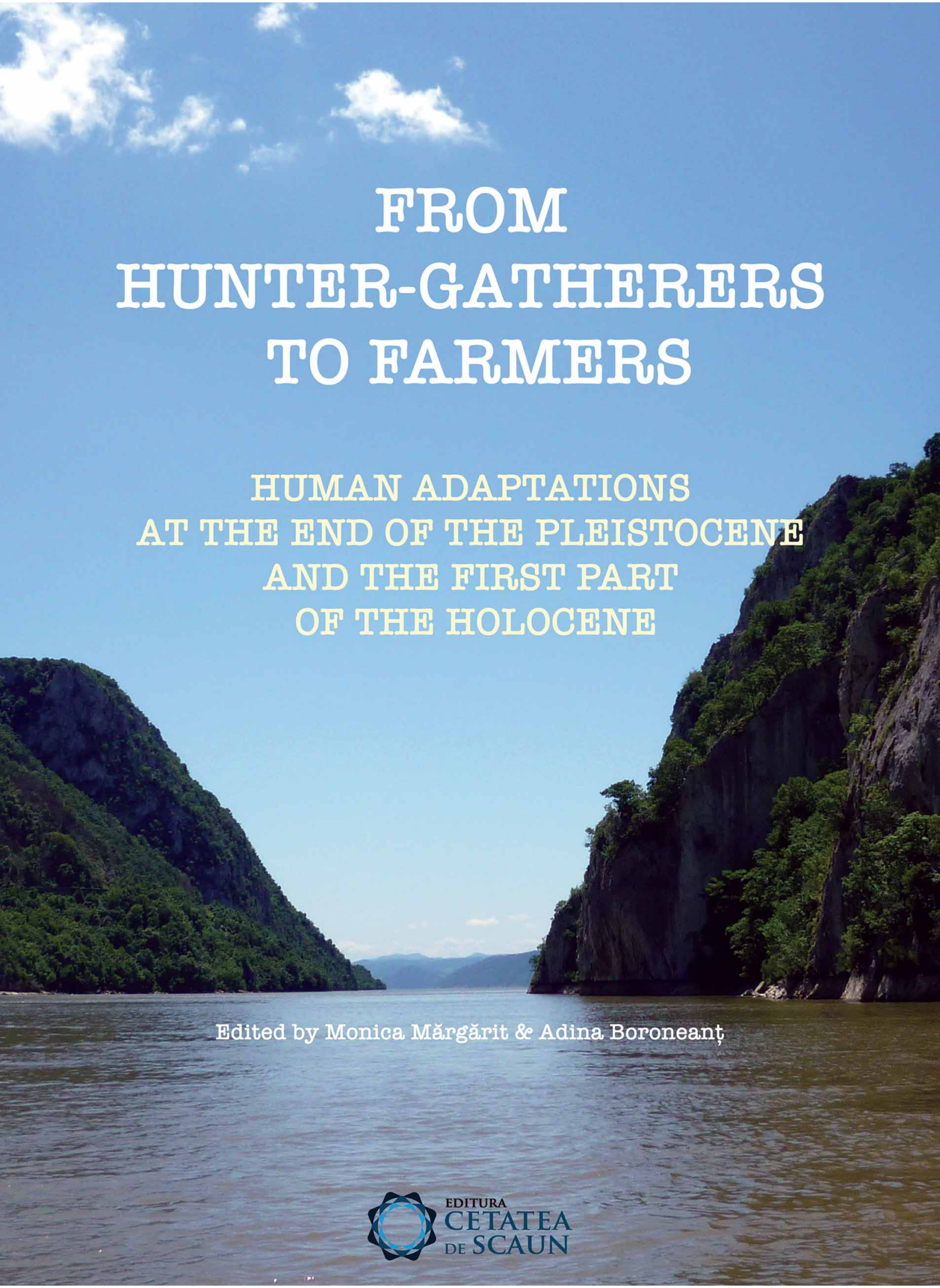

FROM HUNTER-GATHERERS TO FARMERS

HUMAN ADAPTATIONS AT THE END OF THE PLEISTOCENE AND THE FIRST PART OF THE HOLOCENE

Edited by Monica Mărgărit & Adina Boroneanț

EDITURA CETATEA DE SCAUN

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Photo cover: The Danube at Cazanele Mici (the Smaller Cauldrons) in the Iron Gates (photo Adina Boroneanț).

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PROFESSOR CLIVE BONSALL

EDITORIAL

It is difficult to capture one's life in a few words, a few photographs or even a book. The papers in the present volume will hopefully reflect a part of Clive Bonsall's scientific interests during a career that has started some 45 years ago. Their diversity is impressive: from radiocarbon dating, environmental changes, human–environment interactions, funerary behaviour, to paleogenetics and stable isotopes, reconstruction of ancient diets and obsidian sourcing, most of them in close connection to the hunter-gatherer and first farmer communities of Europe. His studies stretched over a large geographical area, focusing recently mainly around the Balkans and the neighbouring regions. He has conducted fieldwork in Britain, Scotland, Romania and Slovenia, edited 9 books and published over 160 papers, book-chapters, notes, as well as book and paper reviews. His main publications include: "The Mesolithic in Europe" (1989), "The Human Use of Caves" (1997), "The Iron Gates in Prehistory" (2008), "Submerged Prehistory" (2011) and "Not Just for Show: The Archaeology of Beads, Beadwork and Personal Ornaments" (2017).

