

# Dating the East Adriatic Neolithic

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*New radiocarbon determinations from Mesolithic, Neolithic, and/or Copper Age contexts at ten sites are presented, bringing the number of absolute dates available for the East Adriatic to more than twice that of a decade ago. The dates show that, from 6000 BC onward, pottery styles (Impressed Ware, Danilo variants, Hvar, Nakovana, and Cetina) emerged, spread, and disappeared at different times, places, and rates within the region. The implications for models of the spread of farming and other features of Neolithic life are discussed. The continued usefulness of the threefold division of the regional Neolithic into 'Early', 'Middle', and 'Late' phases is found to be dubious.*

*Keywords:* Neolithic, Mesolithic, radiocarbon dating, East Adriatic, pottery styles, Impressed Ware

## INTRODUCTION

For decades now, meaningful discussions of crucial issues in the archaeology of the East Adriatic Neolithic have been difficult to sustain. Questions relating to change, whether in settlement pattern, social organization, economy, or long-distance contact, among others, have not been effectively addressed in the region's archaeological discourse, hampered in large part by a flimsy chronological framework built on relatively few and occasionally insecure absolute dates. The need for more thorough radiometric dating of the East Adriatic Neolithic has long been acute.

Until recently, only some seventy-odd radiocarbon dates from under two dozen

sites scattered from Dalmatia to Istria were available for the Mesolithic, Neolithic, and Copper Age combined (Forenbaher & Kaiser, 1999; Forenbaher & Miracle, 2005). To make matters worse, many of those dates are suspect as they lack adequate information about the contexts and associations of the dated material. Southeast of Dubrovnik, through Montenegro and Albania, Neolithic chronometry disappears almost entirely. By comparison, radiocarbon dates for the western (Italian) coast of the Adriatic reach into the hundreds (Skeates & Whitehouse, 1994; Skeates, 2003). New radiometric dates from safe contexts are thus essential if we are to test more rigorously and refine further our understanding of this region's Neolithic prehistory, such

as recently proposed models of the transition to farming in the eastern Adriatic (Forenbaher & Miracle, 2005), changing patterns of cave use (Miracle & Forenbaher, 2006a), and shifts in long-distance contacts, possibly by transhumant pastoralists (Boschian & Montagnari-Kokelj, 2000; Miracle & Forenbaher, 2005).

The East Adriatic Neolithic is marked by long and relatively detailed pottery sequences based on characteristic pottery styles (Batović, 1979; Forenbaher et al., 2004; Čečuk & Radić, 2005; Marijanović, 2005). Some of these styles are believed to have lasted only for short periods of time, but this has never been confirmed by independent chronometric determinations. If these distinctive pottery styles could be shown to have been short lived, and hence diagnostic of relatively brief prehistoric episodes, then we could indirectly date many sites and site components that presently lack materials suitable for chronometric dating with greater confidence. The implications for possible intra-ensemble comparisons within the region are clear.

An improved chronological framework would also allow comparison between the eastern and the western Adriatic coasts. The temporal distribution patterns of characteristic pottery styles in the two areas appear to be similar but not identical; they invite closer inspection. For instance, Impressed Ware pottery seems to last for a long time in the western Adriatic, where it often appears together with stylistically different ceramics that eventually replace Impressed Ware (Skeates, 2003). By contrast, in the eastern Adriatic, later pottery styles seem to replace Impressed Ware relatively quickly, with hardly any overlap in time (Forenbaher et al., 2004). It is possible that the apparent difference is related to the relatively insecure stratigraphies of open-air sites. Dating safe (or safer) contexts in clearly

stratified caves may help us resolve the question.

### NEW RADIOCARBON DATES

To augment the number of radiometric dates for the East Adriatic Neolithic, we submitted samples of organic material (charcoal, human bone, and animal bone) to the Oxford Radiocarbon Accelerator Unit (ORADS) as part of the ORADS project, 'Dating the Neolithic in the Eastern Adriatic Region' (Table 1).

All the samples dated as part of our project came from sites that have been excavated recently, following high standards of excavation. Unless otherwise noted, the selected samples were hand-picked at the time of excavation, air-dried, and stored in foil and plastic bags. Archaeobotanical samples (wood charcoal and charred grains) and bone samples were taxonomically identified. Most of the dated sites are caves with long stratigraphic sequences that have been worked out in detail. These sites are generally characterized by excellent preservation of archaeological materials, with well-defined stratigraphy and features. The newly dated sites fall into two groups—one in the north (Istria and the Kvarner islands), the other in the south (the islands and littoral of southern Dalmatia)—thus allowing comparison between the northern and the southern parts of the eastern Adriatic region (Figure 1).

A total of forty-one samples were submitted; three of these failed owing to 'low yield after pre-treatment and no carbon to date' (T. Higham, Personal Communication, 2008). The thirty-eight successfully dated samples come from ten sites (nine limestone caves and one open-air site—Kargadur). Fifteen samples come from sites in southern and central Dalmatia and twenty-three come from sites in the northern Adriatic (Kvarner and Istria). The

**Table 1.** Radiocarbon dates obtained as part of the ORADS project, 'Dating the Neolithic in the Eastern Adriatic Region'

