1994, 63.
47 Harlan 1989, 79.
48 Harlan 1992, 23.
49 Barker, Antoniadou, Armitage, et al. 2010; Fahmy 2001; Fahmy 2014.
50 Lucarini, Radini, et al. 2016.
51 Hawass, Hassan, and Gautier 1988; Madella, García-Granero, et al. 2014; Morales, Pérez Jordà, et al. 2016; Wendrich, Taylor, and Southon 2010.
52 Holdaway, Wendrich, and Phillipps 2010; B. D. Smith 2001.
53 B. D. Smith 2001.

Bibliography

Adams et al. 2009
Jenny L. Adams, Selina Delgado-Raack, Laure Dubreuil, Caroline Hamon, Hugues Plisson, and Roberto Risch. "Functional Analysis of Macro-Lithic Artefacts. A Focus on Working Surfaces." In *Non-Flint Raw Material Use in Prehistory. Old Prejudices and New Directions*. Ed. by F. Sternke, L. Eigeland, and L.-J. Costa. Oxyford: Archaeopress, 2009, 42–66.

Barakat and Fahmy 1999
Hala Barakat and Ahmed Gamal el-Din Fahmy. "Wild Grasses as "Neolithic" Food Resources in the Eastern Sahara. A Review of the Evidence from Egypt." In *The Exploitation of Plant Resources in Ancient Africa*. Ed. by M. Van der Veen. New York: Kluwer Academic/Plenum Publishers, 1999, 33–46.

Barich 1980
Barbara E. Barich. "Pour une definition du Néolithique en Afrique du Nord et au Sahara." In *Proceedings of the 8th Panafrican Congress of Prehistory and Quaternary Studies, Nairobi, 1977*. Ed. by R. E. Leakey and B. A. Ogot. Nairobi: International Louis Leakey Memorial Institute for African Prehistory, 1980, 271–272.

Barich 1984
Barbara E. Barich. "Fieldwork in the Tadrart Acacus and the "Neolithic" of the Sahara." *Current Anthropology* 25.5 (1984), 683–686.

Barich and Lucarini 2014
Barbara E. Barich and Giulio Lucarini. "Social Dynamics in Northern Farafra from the Middle to Late Holocene. Changing Life under Uncertainty." In *From Lake to Sand. The Archaeology of Farafra Oasis, Western Desert, Egypt*. Ed. by B. E. Barich, G. Lucarini, M. A. Hasan Hamdan, and F. A. Florence: All'Insegna del Giglio, 2014, 467–484.

Barich, Lucarini, et al. 2014
Barbara E. Barich, Giulio Lucarini, Mohamed A. Hamdan, and Fekri A. Hassan. *From Lake to Sand – The Archaeology of Farafra Oasis, Western Desert, Egypt*. Florence: All'Insegna del Giglio, 2014.

Barker, Antoniadou, Armitage, et al. 2010
Graeme Barker, Annita Antoniadou, Simon Armitage, Ian Brooks, Ian Candy, Kate Connell, Katerina Douka, Nicholas Drake, Lucy Farr, Evan Hill, Chris Hunt, Robyn Inglis, Sacha Jones, Christine Lane, Giulio Lucarini, John Meneely, Jacob Morales, Giuseppina Mutri, Amy Prendergast, Ryan Rabett, Hazel Reade, Tim Reynolds, Natalie Russell, David Simpson, Bernard Smith, Chris Stimpson, Mohammed Twati, and Kevin White. "The Cyrenaican Prehistory Project 2010. The Fourth Season of Investigations of the Haua Fteah Cave and Its Landscape, and Further Results from the 2007–2009 Fieldwork." *Libyan Studies* 41 (2010), 63–88.

Barker, Antoniadou, Brooks, et al. 2009
Graeme Barker, Annita Antoniadou, Ian Brooks, Ian Candy, Nicholas Drake, Lucy Farr, Chris Hunt, Robyn Ibrahim A. A. Inglis, Sacha Jones, Jacob Morales, Giuseppina Mutri, Ryan Rabett, Tim Reynolds, David Simpson, Mohammed Twati, and Kevin White. "The Cyrenaican Prehistory Project 2009. The ThirdSeason of Investigations of the Haua Fteah Cave and Its Landscape, and Further Results from the 2007–2008 Fieldwork." *Libyan Studies* 40 (2009), 55–94.