His substantial work in southeastern Europe is reflected by his long-standing collaboration and friendship with many Romanian and Bulgarian archaeologists, and has received due recognition: Clive Bonsall is an Honorary Member of both the "Vasile Pârvan" Institute of Archaeology in Bucharest and the National Institute of Archaeology with Museum in Sofia. His contribution to the archaeology of the Iron Gates has earned him the recognition of the Serbian archaeologists working in the area. His many other research interests and personal collaborations are also reflected in the present volume.

We are grateful to all our contributors: colleagues and friends, new and old, former students and collaborators whose archaeological interests met Clive's if only briefly. We were happy to see that so many of us were able to mobilize in such a short time. We would like to thank all those who answered our call and at a time when every minute of our professional lives is carefully planned in advance, helped us put together this volume in less than a year. They have endured and complied with our constant deadline reminders and requests, checked and re-checked their manuscripts in record times, gracefully complying with the comments and suggestions from the reviewers, and were most patient with our editorial work.

Each paper was submitted to a double reviewing. We would like to also thank our colleagues from various disciplines who accepted to anonymously review the contributions. Their hard and serious work significantly improved the overall content of the volume.

The outcome has exceeded our most optimistic expectation: a volume that geographically covers almost the entire European continent, from Britain to Russia and Greece and touches on most important issues of hunter-gather adaptions through time. A volume brought together by chronological landmarks (the end of the Pleistocene and the beginning of the Holocene) and geographical areas but also by common approaches to issues such as human-animal interactions, exploitation and use of raw materials, and subsistence strategies.

We chose to organize the papers on three main sections, while within the respective theme they follow in chronological succession. The archaeology of the Iron Gates opens the volume, given Clive Bonsall's substantial contribution to the local early prehistory. The eight contributions cover a large range of subjects, from physical anthropology (Andrei Soficaru), re-interpretation of earlier excavations and the subsequent collections (Adina Boroneanț), stone artefacts (Dragana Antonović, Vidan Dimić, Andrej Starović and Dušan Borić) to the study of faunal remains and subsequent paleo-dietary issues (Adrian Bălășescu, Adina Boroneanț and Valentin Radu; Dragana Filipović, Jelena

Jovanović and Dragana Rančić; Ivana Živaljević, Vesna Dimitrijević and Sofija Stefanović), and osseous industries (Monica Mărgărit and Adina Boroneanț; Selena Vitezović). These studies illustrate the still immense research potential of the Iron Gates region despite the fact that most of the sites have been flooded many decades ago.

During the editing of the volume it became obvious that while some of the contributions focused on the evidence from a certain site, others were more of a regional synthesis. This latter section begins with a most interesting paper bringing together world history and underwater archaeology (Jonathan Benjamin and Geoff Bailey). The following nine articles deal with subjects such as social inequalities seen through the study of burial practices (Judith M. Grünberg), lifeways, adaptations and subsistence strategies of the early prehistoric communities (Agathe Reingruber; Mihael Budja; Annie Brown and Haskel Greenfield; Kenneth Ritchie), raw materials acquisition and exploitation (Tomasz Płonka, Maria Gurova, Eva David), exploitation, management and trade of „exotic" goods (Vassil Nikolov).

The nine papers focusing on individual sites present case studies that illustrate the nature of the current research, the rich opportunities offered by the growing range of scientific techniques and their applications to existing collections. This series of papers starts at Zemunica Cave on the coast of the Eastern Adriatic (Siniša Radović and Ankica Oros Sršen), explores the Mesolithic occupations at Malga Rondenetto (Paolo Biagi, Elisabetta Starnini and Renato Nisbet) and Grotta dell'Edera (Barbara Voytek) in Italy, the Mesolithic ornamented weapons of Motala in Sweden (Lars Larsson and Fredrik Molin), ending this Mesolithic journey among the shell middens on the western coast of Scotland (Catriona Pickard). The transition to the Neolithic happens among the beaver tools at Zamojste 2 in Russia (Olga Lozovskaya, Charlotte Leduc and Louis Chaix). The Neolithic Age finds us further south into Bulgaria, exploring the pitfields of Sarnevo (Krum Bacvarov and John Gorczyk) and the gold of Varna (Tanya Dzhanfezova), while during the Bronze Age roe deer hunting is resurrected at Paks–Gyapa in Hungary (László Bartosiewicz and Erika Gál).

The volume presents altogether new results in recent research and new information resulted from the study of old collections. We also hope it points out directions for future research.

It is with great joy that we present Clive Bonsall this volume, as a token of both our appreciation and friendship, for his contributions to the Early Prehistory of Europe in general, and of Southeastern Europe in special.

The Editors

CLIVE BONSALL – SOME YEARS AFTER

When Clive Bonsall came to Romania in 1991, I was taking an undergraduate degree in computers and wasn't even considering becoming an archaeologist. Together with my mother and brother, I used to accompany my father Vasile Boroneanț every year on his summer digs at Schela Cladovei. It was just over a year after the fall of the communist regime in Romania, and everybody at the site was waiting impatiently the arrival of a team of archaeologists from Great Britain, who were coming to visit the site and perhaps start a joint research project. It must have been past mid-night of the expected day when my father woke us up – because the "English" had arrived…. Four very tired people (Clive Bonsall, Kathleen McSweeney, Sue Stalibrass and Mark Macklin – and not all "English") in a Land Rover but still managing to smile… They had spent 10 hours at the border between Hungary and Romania and their first encounter with Romanian cuisine had been carp-head soup (the only thing available on the menu) in Arad…. I believe Clive still remembers the fish-heads sticking out of the large bowl (obviously a reminder of the Lepenski Vir sculpted boulders…).