Site	Sample material	Lab no.	BP	Calibrated age BC		Attribution
				68.2% range	95.4% range	
<b>Mesolithic</b>						
Jačmica	Charcoal, <i>Pinus</i>	OxA-18025	9115 ± 45	8421–8273	8456–8251	Mesolithic
Jačmica	Charcoal, <i>Pinus</i>	OxA-18026	192 ± 26	recent	recent	Mesolithic*
Ovčja peč	Charcoal, <i>Pinus</i>	OxA-18023	9315 ± 45	8634–8483	8716–8352	Mesolithic
Ovčja peč	Charcoal, <i>Pinus</i>	OxA-18024	9310 ± 45	8631–8482	8709–8351	Mesolithic
Pupičina	Charcoal, <i>Pinus</i>	OxA-18028	8930 ± 40	8236–7990	8249–7964	Mesolithic
Vela (Lošinj)	Charcoal, <i>Pinus</i>	OxA-18170	9494 ± 39	9112–8734	9121–8651	Mesolithic
Vela (Lošinj)	Charcoal, <i>Juniperus</i>	OxA-18041	9805 ± 50	9299–9247	9366–9211	Mesolithic
Vela (Korčula)	Bone, <i>Homo sapiens</i>	OxA-18171	8110 ± 37	7140–7051	7289–7038	Mesolithic
<b>Mesolithic–Neolithic transition</b>						
Pupičina	Charcoal, <i>Fraxinus</i>	OxA-18027	6190 ± 36	5213–5070	5291–5029	Mesolithic–Neolithic*
<b>'Early Neolithic' styles</b>						
Kargadur	Charred seed, <i>Hordeum</i>	OxA-21092	6769 ± 33	5706–5640	5721–5629	Impressed
Kargadur	Charred seed, <i>Hordeum</i>	OxA-21093	6612 ± 32	5613–5520	5618–5490	Impressed
Vela (Lošinj)	Charcoal, <i>Rhamnus</i>	OxA-18118	7134 ± 37	6048–5988	6069–5921	Impressed
Nakovana	Charcoal, <i>Juniperus</i>	OxA-18120	7050 ± 37	5986–5902	6008–5846	Impressed A
Nakovana	Charcoal, <i>Juniperus</i>	OxA-18121	6982 ± 36	5971–5811	5981–5758	Impressed B
Nakovana	Charcoal, <i>Pinus</i>	OxA-18122	6975 ± 37	5966–5801	5979–5752	Impressed B
Nakovana	Charcoal, <i>Prunus</i>	OxA-18123	6711 ± 36	5662–5572	5708–5559	Undecorated pottery
Nakovana	Charcoal, <i>Prunus</i>	OxA-18124	6609 ± 37	5613–5514	5618–5487	Undecorated pottery
<b>'Middle Neolithic' styles</b>						
Jačmica	Charcoal, <i>Fraxinus</i>	OxA-18181	6191 ± 31	5213–5074	5286–5039	Danilo–Vlaška
Pupičina	Charcoal, <i>Fraxinus</i>	OxA-18119	6516 ± 36	5526–5469	5554–5377	Danilo–Vlaška
Pupičina	Charcoal, <i>Fraxinus</i>	OxA-18128	6606 ± 36	5613–5512	5617–5486	Danilo–Vlaška
Vela peč	Charcoal, <i>Fraxinus</i>	OxA-20830	9445 ± 45	8783–8642	9113–8614	Danilo–Vlaška**
Vela peč	Charcoal, <i>Fraxinus</i>	OxA-18229	5409 ± 33	4328–4254	4342–4174	Danilo–Vlaška
Kargadur	Bone, <i>Sus scrofa/</i> <i>domesticus</i>	OxA-18172	5686 ± 33	4546–4464	4614–4452	Danilo–Vlaška
Nakovana	Charcoal, <i>Rhamnus</i>	OxA-18125	6236 ± 35	5301–5081	5306–5069	Danilo
Nakovana	Charcoal, <i>Quercus</i>	OxA-18126	6117 ± 34	5204–4988	5208–4951	Danilo polychrome
Nakovana	Charcoal, <i>Ulex</i>	OxA-18127	6004 ± 34	4938–4846	4990–4799	Southern Dalmatian polychrome

Continued

Table 1. Continued

Site	Sample material	Lab no.	BP	Calibrated age BC		Attribution
				68.2% range	95.4% range	
<b>'Late Neolithic' styles</b>						
Jačmica	Charcoal, <i>Cornus/Viburnum</i>	OxA-18182	5263 ± 31	4225–3995	4230–3985	Late Neolithic (Hvar?)
Grapčeva	Bone, <i>Homo sapiens</i>	OxA-18178	5796 ± 30	4705–4613	4718–4553	Hvar (classic)
Grapčeva	Bone, <i>Homo sapiens</i>	OxA-18177	5867 ± 31	4780–4711	4828–4624	Hvar (classic)
Nakovana	Charcoal, <i>Rhamnus</i>	OxA-18173	5631 ± 31	4502–4375	4535–4368	Hvar (outlined)
Nakovana	Charcoal, <i>Rhamnus</i>	OxA-18174	5547 ± 33	4446–4350	4452–4342	Hvar (classic)
Nakovana	Charcoal, <i>Fraxinus</i>	OxA-18175	5190 ± 30	4038–3968	4044–3959	Hvar (late)*
Nakovana	Charcoal, <i>Prunus</i>	OxA-18176	5357 ± 30	4317–4077	4326–4054	Hvar (late)
<b>'Copper Age' styles</b>						
Jačmica	Charcoal, <i>Quercus</i>	OxA-18183	5325 ± 29	4233–4070	4252–4048	Late Neolithic or Copper Age
Novačka	Charcoal, <i>Fraxinus</i>	OxA-18184	5252 ± 29	4222–3989	4229–3978	Late Neolithic or Copper Age
Novačka	Charcoal, <i>Fraxinus</i>	OxA-18185	5100 ± 29	3960–3811	3968–3800	Copper Age (early)
Pupićina	Charcoal, <i>Fraxinus</i>	OxA-18179	5077 ± 30	3950–3804	3959–3797	Copper Age (early)
Pupićina	Charcoal, <i>Salix</i>	OxA-18180	3963 ± 27	2562–2464	2571–2349	Copper Age (late)

\*Considered as too young (see text for specific cases).

\*\*Considered as too old (see text for details). A repeat determination on the same sample provided a result of 9255 ± 38 BP (OxA-20830[b]).

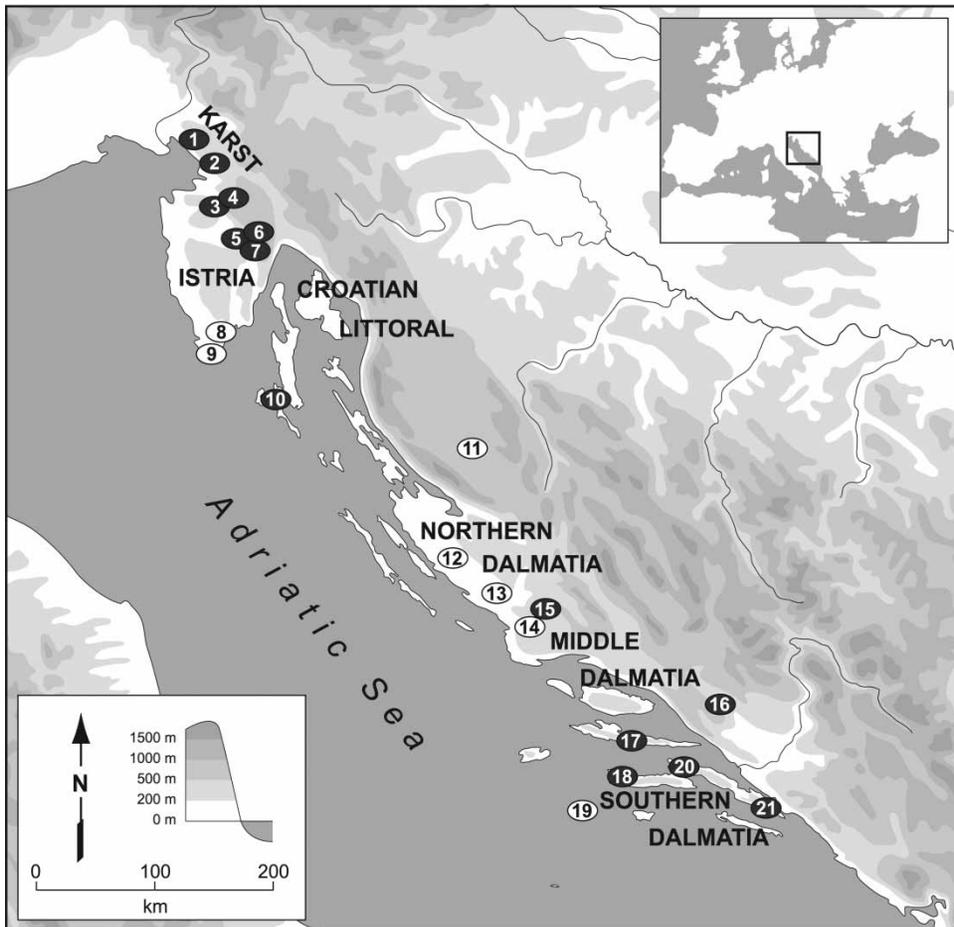
temporal distribution of these dates is as follows: nine from the Mesolithic, eight from the Early Neolithic, nine from the Middle Neolithic, seven from the Late Neolithic, and five from the Copper Age.