Barker, Brooks, et al. 2008
Graeme Barker, Ian Brooks, Lucilla Burn, Caroline Cartwright, Franca Cole, John Davison, Lucy Farr, Rainer Grün, Roisin Hamilton, Chris Hunt, Robyn Inglis, Zenobia Jacobs, Victoria Lech, Jacob Morales, Iain Morley, Mike Morley, Steven Pawley, Alex Pryor, Ryan Rabett, Tim Reynolds, Hwedi el-Rishi, Richards Roberts, David Simpson, Mohammed Stimpson Chris Touati, and Maijke van der Veen. "The Cyrenaican Prehistory Project 2008. The Second Season of Investigations of the Haua Fteah Cave and Its Landscape, and Further Results from the Initial (2007) Fieldwork." *Libyan Studies* 39 (2008), 1–51.

Bishop and Clark 1967
Walter W. Bishop and J. Desmond Clark, eds. *Background to Evolution in Africa*. Chicago: University of Chicago Press, 1967.

Broodbank and Lucarini 2019
Cyprian Broodbank and Giulio Lucarini. "The Dynamics of Mediterranean Africa, ca. 9600–1000 bc: An Interpretative Synthesis of Knowns and Unknowns." *Journal of Mediterranean Archaeology* 32.2 (2019), 195–267.

Douka et al. 2014
Katerina Douka, Zenobia Jacobs, Christine Lane, Rainer Grün, Lucy Farr, Chris Hunt, Robyn H. Inglis, Tim Reynolds, Paul Albert, Maxime Aubert, Victoria Cullen, Evan Hill, Leslie Kinsley, Richard G. Roberts, Emma L. Tomlinson, Sabine Wulf, and Graeme Barker. "The Chronostratigraphy of the Haua Fteah Cave (Cyrenaica, Northeast Libya)." *Journal of Human Evolution* 66 (2014), 39–63.

Fahmy 2001
Ahmed Gamal el-Din Fahmy. "Palaeoethnobotanical Studies of the Neolithic Settlement in Hidden Valley, Farafra Oasis, Egypt." *Vegetation History and Archaeobotany* (2001).

Fahmy 2014
Ahmed Gamal el-Din Fahmy. "Plant Food Resources at Hidden Valley, Farafra Oasis." In *From Lake to Sand. The Archaeology of Farafra Oasis, Western Desert, Egypt*. Ed. by B. E. Barich, G. Lucarini, M. A. Hamdan, and F. A. Hassan. Florence: All'Insegna del Giglio, 2014, 333–344.

Gautier 2014
Achilles Gautier. "Animal Remains from the Hidden Valley Neolithic Site, Farafra Oasis." In *From Lake to Sand. The Archaeology of Farafra Oasis, Western Desert, Egypt*. Ed. by B. E. Barich, G. Lucarini, M. A. Hamdan, and F. A. Hassan. Florence: All'Insegna del Giglio, 2014, 369–374.

Harlan 1989
J. R. Harlan. "Wild-Grass Seed Harvesting in the Sahara and Sub-Sahara of Africa." In *Foraging and Farming. The Evolution of Plant Exploitation*. Ed. by D. R. Harris and G. C. Hillman. London and New York: Routledge, 1989, 79–99.

Harlan 1992
J. R. Harlan. "Wild Grass Seed Harvesting and Implications for Domestication." In *Préhistoire de l'Agriculture. Nouvelles Approches Expérimentales et Ethnographiques*. Ed. by P. C. Anderson. Paris: Centre national de la recherche scientifique, 1992, 21–27.

Hawass, Hassan, and Gautier 1988
Zahi Hawass, Fekri A. Hassan, and Achilles Gautier. "Chronology, Sediments, and Subsistence at Merimda Beni Salama." *Journal of Egyptian Archaeology* 74 (1988), 31–38.

Henry, Hudson, and Piperno 2009
Amanda G. Henry, Holly F. Hudson, and Dolores R. Piperno. "Changes in Starch Grain Morphologies from Cooking." *Journal of Archaeological Science* 36.3 (2009), 915–922.

Hill et al. 2015
Evan A. Hill, Chris O. Hunt, Giulio Lucarini, Giusi Mutri, Lucy Farr, and Graeme Barker. "Land Gastropod Piercing during the Late Pleistocene and Early Holocene in the Haua Fteah, Libya." *Journal of Archaeological Science: Reports* 4 (2015), 320–325.

Holdaway, Wendrich, and Phillipps 2010
Simon J. Holdaway, Willecke Wendrich, and Rebecca Phillipps. "Identifying Low-Level Food Producers. Detecting Mobility from Lithics." *Antiquity* 84.323 (2010), 185–194.