The visit at the site went well and the next year the research project commenced, but not unventfully. It must have been sheer passion for archaeology and keen interest for the Iron Gates Mesolithic that made Clive come back the second year, after having (during the previous first year) the minibus tyres slashed several times by the curious and mischievous Schela Cladovei lads, bits of the flotation equipment vanishing into thin air and two pairs of his new Levis jeans (a rarity in Romania in those days) mysteriously disappearing from his room at the youth camp in Gura Văii…..Not to mention the breaking down of the minibus in a country where there were no spare parts for western cars.

Still, here he is, working in Romania, 26 years later…

And following the first four years of the Schela Cladovei project I had switched to a degree in archaeology (and Clive bears much of the blame…). And we are still excavating at Schela Cladovei…and at least Clive looks unchanged… It is his dedication to the archaeology of the area that has made this second research project possible, project going on successfully for over ten years now.

As it was with me, Clive has influenced the lives of many (older and younger) archaeologists and perhaps future archaeologists. He is an inspiration to our students from the Schela Cladovei excavation and a respected professional among Romanian archaeologists. He has always been ready to help my fellow colleagues, whether it was field work, collecting samples, editing or mere professional advice, although such work had rarely anything to do with the archaeology of the Iron Gates. But during his entire activity in this area, he acted as a "human bridge" between Romanian, Bulgarian and Serbian archaeologies, facilitating professional exchanges, easing the access to modern technologies, information and publications.

Clive Bonsall was/is equally interested in other geographical areas and research topics of European (and not only…) archaeology, and the number of people contributing to this volume testify to the impact he had on individuals and archaeologies elsewhere outside Romania.

This may not be the typical introduction to a Festschrift volume… but then, Clive is not a typical person. Rather cynical but warm hearted underneath, with a wonderful (and at times very dry) sense of humour, and great charm (when he wants it…) he makes a great project co-director and fellow-worker.

I can only but hope that our collaboration would go on for many years from now and that we'll get to see the end of the Schela Cladovei trench we started before we both retire!

Bucharest, September 2017 *Adina Boroneanț*

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COASTAL ADAPTATIONS AND SUBMERGED LANDSCAPES: WHERE WORLD PREHISTORY MEETS UNDERWATER ARCHAEOLOGY

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Abstract: Studies in world prehistory, which include the transition between the Pleistocene and Holocene and the cultural shift from Forager to Farmer, remain incomplete, particularly along the coastal margins. Submerged landscape archaeology has begun to emerge as a serious sub-discipline of both maritime archaeology and world prehistory, with a largely untapped potential to fill in significant gaps in the archaeological record. This chapter reviews the current state of submerged landscape archaeology and considers important elements, both theoretical and practical, and discusses how future generations of prehistorians must be willing and able to engage with archaeology on the continental shelves, worldwide.

Key words: Early prehistory, human migration, land bridges, submerged landscapes, underwater archaeology.

Introduction

In 1985, Clive Bonsall hosted in Edinburgh the third conference on the *Mesolithic in Europe* (Bonsall 1989). Four years prior, in 1981, another conference took place at the Scripps Institution of Oceanography in La Jolla California organised by Patricia Masters and Nicholas Flemming (Masters and Flemming 1983). These two seemingly different meetings on opposite sides of the world would begin to overlap and intertwine in many ways, though not obviously so until some thirty years later. The conference in California led to the now seminal publication of *Quaternary Coastlines and Marine Archaeology*, a volume that was truly unique at the time and served as a benchmark for nearly four decades. It was the first to synthesize significant material and the potential for the seabed to contribute to world prehistory in a meaningful way, and with a global perspective. Its subtitle – *Towards the prehistory of land bridges and continental shelves* – indicated the importance of the discipline to the peopling of the earth. Not until recently has that volume been matched in content or ambition (Benjamin *et al*. 2011; Evans *et al*. 2014; Bailey *et al*. 2017a).

At the same time, the Edinburgh conference initiated a quinquennial series of conferences on the Mesolithic in Europe that have been held continuously since then (the most recent being the 9th conference held in Belgrade in 2015), with Clive as a regular participant and contributor (Vermeersch and Van Peer 1990; Bintz and Thevenin 1999; Larsson *et al*. 2003; McCartan *et al*. 2009; Arias *et al*. in press). These conferences have witnessed an unprecedented expansion of interest in Mesolithic archaeology in Europe, both in geographical scope, volume of research and the range of themes embraced.

Notwithstanding the perennial interest of Mesolithic archaeologists in coastal settlement, marine resources, coastal colonisation and palaeoenvironmental change, the contribution of underwater research has remained peripheral, with just one identifiable underwater contribution in the 5th and 6th conference publications, three in the 7th and one or two identifiable contributions in the programmes of the 8th and 9th, from a total of many hundreds of papers (Larsson 1999; Lübke 2003; Grøn 2009; Lübke 2009; Momber *et al*. 2009).