#### RADIOCARBON DATABASE, CALIBRATION AND BAYESIAN MODELLING

Including our thirty-eight new AMS dates, there are now 190 radiocarbon dates for the Mesolithic to Early Copper Age in the eastern Adriatic region. From this total, we have excluded fifty-four dates for the following reasons: insufficient

information about the associated finds ( $n = 22$ ), ambiguous cultural attribution of associated finds ( $n = 15$ ), uncertain context ( $n = 15$ ), problematic material for dating ( $n = 1$ ), and extremely large standard deviation ( $n = 1$ ). This leaves us with thirty-seven usable radiocarbon dates for the Mesolithic and ninety-nine dates for the Neolithic and Early Copper Age (Table 2). We use this data set to address three linked sets of questions related to the East Adriatic Neolithic:

1. When and at what pace did Neolithic lifeways appear in the region?
2. How old are specific Neolithic pottery styles, how long did they last, and how



**Figure 1.** Map showing the sites mentioned in the text (black: caves, white: open-air). 1, Edera; 2, Ciclami; 3, Jačmica; 4, Novačka; 5, Pupičina; 6, Ovića peć; 7, Vela peć; 8, Kargadur; 9, Vižula; 10, Vela spilja (Lošinj); 11, Đurđeva greda; 12, Tinj; 13, Velištak; 14, Danilo; 15, Škarin samograd; 16, Ravlića pećina; 17, Grapčeva; 18, Vela spila (Korčula); 19, Nakovana; 20, Gudnja; 21, Sušac.

- do they relate to the traditional partition of the Neolithic into Early, Middle, and Late phases?
3. How long did the East Adriatic Neolithic last? When did the transition to the Copper Age take place?

All radiocarbon dates were calibrated using OxCal version 4.1 (Bronk Ramsey, 2009) and InItCal 09 calibration curve (Reimer et al., 2009), and, unless otherwise noted, calibrated date ranges

(reported as ‘cal BC’) are for one standard deviation. We have available a total of ninety-nine Neolithic and Early Copper Age dates suitable for Bayesian modelling of the start and end dates of particular pottery styles. Bayesian modelling was done using the ‘boundary’ command in OxCal v. 4.1. This protocol treats each group of dates associated to a specific pottery style independently and does not make any assumptions about their relative age.

**Table 2** Provenience, association and number of all usable radiocarbon dates

Age or pottery style	Cave sites	Open-air sites	Total		
Mesolithic	Benussi	5		37	
	Ciclami	1			
	Edera	7			
	Jačmica	1			
	Klanjčeva	2			
	Nugljanska	1			
	Ovčja	2			
	Pupićina	6			
	Šebn	3			
	Vela peč	1			
	Vela spila (Korčula)	4			
	Vela spilja (Lošinj)	2			
	Zemunica	2			
Impressed Ware	Gospodska	1	Crno vrilo	4	30
	Grapčeva	1	Kargadur	3	
	Gudnja	2	Konjevrate	1	
	Nakovana	3	Vižula	1	
	Nova pećina	1	Pokrovnik	2	
	Škarin samograd	2	Sušac	1	
	Vela (Korčula)	1	Tinj	3	
	Vela (Lošinj)	1			
	Zemunica	3			
	Early Neolithic undecorated pottery	Edera	1	Đurđeva greda	
Nakovana		2			
Škarin samograd		2			
Danilo (Dalmatia)	Gudnja	2	Danilo	14	19
	Nakovana	1	Pokrovnik	2	
Danilo-Vlaška (Istria and Karst)	Ciclami	1	Kargadur	1	17
	Edera	4			
	Jačmica	1			
	Mitreo	2			
	Pupićina	6			
	Vela peč	2			
Danilo polychrome	Nakovana	1			1
Southern Dalmatian polychrome	Grapčeva	1	Sušac	1	3
	Nakovana	1			
Hvar	Grapčeva	8	Velištak	4	16
	Nakovana	3			
	Pupićina	1			
Early Copper Age	Grapčeva	2	Buković	3	7
	Novačka	1			
	Pupićina	1			
Total number of dates	Cave sites	95	Open-air sites	41	136

### THE TRANSITION TO FARMING IN THE EASTERN ADRIATIC

Recent analyses and reviews of the existing latest Mesolithic and earliest Neolithic dates from the region indicate that while there is often a temporal gap between the last hunter-gatherers and the first farmers in individual sequences (Biagi & Spataro, 2000; Berger & Guilaine, 2009: 34), there is continuity of occupation over the wider

region (Forenbaher & Miracle, 2006: 497–504). However, this observation is based on a smattering of dates from Mesolithic contexts (there are only about thirty-five dates from a dozen sites).

In order to improve the situation, nine samples were submitted for dating from five different cave sites where chipped stone assemblages permitted attribution to the Mesolithic or transitional Mesolithic-Neolithic: Pupićina, Ovčja, Jačmica, Vela

spilja (Lošinj) and Vela spila (Korčula). Despite our careful selection of what we considered to be secure contexts, two of the dates came out as too young. One sample (pine wood charcoal) from Jačmica (OxA-18026:  $192 \pm 26$  BP) is evidently modern and from a recent disturbance. The second sample (ash wood charcoal) from Pupićina (OxA-18027:  $6190 \pm 36$  BP) came from a layer of clay overlying a calcitic crust containing Mesolithic artefacts and remains of wild animals dated to  $8930 \pm 40$  BP (OxA-18028), and underlying a series of ash lenses with Middle Neolithic artefacts and remains of domestic animals dated to  $6516 \pm 36$  BP (OxA-18119) and  $6606 \pm 36$  BP (OxA-18128). This date is out of sequence relative to the overlying Middle Neolithic dates and is thus considered to be unreliable.