Huss-Ashmore and Johnston 1994
Rebecca Huss-Ashmore and Susan L. Johnston. "Wild Plants as Cultural Adaptations to Food Stress." In *Eating on the Wild Side. The Pharmacologic, Ecologic and Social Implications of Using Noncultigens*. Ed. by N. L. Etkin. Tucson, AZ: The University of Arizona Press, 1994, 62–82.

Leonard et al. 2015
Chelsea Leonard, Layne Vashro, James F. O'Connell, and Amanda G. Henry. "Plant Microremains in Dental Calculus as a Record of Plant Consumption. A Test with Twe Forager-Horticulturalists." *Journal of Archaeological Science: Reports* 2 (2015), 449–457.

Lucarini 2013
Giulio Lucarini. "Was a Transition to Food Production Homogeneous along the Circum-Mediterranean Littoral? A Perspective on the Neolithisation Research from the Libyan Littoral." In *Neolithisation of Northeastern Africa*. Ed. by N. Shirai. Berlin: Ex Oriente, 2013, 149–174.

Lucarini 2014
Giulio Lucarini. "Exploitation and Management of Wild Grasses at Hidden Valley, Farafra Oasis." In *From Lake to Sand – The Archaeology of Farafra Oasis, Western Desert, Egypt*. Ed. by B. E. Barich, G. Lucarini, M. A. Hamdan, and F. A. Hassan. Florence: All'Insegna del Giglio, 2014, 345–367.

Lucarini 2016
Giulio Lucarini. "Editorial: The Neolithic from the Sahara to the Southern Mediterranean Coast: A Review of the Most Recent Research." *Quaternary International* 410, Part A (2016), 2–5.

Lucarini and Radini 2020
Giulio Lucarini and Anita Radini. "First Direct Evidence of Wild Plants Grinding Process from the Holocene Sahara: Use-Wear and Plant Micro-Residue Analysis on Ground Stone Tools from the Farafra Oasis, Egypt." *Quaternary International* 555 (2020), 66–84.

Lucarini, Radini, et al. 2016
Giulio Lucarini, Anita Radini, Huw Barton, and Graeme Barker. "Exploitation of Wild Plants in Neolithic North Africa. Use-Wear and Residue Analysis on Non-Knapped Stone Tools from the Haua Fteah Cave, Cyrenaica, Libya." *Quaternary International* 410.Part A (2016), 77–92.

Madella, García-Granero, et al. 2014
Marco Madella, Juan José García-Granero, Welmoed A. Out, Philippa Ryan, and Donatella Usai. "Microbotanical Evidence of Domestic Cereals in Africa 7000 Years Ago." *PLoS One* 9.10 (2014).

Madella, Lancellotti, and García-Granero 2016
Marco Madella, Carla Lancellotti, and Juan José García-Granero. "Millet Microremains. An Alternative Approach to Understand Cultivation and Use of Critical Crops in Prehistory." *Archaeological and Anthropological Sciences* 8.1 (2016), 17–28.

McBurney 1967
Charles B. M. McBurney. *The Haua Fteah (Cyrenaica) and the Stone Age of the South-East Mediterranean*. Cambridge and London: Cambridge University Press, 1967.

Morales, Pérez Jordà, et al. 2016
Jacob Morales, Guillem Pérez Jordà, Leonor Peña-Chocarro, Youssef Bokbot, Juan Carlos Vera, Rafael M. Martínez Sánchez, and Jörg Linstädter. "The Introduction of South-Western Asian Domesticated Plants in North- Western Africa. An Archaeobotanical Contribution from Neolithic Morocco." *Quaternary International* 412 (2016), 96–109.

Morales, Pérez-Jordà, et al. 2013
Jacob Morales, Guillem Pérez-Jordà, Leonor Peña-Chocarro, Lydia Zapata, Mónica Ruíz-Alonso, Jose Antonio López-Sáez, and Jörg Linstädter. "The Origins of Agriculture in North-West Africa. Macro-Botanical Remains from Epipalaeolithic and Early Neolithic Levels of Ifri Oudadane (Morocco)." *Journal of Archaeological Science* 40 (2013), 2659–2669.

Sinclair, Shaw, and Andah 1993
Paul Sinclair, Thurstan Shaw, and Bassey Andah. "Introduction." In *The Archaeology of Africa. Food, Metals and Towns*. Ed. by T. Shaw, P. Sinclair, B. Andah, and O. Alex. London and New York: Routledge, 1993, 1–31.