In this chapter, we introduce some of the key developments, particularly during the past decade, that have stimulated the growth of interest in underwater exploration, review the current state of progress, and assess the practical and theoretical issues that need to be addressed if the field is to prosper. We offer this chapter from the perspective of one of his former PhD students and postdoctoral colleague (Benjamin) and one of his long-standing colleagues in Mesolithic coastal research (Bailey) as a tribute to Clive's enduring contribution to Mesolithic studies and his recognition and support of the new field of the underwater exploration of submerged prehistory.

Historical perspectives

Neither Masters and Flemming nor the contributors to their volume were the first to recognise the potential for site discovery under water. Bynoe *et al*. (2016) and Sturt *et al*. (2017) have recently summarised the range of work carried out in the North Sea by British and European Scholars of the past hundred years. They rightly point to Reid (1913) whose seminal publication on *Submerged Forests* was the first to insist that attention must be paid to submerged deposits as an archaeological resource, not to be overlooked. Grahame Clark's work on the *Mesolithic of Northern Europe* (Clark 1936) is noted by Sturt *et al*. (2017) as having been influenced by the find of a barbed point (the Leman and Ower Harpoon) four years earlier by the English fishing trawler, *Colinda*. Clark's interests did not spur on a revolution in underwater archaeology, however, probably due to technical constraints in an era that predated SCUBA diving by at least a decade (and the popularisation of such activity by several decades). However, Reid's observations over a hundred years ago remain relevant today particularly in light of the past decade of exploration in the North Sea region, for example, by Gaffney *et al*. (2009) and Tizzard *et al*. (2014). Pioneer discoveries in other parts of the world during the 20th century pointed to the potential significance of underwater finds without creating any significant momentum towards their systematic recovery (Bailey 2014).

Otherwise, significant research was largely confined to a small group of pioneer underwater archaeologists working in relative isolation, such as those working in Denmark and Israel from the 1970s onwards. There, diving archaeologists took advantage of the fact that some material was already known in underwater environments that were relatively accessible in shallow-water conditions. Notable research in this period includes the work on the Danish sites of Tybrind Vig (Andersen 1985, 2013), Møllegabet II (Skaarup and Grøn 2004), and the Israeli site of Atlit Yam (Galili *et al*. 1993).

An important meeting organised in 1993 by Anders Fischer was the *Man & Sea in the Mesolithic* symposium held in Denmark (Fischer 1995a). Subtitled *Coastal settlement above and below present sea level*, it introduced the Danish work on sea-level change and underwater archaeology to a wider international audience, with contributions on coastal settlement from further afield in Europe and elsewhere including Clive Bonsall and co-authors on western Scotland. It also introduced Fischer's 'fishing site model' (Fig. 1), a predictive model for locating submerged coastal settlements on the assumption that they would have been located on shorelines with the best locations for trapping large quantities of fish with

stationary fish traps built out from the shore, for example near the mouths of streams and on small islands and peninsulas next to shallow offshore topography (Fischer 1995b).

The Impact of SPLASHCOS: Beyond the Danish Model

The year 2009 was an important one for the study of Submerged Landscape Archaeology. A session at the 15th Annual Meeting of the European Association of Archaeologists (Riva del Garda, Italy) entitled *Underwater archaeology and the future of submerged European prehistory*, was organised by members of the Archaeology Department at the University of Edinburgh, including the first author and Clive Bonsall. The sixteen papers and additional posters presented during this full-day session ranged geographically from the North Atlantic to the Black Sea, inspired hearty discussion and were well-attended by both underwater and terrestrial archaeologists. Topics included new sites and material, modelling of changing landscapes, migrations of prehistoric populations, remote sensing techniques, survey and excavation methodology, new site prospection, heritage management, research prioritisation, legislation, as well as applications of palaeoenvironmental and anthropological perspectives. The papers presented at the EAA meeting represented a substantial segment of the published volume *Submerged Prehistory* led by the first author, with Clive Bonsall and other colleagues as co-editors (Benjamin *et al*. 2011). The volume was European in focus, but included some introduction to other examples from around the world.

In the same year, the second author along with partners from the Deukalion Project (notably Pablo Arias, Nic Flemming, Friedrich Lueth and Dimitris Sakellariou) was successful in a major application to the EU COST scheme (Cooperation in Science and Technology) to fund a research network known as COST Action TD0902 'SPLASHCOS' (Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf). SPLASHCOS would be a four-year programme beginning in November 2009 to develop the emerging field, focused on capacity building, information sharing, meetings, conferences and training schools. The Network was largely considered a success, and has since led to a number of major projects in the discipline in Europe and further afield (see http:// www. splashcos.org/).

In 2010 The *Journal of Island and Coastal Archaeology* published as its forum article a re-evaluation of Fischer's (1995b) predictive model for site prospection and discovery (Benjamin 2010). The subsequent comments were provided by several scholars familiar with the discipline and these ideas, including Masters (2010) and Flemming (2010). The simplicity of the Danish model was worth discussing then and remains so today. Concepts such as landscape evaluation for prehistoric occupation, reliable sources of marine and terrestrial protein, an understanding by archaeologists where these activities are likely to have been undertaken, and a knowledge of the deposits most likely to preserve organic remains, all contributed to the Danish model's success. Denmark remains amongst the most well documented and abundant international resources for studying submerged prehistoric landscape archaeology, if not the peak location globally.