The remaining seven dates all belong to the eighth to the tenth millennia cal BC (Table 1). Dates from sites in the northern Adriatic (Jačmica, Ovčja, Pupićina, Vela spilja [Lošinj]) are associated with typologically 'Early Mesolithic' lithic assemblages, vertebrate assemblages dominated by red deer, roe deer, pig, and mollusc assemblages dominated by terrestrial species. The new radiocarbon dates from the ninth to the tenth millennia cal BC add nuance to the existing pattern of an intensive Early Mesolithic occupation of the region. The relative paucity of typologically 'Late Mesolithic' sites and dates from the seventh to the eighth millennia cal BC in the northern Adriatic region may reflect a shift in settlement pattern (from caves to open-air sites and/or from inland to coastal locations) or a decrease in population. The single date from southern Dalmatia (Vela spila [Korčula]) is associated with a typologically indeterminate lithic assemblage, a vertebrate assemblage dominated by fish and fox, and a mollusc assemblage dominated by marine species. This date is from the eighth millennium

BC and fits well with other evidence from the site of comparatively intense 'Late Mesolithic' occupation during the seventh to the eighth millennia cal BC (Miracle & Radić, In press). None of these new dates, however, falls close to the time of the transition to farming, which in this region took place around 6000 cal BC. They bear upon the issue of a putative Mesolithic/Neolithic 'gap' by supporting, rather than disproving, its existence.

Little doubt remains that innovations related to farming spread into the Adriatic from the southeast (Chapman & Müller, 1990; Skeates, 2003; Legge & Moore, 2011: 178; but for an alternative view, see Budja, 1999). A recent model postulated a two-stage process in which pottery and domestic animals dispersed very rapidly in the southern Adriatic and along the coastal strip, while the complete 'Neolithic package' (including pottery, domestic animals, and settled villages) moved more slowly in the northern Adriatic and into the hinterland. The temporal and regional shift in the rate of spread was explained as a consequence of variable interactions with existing local foraging populations (Forenbaheer & Miracle, 2005).

Further refinement and testing of this and other models required more securely dated contexts from sites across the region. To this end, we submitted for dating six samples from the earliest Neolithic contexts of five caves (Nakovana, Vela spilja [Lošinj], Pupićina, Vela peć, and Jačmica) and an open-air site (Kargadur) (Table 1). At Nakovana, Vela spilja (Lošinj) and Kargadur, the dated contexts contained Impressed Ware pottery. At Pupićina, Vela Peć and Jačmica, they contained Danilo-style pottery, which is considered Middle Neolithic in regions farther to the south-east, but is the earliest pottery in northern Istria (Forenbaheer & Miracle, 2005: 520, 2006: 492–95; Forenbaheer & Kaiser, 2006).

The date from Vela peć (OxA-20830: 9445 ± 45 BP) is evidently too old. In this case, a charcoal residual from the immediately underlying Mesolithic layer must have been submitted. Of the remaining five dates, the most remarkable is the one from Vela spilja (Lošinj), a site located on the island of Lošinj in the northern Adriatic (OxA-18118: 7134 ± 37 BP, 6048–5988 cal BC). The charcoal sample of *Rhamnus* sp. was recovered under controlled conditions in the course of recent excavations from an undisturbed Impressed Ware context (Komšo et al., 2005). This is one of the earliest Neolithic dates anywhere in the Adriatic, roughly contemporary with the earliest secure Neolithic dates in Dalmatia (Forenbaher & Kaiser, 1999: 33–34) and the Tavoliere (Skeates, 2003: 184). Unless one invokes an ‘old wood effect’, this date suggests that the first stage of maritime exploration by Impressed Ware ‘pioneers’ extended further north and the rate of spread of some Neolithic technologies during this first stage was faster than we previously thought (Forenbaher & Miracle, 2005).

A number of other high-resolution AMS determinations from safe contexts at Early Neolithic sites in the eastern Adriatic have become available over the last few years (Marijanović, 2009: 114; Drnić et al., 2010; Berger et al., 2011; Legge & Moore, 2011: 179; Radović, 2011). At the same time, some of the old dates have been reattributed to different periods or discarded due to problems with their attributions (Radić, 2009; Berger et al., 2011). In combination with the unexpectedly early date from Vela spilja (Lošinj), this relative wealth of new data prompts us to reconsider and slightly modify the two-stage model of Neolithic beginnings. It now appears that the first stage of farmer-forager contacts and maritime explorations encompassed most of the Adriatic region, spreading new technologies (pottery),

exogenous domesticates (sheep and goat), and novel subsistence strategies (herding). During the second stage, farming villages were established in what were then the most attractive locations. Moving from the southeast to northwest in the Adriatic region, the first stage lasted progressively longer and the second stage began progressively later. A more detailed discussion of our modified model for the spread of farming in the Adriatic will be published elsewhere (Forenbaher & Miracle, In press).

#### DATING SPECIFIC EAST ADRIATIC NEOLITHIC POTTERY STYLES

Relative dating based on characteristically shaped and/or decorated potsherds is a long-standing tradition among eastern Adriatic prehistorians (e.g. Novak, 1955; Korošec, 1958; Batović, 1979; Dimitrijević, 1979; Müller, 1994; Čečuk & Radić, 2005; Marijanović, 2005). It still remains our last resort when dealing with surface finds or excavated contexts that do not contain chronometrically datable materials.