A. B. Smith 1989
Andrew B. Smith. "The Near Eastern Connection. Early to Mid-Holocene Relations between North Africa and the Levant." In *Late Prehistory of the Nile Basin and the Sahara*. Ed. by L. Krzyzaniak and M. M. Kobusiewicz. Poznan: Poznan Archaeological Museum, 1989, 69–77.

B. D. Smith 2001
Bruce D. Smith. "Low-Level Food Production." *Journal of Archaeological Research* 9.1 (2001), 1–43.

Tao et al. 2015
D. Tao, J. Zhang, W. Zheng, Y. Cao, K. Sun, and S.-a. Jin. "Neolithic Morocco." *Journal of Archaeological Science: Reports* 2 (2015), 486–491.

Tassie 2014
Geoffrey John Tassie. *Prehistoric Egypt, Socioeconomic Transformations in North-East Africa from the Last Glacial Maximum to the Neolithic, 24.000 to 4.000 BC*. London: Golden House Publications, 2014.

Thanheiser 2011
Ursula Thanheiser. "Island of the Blessed. 8000 Years of Plant Exploitation in the Dakhleh Oasis, Egypt." In *Windows on the African Past. Current Approaches to African Archaeobotany*. Ed. by A. G. Fahmy, S. Kahlheber, and C. D'Andrea. Frankfurt a. M.: Africa Magna Verlag, 2011, 79–90.

Torrence and Barton 2006
Robin Torrence and Huw Barton, eds. *Ancient Starch Research*. Walnut Creek (CA): Left Coast Press, 2006.

M.-J. Tubiana and J. Tubiana 1977
Marie-José Tubiana and Joseph Tubiana. *The Zaghawa from an Ecological Perspective*. Rotterdam: A. A. Balkema, 1977.

Wang et al. 2016
Tingting Wang, Benjamin T. Fuller, Dong Xuan Wei, Xiaocheng E. Chang, and Yaowu Hu. "Investigating Dietary Patterns with Stable Isotope Ratios of Collagen and Starch Grain Analysis of Dental Calculus at the Iron Age Cemetery Site of Heigouliang, Xinjiang, China." *International Journal of Osteoarchaeology* 26.4 (2016), 693–704.

Wasylikowa 2001
Krystyna Wasylikowa. "Site E-75-6. Vegetation and Subsistence of the Early Neolithic at Nabta Playa, Egypt, Reconstructed from Charred Plant Remains." In *Holocene Settlement of the Egyptian Sahara. Vol. 1. The Archaeology of Nabta Playa*. Ed. by F. Wendorf and R. Schild. New York: Kluwer Academic/Plenum Publishers, 2001, 544–591.

Watts 1983
Michael Watts. *Silent Violence*. Berkeley, Los Angeles, and London: University of California Press, 1983.

Watts 1988
Michael Watts. "Coping with the Market. Uncertainty and Food Securing among Hausa Peasants." In *Coping with Uncertainty in Food Supply*. Ed. by I. De Garine and G. A. Harrison. Oxford: Clarendon Press, 1988, 260–289.

Wendorf, Schild, and Associates 2001
Fred Wendorf, Romuald Schild, and Associates. *Holocene Settlement of the Egyptian Sahara, Vol. I: The Archaeology of Nabta Playa*. New York, NY: Kluwer Academic/Plenum Publishers, 2001.

Wendrich, Taylor, and Southon 2010
Willeke Wendrich, R. Ervin Taylor, and John Southon. "Dating Stratified Settlement Sites at Kom K and Kom W. Fifth Millennium BCE Radiocarbon Ages for the Fayum Neolithic." *Instruments and Methods in Physics Research B* 268 (2010), 999–1002.

Wetterstrom 1993
Wilma Wetterstrom. "Foraging and Farming in Egypt. The Transition from Hunting and Gathering to Horticulture in the Nile Valley." In *The Archaeology of Africa. Food, Metals and Towns*. Ed. by T. Shaw, P. Siclair, B. Andah, and O. Aley. London and New York: Routledge, 1993, 165–226.

Yang, Ma, et al. 2014
Xiaoyan Yang, Zhikun Ma, Qan, Linda Perry, Xiujia Huan, Zhiwei Wan, Mingqi Li, and Jingyun Zheng. "Experiments with Lithic Tools. Understanding Starch Residues from Crop Harvesting." *Archaeometry* 56.5 (2014), 828–840.