However, the success of the Danish model also points to the conditions necessary for its successful implementation: a community of scholars including avocational archaeologists and divers involved in the 'hunt' for new sites; the sheer abundance of cultural material due to excellent raw material for the manufacture of flint artefacts; low tidal range; relatively sheltered seas; organic rich wetland sediments (gyttja) which neatly protect and preserve archaeological deposits and organic remains of bone and wood; and a well-informed community of sports divers able to report chance finds as they become exposed; to name a few attributes which make the Danish Model an obvious starting point. The material is preserved beautifully in shallow nearshore

environments because this is where relative sea level (RSL) stabilised, and the people describe as Kongemose or Ertebølle (late Mesolithic), were coastal dwelling hunter-gatherer-fishers, who lived in these areas during the early to middle Holocene just prior to RSL stabilisation. It is an obvious first port of call for scholars to review, in order to project their interests further afield, but it is not appropriate to apply elsewhere without serious consideration, adaptation and acceptance of limitations (Benjamin 2010).

The SPLASHCOS community was formed principally by two groups: Archaeologists and Geoscientists. Some of the archaeologists were non-diving prehistorians, and some were maritime or marine-focused archaeologists (i.e., 'underwater archaeologists'). Amongst the geoscientists, the specialisations also differed, and included geologists, geo-morphologists, sea-level experts, palaeo-environmentalists oceanographers and geophysicists (see Bailey *et al*. 2012, 2017a). The network and its two broad categories of researchers coincided with (or perhaps produced) two broad categories of scale regarding methods of inquiry: one aimed at the wider landscape, especially favoured by the palaeoenvironmental and geological community, the other with the site-level scale, favoured by the archaeologists. This is perhaps in part because archaeologists are traditionally trained to study past people, observed and interpreted through their material culture or physical remains. As such, the archaeologists within SPLASHCOS were often and historically concerned with finding an individual site (or complex of sites) and studying that material in order to answer questions about local, regional or global aspects of human prehistory.

The archaeologists who have found the most obvious success come from two contrasting environments: the southwest Baltic (e.g., Uldum *et al*. 2017, Skriver *et al*. 2017), and the Mediterranean Levant (e.g., Galili *et al*. 2017a, b). There, sites were encountered and uncovered mainly by SCUBA divers, sometimes accidentally, and sometimes strategically. In both cases, the archaeologists involved were intimately familiar with the archaeology, geomorphology and local variables that made the search for new sites fruitful. Applying their strategies further afield, however, requires careful consideration and considerable adaptation, based almost entirely on local knowledge. In contrast with the successes of the Israeli and Danish contingents of SPLASHCOS, many other areas of the European Continental Shelf have not yielded the type or scale of results predicted by Masters and Flemming (1983). This is due to many factors, including research bias, relationship with industry and national frameworks for funding and management.

Missiaen *et al*. (2017. Fig. 2.1) graphically illustrate the problem of grappling with the depth: age ratio in underwater discovery of archaeological material, which is strongly biased toward the shallow, relatively young material of the middle Holocene because of its ease of accessibility. They also highlight the technological problem of addressing differences of scale in underwater survey, ranging from the need to cover hundreds of square kilometres to assess variations in submerged topography and palaeoshorelines to the search for individual artefacts at the sub-metre scale (Missiaen *et al*. 2017. Fig 2.2). This exposes the problem of how to encounter and study deeper, older and more ephemeral sites.

The use of geophysical and geotechnical techniques in collaboration with offshore industrial companies and government heritage agencies, which supply vessel time and an opportunity to move material at an industrial scale, are this generation's answer to the problem. Projects such as the mapping of North Sea palaeolandscapes (Gaffney *et al*. 2007), the recovery of geochronological and palaeoenvironmental data in association with Middle Pleistocene fauna and artefacts in Area 240 in the North Sea (Tizzard *et al*. 2014), and the purposeful search for, discovery and excavation of early Mesolithic sites during the

excavation of new harbour facilities at the Port of Rotterdam (Moree and Sier 2015) are outstanding examples of what can be achieved. These projects, however remain relatively rare, though they do exist particularly in Northern Europe (see also Sturt *et al*. 2017).

Outside of Northern Europe, it remains to be seen how much future work by archaeologists, including education and community engagement, may lead to the rapid advancement of submerged landscape archaeology. Research bias and a focus on other maritime archaeologies or distinct periods within underwater archaeology may also contribute to the overlooking of submerged prehistory; this was the case in the Adriatic region which is historically rich in classical shipwrecks, but which is now beginning to demonstrate substantial and significant material from earlier periods, found on and within its submerged environments (Benjamin *et al*. 2011). Large scale palaeogeographic reconstruction has also begun to have a serious impact on understanding broader questions of human migrations and dispersals and island colonisations (e.g., Bailey and Flemming 2008; Bailey *et al*. 2017b, Flemming 2017; Sakellariou and Galanidou 2017).

Global Analogies and Indigenous Archaeologies

North America has long demonstrated potential to study inundated sites within Indigenous Archaeologies, with Goggin (1960) first writing about this in the very early days of SCUBA, with particular reference to the cenotes of karstic environments, such as those found in Florida, and Mexico. Later, Michael Faught's pioneering work in Florida in the 1990s demonstrated the serious potential for underwater sites to be located on the continental shelf of North America (Faught 2002, 2004). More recently Halligan *et al*. (2016) have continued to demonstrate the significance of underwater practices to the archaeology of Indigenous North America. Their recent study at the site of Page-Ladson in the Aucilla River in the Gulf of Mexico has demonstrated the presence of palaeo-river and paleo-lake sediments in a sinkhole now submerged in 9 m depth of water. Butchered mastodon bones and stone tools were found in undisturbed stratigraphic context, and over 70 radiometric dates yielded an average of 14,550 BP. At this period, when sea levels were lower than present, the site would have been some 200 km inland from the coastline. This has significantly impacted the discussion around colonisation of the Americas, contributing new evidence for a pre-Clovis colonisation of the Americas and calling into question some of the interpretation of DNA evidence.