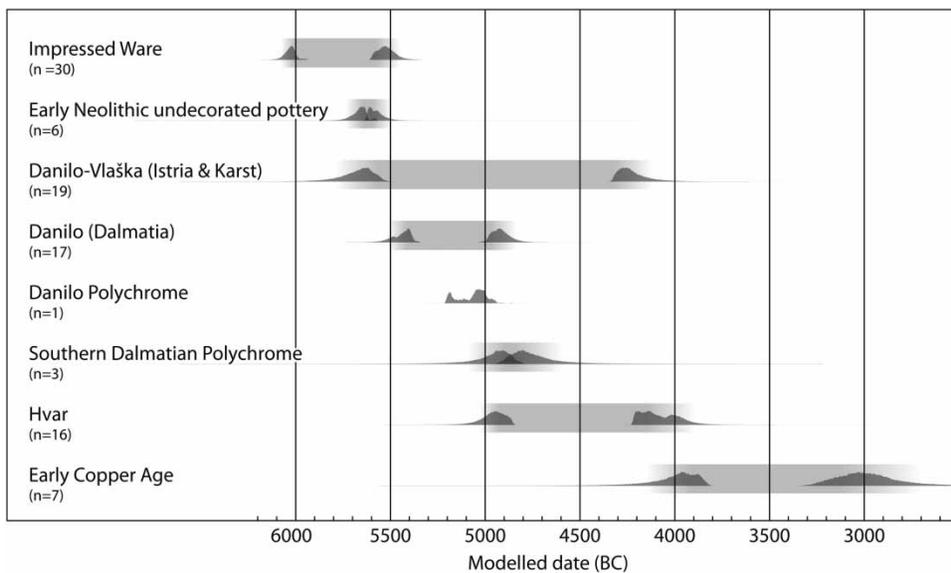
As related earlier, one of our aims was to explore the timing and duration of specific pottery styles in order to judge the suitability of characteristic potsherds for relative dating. To this end, twenty-four samples (including those from the earliest Neolithic contexts mentioned above) were submitted from six caves (Jačmica, Pupičina, Vela peć, Vela spilja [Lošinj], Grapčeva and Nakovana) and an open-air site (Kargadur). Samples were taken from contexts containing pottery stylistically characteristic of the defined Neolithic sequence. The three major stylistic traditions of the East Adriatic Neolithic were investigated: the ‘Early Neolithic’ Impressed Ware, the ‘Middle Neolithic’ Danilo complex, and the ‘Late Neolithic’ Hvar style.

### ‘Early Neolithic’ Impressed Ware

While information from the southern Adriatic remains scarce, it seems that the geographic distribution of Impressed Ware (Batović, 1979; Müller, 1994; Forenbaher & Miracle, 2005) covers the entire eastern Adriatic coast and its hinterland, except its extreme northern end (northern Istria and the Trieste Karst of southern Slovenia and northeast Italy). The six new dates for Impressed Ware fall between around 6000 and 5500 cal BC (Table 1), which corresponds to the time-span proposed by Forenbaher and Kaiser (1999) for the duration of that stylistic complex in the eastern Adriatic. Only two of about thirty-five radiocarbon dates currently available from the region are younger than 5500 BC, and the reliability of both dates is open to question. The date from Vizula (HD-11733: 6140 ± 70 BP, 5208–5003 cal BC, Chapman & Müller, 1990: 130) comes from an old excavation and its association with Impressed Ware is

tenuous, while that from Tinj (GrN-15238: 6280 ± 210 BP, 5471–5011 cal BC, Chapman & Müller, 1990: 130; Chapman et al., 1996: 186) has a very large standard error that renders it practically useless. Aside from these, a single very early date from Vela spila (Korčula), originally published as associated with early Impressed Ware (Z-1967: 7300 ± 120 BP, 6337–6032 cal BC, Čečuk & Radić, 2001: 102, 108, note 4), has recently been reattributed to a hypothetical ‘Mesolithic/Neolithic transitional period’ (Radić, 2009: 17).

The available dates suggest, therefore, that Impressed Ware came into use in the eastern Adriatic region shortly before or around 6000 cal BC and went out of use about five centuries later—an impression that is supported by Bayesian modelling of the dates (Figure 2). This pattern differs from the situation on the opposite side of the Adriatic, where Impressed Ware continues to appear together with stylistically later pottery for several more centuries



**Figure 2.** Approximate temporal spans of eastern Adriatic pottery styles. Probability density functions for start and end boundaries of specific pottery styles were generated using Bayesian modelling.

during the second half of the sixth millennium cal BC (Skeates, 2003: 170).

Most authors distinguish between an earlier 'Impressed A' and a later 'Impressed B' style (e.g. Batović, 1979; Müller, 1994; Čečuk & Radić, 2005). Large surface areas of pottery vessels covered by dense impressions made by the edge of a *Cardium* shell or by some other small object mark the former style, while bands of zigzag impressions characterize the latter style (Figure 3.1–2). Potsherds attributable to both styles were recovered from stratified contexts at Nakovana Cave, with 'Impressed A' underlying 'Impressed B'. Three charcoal samples from those contexts yielded a tight cluster of radiocarbon determinations that follow the stratigraphic sequence. As expected, 'Impressed A' was dated to immediately after 6000 BC. Somewhat surprisingly, dates for 'Impressed B' are only half a century younger.

Only two other dates have been linked explicitly to a specific Impressed Ware style. At Vela spila (Korčula), an 'Impressed B' context is just as early as the one at Nakovana (Z-1968: 7000 ± 120 BP, 5989–5767 cal BC, Radić, 2009: 17). On the other hand, the open-air Early Neolithic site SU-002 on the island of Sušac, summarily attributed to the 'Impressed A' style, yielded a single, relatively late date (ETH-22912: 6925 ± 65 BP, 5877–5736 cal BC, Radić, 2009: 17). These dates do not support the contention that the widely accepted stylistic division of the Impressed Ware in the eastern Adriatic reflects an important chronological distinction.

### **The end of Impressed Ware and the transition from 'Early' to 'Middle' Neolithic**

The date from Sušac mentioned above is the youngest date that we have presently

for Impressed Ware in southern Dalmatia. Currently available radiometric evidence thus suggests that Impressed Ware pottery lasted only about three centuries in this area (disappearing soon after 5800 cal BC), while it lingered a few centuries longer further to the north. At present, the best evidence for the end of Impressed Ware style comes from Nakovana Cave, where a thick layer dominated by undecorated pottery separates the latest Impressed Ware from the earliest Danilo-style incised-geometric pottery.

Two contexts with only undecorated pottery at Nakovana Cave yielded radiometric dates around 5600 cal BC (Table 1), which makes them contemporary with later Impressed Ware sites in Northern Dalmatia and Istria. In this respect, Nakovana is not alone. Neolithic contexts containing only undecorated pottery have been noted at several other sites, three of which have been dated: Edera in the Trieste Karst (GX-19569: 6700 ± 130 BP, 5721–5515 cal BC, Biagi, 1995), Škarin Samograd in the northern Dalmatian hinterland (HD-12094: 6750 ± 60 BP, 5711–5626 cal BC, and HD-11773: 6740 ± 50 BP, 5707–5623 cal BC, Chapman & Müller, 1990), and Đurđeva Greda in Lika (Beta-293836: 6710 ± 50 BP, 5669–5564 cal BC, Forenbaher & Vujnović, In press). Remarkably, all of these dates cluster around 5600 BC.