Yang, Zhang, et al. 2012
Xiaoyan Yang, Jianping Zhang, Linda Perry, Zhikun Ma, Zhiwei Wan, Mingqi Li, Xianmin Diao, and Houyuan Lu. "From the Modern to the Archaeological. Starch Grains from Millets and Their Wild Relatives in China." *Journal of Archaeological Science* 39.2 (2012), 247–254.

Zohari, Hopf, and Weiss 2012
Daniel Zohari, Maria Hopf, and Ehud Weiss. *Domestication of Plants in the Old World. The Origin and Spread of Domesticated Plants in Southwest Asia, Europe, and the Mediterranean Basin*. Oxford: Oxford University Press, 2012.

Illustration and table credits

ILLUSTRATIONS: **1** G. Lucarini. **2** Photo: G. Lucarini. **3** Photos: G. Lucarini. **4** Photo: B. E. Barich. **5–9** Photos: G. Lucarini. **10** Photos: A. Radini. **TABLES:** **1** A. Radini.

GIULIO LUCARINI

Giulio Lucarini, PhD (University of Naples L'Orientale 2006) holds a permanent post as Researcher at the Institute of Heritage Science (ISPC), National Research Council of Italy (CNR) and an Adjunct Professorship in Prehistory and Protohistory at the University of Naples L'Orientale. Since finishing his PhD, his research has focused on human adaptations to the environment and on the emergence of food production in North Africa. He is interested in the study of material culture and how artefact assemblages reflect possible socio-economic change and modification in human-environment interactions.

Dr. Giulio Lucarini
Institute of Heritage Science (ISPC)
National Research Council of Italy (CNR)
Area della Ricerca di Roma 1, via Salaria km 29,300, C.P. 10, 00015 Monterotondo (Rome)
Italy

Other affiliations:
Department of Asian, African and Mediterranean Studies, University of Naples L'Orientale, Italy;
McDonald Institute for Archaeological Research, University of Cambridge, UK;
International Association for Mediterranean and Oriental Studies (ISMEO), Rome, Italy.

E-mail: giulio.lucarini@cnr.it

ANITA RADINI

Anita Radini, Ph.D. (University of York) is a Wellcome Trust Research Fellow in Medical Humanities at the Department of Archaeology, University of York. She is an archaeological scientist with over 15 years of experience in microfossils and plant macro-remains. Her research focuses on the complex interactions between people, their environment, and their health outcomes. She is interested in the study of 'lost' foods.

Dr. Anita Radini
Department of Archaeology
University of York
King's Manor
York
YO1 7EP
United Kingdom
E-mail: anita.radini@york.ac.uk

JOANNE M. ROWLAND, PhD (University College London), is a Senior Lecturer in Archaeology at the University of Edinburgh. Her research focuses on social transitions in 5th-early 3rd millennium BC Egypt. She was a research fellow at the University of Oxford, the Royal Museums of Art and History, Brussels, and Junior Professor at the Freie Universität Berlin.

GIULIO LUCARINI, PhD (University of Naples L'Orientale), holds a permanent post as Researcher at the National Research Council of Italy (ISPC-CNR), and an Adjunct Professorship in Prehistory and Protohistory at the University L'Orientale. His research has focused on human adaptations to the environment and the emergence of food production in North Africa.

GEOFFREY J. TASSIE (†), PhD (University College London), was research fellow on the Neolithic in the Nile Delta, Topoi. His research focused on prehistoric northeast Africa, cultural heritage management, palaeoethnotrichology, and excavation methods. He was a research fellow at the University of Edinburgh and honorary research fellow/associate lecturer at the University of Winchester.

Within the BERLIN STUDIES OF THE ANCIENT WORLD series, monographs and volumes of all fields of ancient studies are published. These publications form the results of research conducted within the Excellence Cluster *Topoi. The Formation and Transformation of Space and Knowledge in Ancient Civilizations*, a research association between the Freie Universität Berlin and the Humboldt-Universität zu Berlin as well as the partner institutions Berlin-Brandenburgische Akademie der Wissenschaften, Deutsches Archäologisches Institut, Max-Planck-Institut für Wissenschaftsgeschichte and Stiftung Preußischer Kulturbesitz.
The series is part of the research platform *Edition Topoi* and fully accessible at www.edition-topoi.org.

ISBN 978-3-9819685-5-2

9 783981 968552

68 BERLIN STUDIES OF THE ANCIENT WORLD

www.edition-topoi.org