Other indigenous archaeologies in North America include contributions from Canada, from both the Atlantic (e.g., Lacroix *et al*. 2014), and the Pacific coasts (e.g., Fedje and Josenhans 2000). The ambitious but incredibly important study area of Beringia, where North America meets Asia (modern Alaska and Russia, respectively), is amongst the most sought after areas of research for understanding the peopling of the Americas and World Archaeology. Although some attempts have been made to explore this still wild terrain (e.g., Dixon and Monteleone 2014), conclusive evidence for human migrations during the last glacial maximum (LGM) will continue to be the mission for future generations of scholars and explorers.

On the other side of the world, the continents scientists refer to as Sunda and Sahul (now Southeast Asia and Australia plus New Guinea, respectively) presents another 'final frontier' of underwater archaeology. Since at least 65,000 years ago, the recently published earliest date for human entry into Australia and New Guinea (Clarkson *et al*. 2017), one third of the continental land mass has been drowned by postglacial sea-level rise. As in other parts of the world, there is good reason to suppose that this drowned territory offered attractive landscapes and resources for human occupation (Bailey and Flemming

2008). Also, on the basis of work that is being conducted in other parts of the world, there is good reason to suppose that some features of this drowned landscape and their associated archaeological remains have survived inundation and can be retrieved by underwater exploration (Benjamin *et al*. 2011; Evans *et al*. 2014; Bailey *et al*. 2017a). However, relatively little underwater exploration has so far taken place in Australia despite the fact that investigations of this sort are of particular importance in the Australian context, given that the earliest colonisation took place during a period when first land fall and the earliest processes of settlement and dispersal must have occurred in coastal territory that is now under water (Nutley 2014)

A current project is now underway – *The Deep History of Sea Country: Climate, Sea Level and Culture,* funded by the Australian Research Council, to begin to explore the drowned continental shelf of Australia in a systematic way and to seek to integrate the existing on-land terrestrial record of human occupation with investigation of the drowned shelf, using a full range of acoustic, imaging, geoarchaeological and archaeological techniques. The target area is the Dampier archipelago of Western Australia. Here, several factors provide a promising basis for offshore investigation. These include an abundant on-land archaeological record including shell middens, fish traps and rock art, including deep cave sequences on present-day islands that were progressively inundated by sea-level rise (Ward and Veth 2017; Veth *et al*. 2017), and existing data on high resolution bathymetry (Benjamin *et al*. in press). It is expected that this programme of work will lead to a sustained interdisciplinary relationship between archaeology and marine science, and one which will continue to make use of emerging technologies that allow for the collection of more data – and more accurate data – from the continental shelf. Greater awareness in the maritime archaeological community should also lead to the critical mass required for national strategies, both in research and management communities.

Perceptions and realities: practicalities and the submerged prehistorian

Globally, archaeologists who focus on early prehistory have largely avoided having to get wet. At the same time, maritime archaeologists, who are more than keen to put on a wetsuit or a drysuit, have largely focused on more recent periods and sites with a more distinguishable archaeological signature (see Benjamin and Hale 2012). As much as any other sub-discipline of archaeology, submerged landscape archaeology is a particularly useful lens through which to review and consider broader archaeological theory, method and interpretation. It is a sub-disciplinary niche increasingly accepted by the mainstream and it can be qualified as prehistoric, maritime, marine, or more descriptively, now-submerged terrestrial archaeology.

Prehistorians and specialists in Indigenous archaeologies, however, still have work to do in terms of public perception and media representation. A clear bias can be observed in the language used in the media of maritime archaeology that would appear to exclude the study of marine-focused coastal societies, including prehistoric or pre-contact/ indigenous (non-European) cultures, within a contemporary definition of maritime archaeology (Gately and Benjamin. in press). Maritime Archaeology, as a specialism, has traditionally focused on human interaction with the sea – but qualified so as to consider culturally and socially significant scales of technology, necessitating port structures, large vessels, or global trade and exploration. This despite evidence for exploitation of the marine environment since at least 160,000 years ago (Jerardino 2016), direct evidence for the use of watercraft during the European Mesolithic (Andersen 1987; Pickard and Bonsall 2004) and Neolithic (e.g. Fugazzola Delpino *et al*. 1993) as well as various examples of temporal and geographic scope outside of the historical and European-focused high Ages of Sail and Steam and modern naval power

(see for example McGrail 2001; Anderson *et al*. 2010).

Further, modern day ethnographic observations (McNiven 2004; Ransley 2012) indicate that human-marine interaction and aquatic transportation are far from recent phenomena. Rather, the focus of archaeology under water on recent and prominently visible material results from the initial visibility of archaeological signatures and research bias, which is permitted to self-perpetuate though practical aspects of resource allocation and responsibilities and jurisdictions of marine historic environment managers as distinct from those with a terrestrial remit (Benjamin and Hale 2012). A clear result of this bias is that it can lead to a focus on what are often large, even monumental, objects and architecture. This reinforces the perception that the purpose of maritime and underwater archaeology is the *recovery* of these large impressive objects (Gately and Benjamin. in press). It is the responsibility of the prehistorian and archaeologists of cultures existing before eustatic stabilisation (i.e., ca. 5500 BP), to ensure that maritime archaeology is not limited simply to colonial histories of technologically advanced societies. There is no reason why earlier or vernacular maritime traditions should be relegated in such a way.