There is no evidence of a 'monochrome ware' horizon that would precede the Impressed Ware (Müller, 1988: 234, 1994: 217)—an issue that we have already discussed in some detail (Forenbaher & Kaiser, 2006: 196–98). A few isolated plain sherds have been reported recently from the lowest Neolithic levels of Vela spila (Korčula) (Radić, 2005: Figure 3, 336–37, 2009: 16–18), but details of their relationship to the overlying Impressed Ware contexts and the underlying Mesolithic contexts remain to be resolved. For

the time being, the new dates support our previous suggestion that Impressed Ware is the first pottery style in the eastern Adriatic region.

Bayesian modelling (Figure 2) suggests a complete overlap between the end of Impressed Ware and the appearance of assemblages with only undecorated pottery. In Istria and the Karst, these assemblages of undecorated pottery overlap with the start of the Danilo-Vlaška styles, whereas in Dalmatia such assemblages precede the Danilo style. Further work is needed to clarify these spatio-temporal patterns.

### **'Middle Neolithic' Danilo complex**

The Danilo complex (Batović, 1979) probably encompasses the entire eastern Adriatic region, although information from its southern part is again scarce. It includes the 'Danilo-Vlaška' variant in Istria and the Trieste Karst (Barfield, 1972; Forenbaher & Kaiser, 2006: 198–202), as well as at least two distinctive styles of polychrome painted *figulina* pottery in Dalmatia (Korošec, 1958; Čečuk & Radić, 2005; Marijanović, 2005). We begin by addressing the very wide time-span covered by the nine new dates (Table 1). One of them, the ninth millennium cal BC date from Vela peč (OxA-20830), has already been dismissed as aberrant (see above). Six of the remaining eight dates fall between around 5600 and 4900 BC, corresponding to the duration of the Middle Neolithic proposed by Forenbaher and Kaiser (1999). Two dates, however, are very much younger (OxA-18229 and OxA-18172), falling around and/or after 4500 cal BC.

The geographic distribution of more than forty Danilo radiocarbon dates reveals interesting patterns. Almost all of the early dates for Danilo come from three caves in

Istria or the Trieste Karst: Pupičina (Miracle & Forenbaher, 2006b), Edera (Biagi & Spataro, 2000), and Ciclami (Gilli & Montagnari Kokelj, 1992). This is the area where geometric-incised Danilo pottery (Figure 3.3) is not preceded by Impressed Ware. The earliest dates from Dalmatia are those from Gudnja Cave, where the Danilo component has been dated to soon after 5500 cal BC (Chapman, 1988: 7), but most of the Dalmatian dates for Danilo fall between 5300 and 4800 cal BC (Chapman & Müller, 1990; Moore et al., 2007). Only five dates are younger than 4700 cal BC; all of them, once again, are from sites in Istria (Table 1) and the Trieste Karst (Montagnari-Kokelj & Crismani, 1996).

Radiocarbon dates thus suggest a temporal overlap between Impressed Ware and Danilo styles from around 5600 to 5500 BC in the northern Adriatic region. This temporal overlap is confirmed by Bayesian modelling (Figure 2). There is no mixing, however, of Impressed Ware and Danilo styles within any of the clearly stratified and well-excavated cave sites such as Nakovana (Forenbaher & Kaiser, 2010: 27), Vela spila (Korčula) (Čečuk & Radić, 2005: 109), Ravliča pećina (Marijanović, 1981: 11, 44), or Gudnja (Marijanović, 2005: 32, 34).

Dalmatian Neolithic pottery assemblages in which Danilo or early Hvar styles predominate usually contain a small quantity of *figulina* type finewares (Spataro, 2002: 13). These are attributed by various authors to a number of different polychrome painted styles. A well-defined style, commonly referred to as 'Danilo polychrome' (Figure 3.4), is best known from the Middle Neolithic village of Danilo itself (Korošec, 1958: 40–53), and is restricted mainly (but not exclusively) to northern Dalmatia. Our new date from Nakovana Cave (OxA-18126: 6117 ± 34 BP, 5204–4988 cal BC, Table 1) is currently the only



**Figure 3.** Characteristic potsherds: 1, Impressed Ware A; 2, Impressed Ware B; 3, Danilo incised geometric; 4, Danilo polychrome (after Korošec, 1958: Plate 98); 5, southern Dalmatian polychrome; 6, outlined Hvar; 7, classic Hvar; 8, channelled Hvar; 9, Nakovana; 10, early Cetina.

published radiometric date explicitly associated with the Danilo polychrome style; it places this style near the end of the sixth millennium cal BC (Figure 2).

A somewhat different polychrome painted *figulina* style, here defined as the 'Southern Dalmatian Polychrome', is best known from cave sites such as Gudnja,

where it has been attributed to the ‘Gudnja culture’ (Dimitrijević, 1970: 115; Petrić, 1976: 300–03; Marijanović, 2005: 40–45), or Vela spila (Korčula), where it has been assigned to the ‘Vela Luka culture’ (Čečuk & Radić, 2005: 112–15). Most of such potsherds were recovered from the latest Middle Neolithic or the earliest Late Neolithic contexts in southern Dalmatia (Figure 3.5). Three radiocarbon dates from three different sites, Nakovana (OxA-18127:  $6004 \pm 34$  BP, 4938–4846 cal BC, Table 1), Grapčeva (Beta-103487:  $6000 \pm 80$  BP, 4993–4794 cal BC, Forenbaher & Kaiser, 2008: 21), and Sušac (laboratory identification number not reported,  $5895 \pm 65$  BP, 4843–4693 cal BC, Della Casa & Bass, 2001) make up a tight cluster around 4900–4800 cal BC (Figure 2).

The sub-regional distribution of radiocarbon dates for the Danilo complex thus hints at the possibility that this style may have originated in Istria and the Trieste Karst around 5600 cal BC, and that there it lasted almost until the end of the fifth millennium cal BC, making it contemporary with Hvar style pottery in Dalmatia. Typical ‘late Neolithic’ Hvar-like pottery appears only sporadically at northern Adriatic sites (Cermesoni et al., 1999: 239; Forenbaher & Miracle, 2006: 528–30), usually together with more abundant Danilo-Vlaška pottery. Ceramic vessels in the Classic Hvar style, it now seems, may have been restricted to Dalmatia, while farther north a slightly modified Danilo-Vlaška pottery tradition with occasional Hvar-like elements was present.

### ‘Late Neolithic’ Hvar style

Hvar style pottery, decorated by a rich variety of incised and painted designs, is best known from Grapčeva Cave on the island of Hvar (Novak, 1955; Forenbaher

& Kaiser, 2008; Forenbaher et al., 2010). All major Hvar sites are located in Dalmatia and its hinterland.