It is also important to consider how resources are procured and management is implemented in modern society. Here the 'maritime prehistorian' has another important role to play. There is little argument that a systematic excavation of an information-rich Mesolithic site undertaken by trained archaeologists would be considered archaeology; the question of whether or not we classify it as 'maritime archaeology' is less important. However, this is more than a matter of archaeological navel-gazing, or mere semantics. There are practical issues related to the legal protection of all underwater cultural heritage, which informs management jurisdiction, resource allocation, protection, funding, and site access by both specialists and the public. So while the semantics might not be the principal concern, such implications require some thoughtful consideration of how maritime and underwater archaeology is defined as a discipline and whether or not prehistorians are engaged with the maritime and underwater archaeological community. The tide, however, appears to be turning as maritime archaeology programs around the world have begun to accept that submerged landscape archaeology is an important discipline that should be taught and learned within archaeology and maritime archaeology specialist degrees (see for example Southampton University's Centre for Maritime Archaeology; Flinders University's Maritime Archaeology Program; and several other programs within the UNESCO UNITWIN Network for Underwater Archaeology, which include traditional Nautical/Maritime themes alongside submerged prehistory in their degrees and research profiles).

Beyond the perceived differences of 'terrestrial versus underwater' archaeology, there exist the practicalities of operating in the marine environment. This requires additional specialist knowledge, skill, experience and equipment – and this is no small detail. While the disciplines of carrying out archaeological survey and excavation are, ideally, unchanged, regardless of whether work is carried out on land or under water, the mechanisms, access, tools and often the training required do not necessarily align easily with the traditional tool kit and skill set of a prehistorian. Safety and compliance are additional, substantial aspects that the prehistoric archaeological community may be tempted to ignore, or use as an excuse for not getting wet. However, serious prehistorians must engage with these practical matters in order to study world prehistory beyond our modern shores.

Nothing can be more representative of this final point than the understanding of safety and compliance around maritime operations, and especially diving (Fig. 2). To understand the barriers to world prehistory posed by this real world dilemma, it is essential that archaeologists, both maritime historical and

prehistoric specialists, engage with the challenges facing professional scientific diving. This discussion requires the archaeologist to be aware of the legal histories of occupational health and safety and the regulatory bodies that govern who is allowed under water and under what circumstances they may participate as professional underwater archaeologists (for a comprehensive overview see Benjamin and MacKintosh 2016).

The main aim of law regulating scientific diving, or commercial and occupational diving in general, is to protect divers and discourage employers from putting employees into an unsafe working environment. However, it is difficult to classify general risks involved with all diving, since diving varies substantially across a wide spectrum from recreational and sports diving at one extreme to commercial diving at the other. Diving for archaeological or scientific purposes exists within this spectrum, involving divers with qualifications and accreditation from a mix of recreational training systems (beginning with Open Water or Sport Diver categories, continuing through to more advanced training, such as Rescue Diver, Dive Leader or Dive Instructor). Some bespoke Scientific Diver Training exist such as the American Academy of Underwater Sciences (AAUS), or CMAS Scientific Diver. Sometimes a more commercial-style of diver training may be obtained which may include the use of full face masks or high pressure surface supply breathing equipment.

Scientific and Archaeological diving practitioners have good safety records and low incident rates. However, historically, groups of commercial divers have attempted to ban SCUBA for all professional diving, since they believe diving carried out for archaeological or other purposes by divers who lack surface-supply training and commercial accreditation is inherently unsafe (Benjamin and MacKintosh 2016). This has prompted legal battles, debates and political manoeuvring in various legal regimes, worldwide. Underwater archaeologists have been and must continue to be engaged with this discussion as it relates to the ethics of archaeological site access and the ethics of science. Many archaeologists begin as recreational divers, and some progress through scientific diver training in regimes around the world which recognise a pathway to professionalism through prior learning and experience as a recreational or sport diver. Commercial diver training may be advantageous and can add value to an underwater archaeologist's skill set and CV, but many do not consider this to be a necessary pre condition. If a student has the opportunity to obtain more training, including scientific-specific dive training as well as commercial diver training, these are almost certainly likely to be useful skills. However, commercial diver training is rarely fit-for-purpose as a minimum requirement for underwater archaeology, particularly as a means to enter the field. Requiring such a threshold widens the gap between terrestrial and underwater archaeology, a divide which maritime archaeologists have openly condemned for decades (Benjamin and MacKintosh 2016).

Working in and around water poses a specific set of risks to safety and this point must always be respected and understood by any archaeologists looking to deploy divers in any capacity. Marine safety must be the first point of consideration of any fieldwork project and it is the responsibility of all archaeological divers to operate responsibly. This point may not be fully appreciated by traditionally trained prehistorians looking to pursue underwater research. Conversely, it may be too daunting to engage with all together. There is no doubt that the demands and constraints of offshore work generally and diving in particular impose very different conditions on the conduct of archaeological survey and exploration. The work can be slow, subject to interruptions and delays imposed by the use of specialised equipment, safety considerations and the vagaries of wind, weather and tides. And these are limitations that the practised land archaeologist may chafe against. But they cannot be ignored, and

we emphasise this both from the point of view of an archaeologist with professional diving experience (Benjamin) and one who is not a professional diver (Bailey) but has learned the disciplines of underwater work by leading projects involving collaboration with professional diving teams and learning from them (Fig. 3).

However, prehistorians should take heart from the fact that underwater archaeology and scientific diving can be very safe when they are well managed and the right people and mechanisms are in place. Risk-assessment based decision-making and responsible operational planning and practice have led to very low incident and accident rates within scientific diving communities worldwide (Benjamin and Mackintosh 2016). As with so many other aspects of modern archaeological research, fieldwork is inherently inter-disciplinary in nature, and this requires mutual understanding and compromise across the boundaries of the many disciplines that may be involved. In this respect, work under water is no different from work on land.

Thus, the safety and logistical requirements of underwater work should not serve to deter traditionally land-locked prehistorians from venturing offshore – they should just be aware of the additional knowledge and seek out the appropriate skill sets and collaborators. It is encouraging to see cross- collaborative research institutes begin to further this necessary partnership, illustrated by such joint initiatives as that currently underway between Southampton and the UK's National Oceanographic Centre, or more recently between University of California San Diego's (traditionally land-focused) Anthropology Department, and their work with the aforementioned Scripps Institution of Oceanography. Indeed, this may well serve as a model on which future programs may enhance in-house capacity and further the discipline worldwide.

Conclusion

Prehistoric archaeologists must begin to pursue underwater archaeology in a serious and concerted effort worldwide. Clive Bonsall has come to understand this point, which is how a land-loving Mesolithic specialist became the second editor and co-author of *Submerged Prehistory* (Benjamin *et al.* 2011). The future of prehistoric studies will necessarily include offshore territories that used to be culturally occupied landscapes. There are many deterrents to such a commitment, including the unfamiliarity of working under water, the new skills and collaborative partnerships required, the logistical and safety requirements that have to be respected, and the costs of the technology needed including ship time. However, none of these are insuperable. Many projects have been recently completed or are now under way in various parts of the world, demonstrating that funding can be made available through national and international funding agencies or charitable foundations, or can be mitigated by collaborations with offshore industries, resulting in new and mutually beneficial collaborations with other disciplines, and leading to new discoveries (Fig. 3).

There is almost no coastal region in the world that did not have a component of offshore land, in many cases a very extensive area, that was exposed and available for exploitation, sometimes an inherently attractive territory well stocked with resources of soil and food and water, when sea level was lower than the present. A map of archaeology in a coastal region pre-dating the mid-Holocene that stops at the modern coastline can no longer be considered adequate. Even a map that shows the approximate position of the palaeoshoreline, but leaves blank the intervening area between it and the modern coastline, barely begins to address the problem.

This data gap will remain as long as specialists in prehistoric archaeology are not fully committed to understanding the requirements and logistics associated with

working on and in the water. Until that point is reached, there will remain glaring voids in the ways in which research questions are defined and investigated regarding such themes as early human migration, dispersal and adaptation, the development of sedentary settlements, the origins of seafaring and fishing, and the later dispersal of peoples, cultures and economic innovations in the prehistoric period, not least in relation to one of Clive Bonsall's own research interests, the transition from forager to farmer and the early spread of agriculture. Most if not all of these developments originated in coastal regions or involved a strong coastal element. Since most coastal regions for most of prehistory are now submerged, the case for systematic offshore research and engagement with the disciplines of underwater investigation can no longer be ignored.

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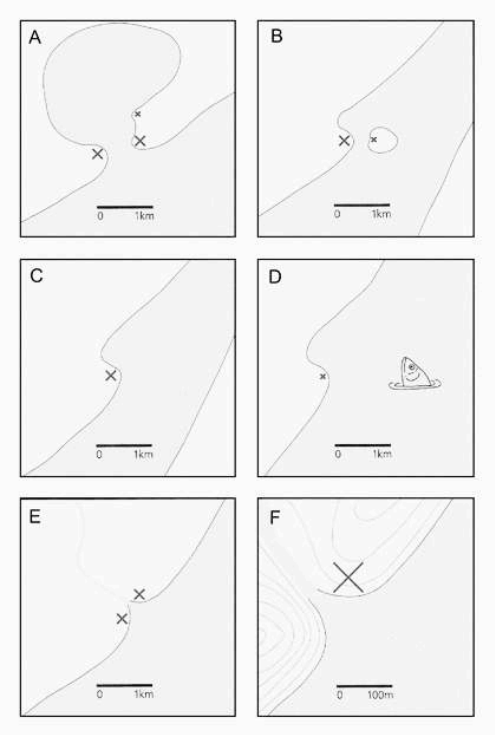

Figure 1. The 'Danish Model' for the prediction of fishing site locations (after Fischer 1995b).

Figure 2. The first author recording Neolithic material in NW Scotland (photo: R. Ortiz). Scientific diving is a distinct form of professional diving, distinct from both recreational diving and commercial diving.

Figure 3. (Left) The second author (Bailey) carrying out an underwater archaeological survey at the site of Hjarnø, Denmark. Prehistorians must embrace working in the marine environment (or collaborate with those who do). Even a traditional, land-loving prehistorian can be quickly trained to support simple survey work, particularly in shallow waters. (Right) An archaeological diver (P.M. Astrup) records the profile of a submerged late Mesolithic shell midden at the Hjarnø site (photos: J. Benjamin, May 2017).