Only ten radiocarbon dates from three sites have been published previously (Miracle & Forenbaher, 2006b: 76; Forenbaher et al., 2010: 345; Podrug, 2010: 20). Of the seven new dates reported here (Table 1), six are from Hvar levels at Grapčeva and Nakovana caves. The seventh date, from Jačmica Cave in Istria, dates a context whose attribution to the ‘Late Neolithic’ relies on the presence of a few Hvar-like sherds. All of these dates fall between 4800 and 4000 cal BC, which corresponds to the duration of the Late Neolithic proposed by Forenbaher and Kaiser (1999). There is, however, a stratigraphic inversion of the two dates from Nakovana Cave that are associated with late Hvar pottery. The later date (OxA-18175) comes from a stratigraphically older context that abuts a disturbed context next to the cave wall. This makes it more suspect than the earlier date (OxA-18176), which corresponds to a clearly stratified and stratigraphically younger context interpreted as a hearth.

There are a few characteristic ways of decorating Hvar pots that appear to be rather restricted in time. Prominent among them is the ‘outlined style’ (Forenbaher & Kaiser, 2008: 51–52; Forenbaher et al., 2010: 346) in which complex geometric designs were produced by a combination of decorative techniques. First, the design was outlined by incision, then the surrounding surface was burnished, and finally the incised motif itself was filled with bright red paint after the vessel had been fired (Figure 3.6). Sherds decorated in this manner appear at the bottom of the ‘Late Neolithic’ stratigraphic sequences at Grapčeva, Nakovana, and Vela spila (Korčula); they dwindle and disappear in higher Hvar levels. They also appear in quantity at Velištak, an open-air

site in northern Dalmatia dated by two radiocarbon determinations to around 4800 cal BC (UCIAMS-78155: 5975 ± 15 BP, 4897–4809 cal BC, and UCIAMS-78156: 5920 ± 15 BP, 4830–4746 cal BC, Podrug, 2010: 20). These dates correspond closely to the single date associated with the outlined Hvar style from Grapčeva cave (Beta-103486: 5900 ± 60 BP, 4842–4709 cal BC) (Forenbaher et al., 2010: 345). Intriguingly, the only other date for outlined Hvar, OxA-18173 (5631 ± 31 BP, 4502–4375 cal BC) from Nakovana Cave (Table 1), is about three centuries younger. By that time, outlined decoration apparently had gone out of use at Grapčeva, but given the scarcity of dates and the small dimensions of the Grapčeva test trench, this is far from certain. Future research will show whether the outlined Hvar style had a shorter life at some sites and a longer life at others.

Channelling is another characteristic and temporally restricted decorative technique that appears on dark, burnished bowls in Late Hvar contexts (Figure 3.8). Currently, four dates are available for such contexts, two from Grapčeva (Forenbaher et al., 2010: 345) and two from Nakovana (Table 1). Unfortunately, one of the dates from Nakovana has been discarded as unreliable (see above). Likewise, one of the dates from Grapčeva is out of sequence and should also be discarded (Forenbaher & Kaiser, 2008: 27). That leaves us only with single dates from Nakovana (OxA-18176: 5357 ± 30 BP, 4317–4077 cal BC) and Grapčeva (Beta-106625: 5210 ± 40 BP, 4042–3974 cal BC) which suggest that channelled Late Hvar bowls were used during the last quarter of the fifth millennium cal BC.

Recent careful work at stratified cave sites such as Grapčeva (Forenbaher & Kaiser, 2008; Forenbaher et al., 2010), Vela spila (Korčula) (Čečuk & Radić, 2005) and Nakovana (Forenbaher & Kaiser, 2010) has

indicated that a few specific Hvar-style decorative techniques and designs are chronologically sensitive; they were preferred only during certain short periods of time. However, most Hvar styles, including the iconic dark, burnished, red-painted ware (Figure 3.7), are not so diagnostic. Bayesian modelling of the dates supports the impression that they continued to be generally popular from approximately 4800 to 4000 cal BC (Figure 2).

### THE DURATION OF THE EAST ADRIATIC NEOLITHIC AND THE TRANSITION TO THE COPPER AGE

Less is known about the Copper Age than any other period in the entire post-Mesolithic prehistory of the eastern Adriatic. Its definition rests almost entirely on certain stylistic traits of pottery (Petrić, 1976; Dimitrijević, 1979; Forenbaher, 2000). The transition from the Neolithic to the Copper Age has been difficult to pin down owing to the fact that 'Early Copper Age' pottery assemblages share many features with 'Late Neolithic' ones. Common in central and southern Dalmatian assemblages, restricted sets of pottery shapes and decorative elements (Figure 3.9) are often assigned to the 'Nakovana culture.' These stylistic traits are only occasionally present in the northern Adriatic assemblages.

The five new radiocarbon dates for the Copper Age (Table 1) are discussed in chronological order. The first two dates fall around 4100 cal BC, but one of them (OxA-18183 from Jačmica) is unreliable since it is out of sequence with the other dates from the same site. The other date (OxA-18184 from Novačka) comes from a context rather vaguely attributed to the 'Late Neolithic' or 'Copper Age' and therefore is not very useful. The next two dates (OxA-18185 from Novačka, and

OxA-18179 from Pupičina) are associated with pottery exhibiting some Nakovana-like traits; both fall around 3900 cal BC. Finally, the youngest date (OxA-18180 from Pupičina) is associated with 'Early Cetina' style pottery (Figure 3.10) (Marović & Čović, 1983; Della Casa, 1995) and falls around 2500 cal BC, an age traditionally thought to correspond to the Late Copper Age–Early Bronze Age transition.

As noted above, the latest secure 'Late Neolithic' dates fall around 4000 cal BC. The seven currently available and reliable dates from four Early Copper Age sites spread along the eastern Adriatic coast span the entire fourth millennium cal BC. Typical Nakovana pottery shapes and decoration appear at some point between 4000 and 3500 cal BC (see Forenbaher & Kaiser, 1999). As things now stand, the transition from the Neolithic to the Copper Age is blurred, but probably occurs around the beginning of the fourth millennium cal BC (Figure 2).

#### SUMMARY AND CONCLUSION

How improved is the chronological picture? The new radiocarbon dates reported here put the East Adriatic Neolithic into sharper focus even if its edges, the beginnings and endings of local iterations of the Neolithic, remain pixelated.

The new radiocarbon dates for the Mesolithic do not narrow the existing gap that separates the latest Mesolithic from the earliest Neolithic assemblages in the eastern Adriatic region. If anything, they support rather than disprove its existence. One should bear in mind, however, that only a very few sites are known that contain both Late Mesolithic and Early Neolithic components, and not all of them have been dated yet. So, for the moment, the issue of the 'Mesolithic gap' remains unresolved. This has a bearing on the first

of several subsequent, crucial issues in the Holocene prehistory of the eastern Adriatic: the arrival of food production.

The new dates for the earliest Neolithic support the two-stage model for the spread of farming in the Adriatic (Forenbaher & Miracle, 2005) with a minor modification (Forenbaher & Miracle, *In press*). The date from Vela spilja (Lošinj), taken in conjunction with other reliable radiocarbon dates that have become available recently, suggests that the first stage of farmer–forager contacts and maritime explorations embraced almost the entire coastal zone of the eastern Adriatic region. Doubtless composed of complicated interactions, we cannot track the earliest encounters between members of farming and of foraging societies with much precision yet, thanks to the patchy radiocarbon silence of the archaeological record. What we do see, though, is that shortly after the initial explorations there followed a second stage. Then, farming villages were established in what were apparently the most attractive locations. From southeast to northwest in the Adriatic basin, the first, exploratory stage of the Neolithic lasts progressively longer and the second, village stage begins progressively later.

As expected, all of the new dates associated with Impressed Ware pottery fall within the first half of the sixth millennium cal BC. It is not possible to make any finer chronological distinctions with confidence. The division of Impressed Ware into an earlier 'Impressed A' and a later 'Impressed B' has not been confirmed. While several dates suggest a possible temporal overlap between the Impressed Ware and the Danilo complex around the middle of the sixth millennium cal BC, these two distinct pottery styles do not mix at any of the clearly stratified cave sites. To the contrary, several dates suggest that in some areas assemblages with only undecorated pottery separate the

Impressed Ware and Danilo complexes at around 5600 cal BC.

In Dalmatia, most of the dates associated with Danilo pottery fall between 5300 and 4800 cal BC. Further north, dates on materials associated with the Danilo-Vlaška pottery style variant span a much longer period, from 5600 to 4300 cal BC. This suggests that Danilo styles may have originated in the northern Adriatic region (northern Istria and the Trieste Karst) around 5600 cal BC, and that the Danilo-Vlaška variant then endured for most of the fifth millennium cal BC. A few contexts containing polychrome painted *figulina* pottery have been dated to the late sixth and the early fifth millennia cal BC (Danilo polychrome and the southern Dalmatian polychrome, respectively), but we are not yet certain that those styles were shortlived.

All of the new dates for Hvar style pottery are between 4800 and 4000 cal BC, as expected. While many distinctive Hvar decorative techniques and designs were in use throughout these eight centuries, a few ceramic elements may be more tightly clustered in time. For instance, the 'outlined style' appears to be limited to the earlier part of the fifth millennium cal BC, while channelled decoration seems to be limited to the last centuries of the fifth millennium cal BC. Some of the elements of the Nakovana pottery style began to appear soon after, heralding the transition from the Neolithic to the Copper Age soon after 4000 cal BC.

While it is still not possible to pin down precisely the duration of any one of the pottery styles we have discussed, it is already clear that some of them are more chronologically diagnostic than others (Figure 2). Furthermore, some of them are geographically restricted to only a part of the region. Impressed Ware is absent from the far north; the two polychrome *figulina* styles are restricted to northern and

southern Dalmatia, respectively; and Hvar style vessels are restricted primarily to Dalmatia. It goes without saying that none of these geographic exclusions is absolute.

In conclusion, what the new dates reported here for the East Adriatic Neolithic show is that beginning around 6000 cal BC, pottery styles emerged, spread, and disappeared at different times and at different rates within the region. This calls into question the usefulness of the old, threefold division of the Neolithic into 'Early', 'Middle', and 'Late' phases. To simply shoehorn assemblages into the old phases, as has been the traditional practice in the region, distorts the record.

Why persist? We now have the beginning of a more solid and reliable chronological framework built on absolute dates. With a finer-grained chronological picture, we should be able to examine the temporal and geographic patterns in past cultural remains. In the case of ceramics, for example, the new framework allows us to explore the possible social, cultural, and ecological factors that led people to develop, transmit, adopt, and/or abandon particular styles of pottery. Tackling these, and other, more nuanced questions requires further refinement of chronometric control: that is, many more radiocarbon dates from secure contexts associated with appropriate cultural remains. The expanding database of radiocarbon dates for eastern Adriatic Mesolithic, Neolithic, and Copper Age assemblages allows us to liberate material culture in general and prehistoric pottery in particular; these remains no longer need to be slaves to chronological masters.

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## Datation du Néolithique de l'Est Adriatique

*On présente ici de nouvelles déterminations par radiocarbone provenant de contextes mésolithiques, néolithiques et/ou de l'Âge du Cuivre de dix sites différents, plus que doublant ainsi le nombre de dates absolues disponibles pour l'Est Adriatique par rapport à 10 ans plus tôt. Les dates montrent qu'à partir de 6000 cal BC des styles céramiques (céramique à impressions, variantes Danilo, Hvar, Nakovana et Cetina) se répandent et disparaissent en des temps, places et rythmes différents au sein de la région. Les conséquences pour les modèles de diffusion de l'agriculture et autres aspects de la vie néolithique sont étudiés. On doit se poser la question si la triple division du Néolithique régional en des phases 'début', 'moyen' et 'récent' demeure utile. Translation by Isabelle Gerges.*

*Mots clés:* Néolithique, Mésolithique, datation au radiocarbone, Est Adriatique, styles céramiques, céramique imprimée

## Zur Datierung des ostadriatischen Neolithikums

*In diesem Beitrag werden neue Radiokarbonaten aus Kontexten des Mesolithikums, des Neolithikums und/oder der Kupferzeit von zehn verschiedenen Fundplätzen vorgestellt, womit sich die Zahl der Daten, die für den ostadriatischen Raum zur Verfügung stehen, im Vergleich zum letzten Jahrzehnt mehr als verdoppelt hat. Die Daten zeigen, dass ab 6000 v. Chr. zu verschiedenen Zeiten, an*

*unterschiedlichen Orten und in abweichendem Maße innerhalb der Region verschiedene Keramikstile (Impresso, Danilo-Varianten, Hvar, Nakovana und Cetina) erschienen, sich verbreiteten und wieder verschwanden. Die Konsequenzen dieser Ergebnisse für Modelle der Verbreitung der Landwirtschaft und anderer Merkmale des jungsteinzeitlichen Lebens werden diskutiert. Dabei wird die Zweckmäßigkeit der traditionellen Dreiteilung des lokalen Neolithikums in eine 'frühe', eine 'mittlere' und eine 'späte' Phase in Zweifel gezogen. Translation by Heiner Schwarzberg.*

*Stichworte:* Neolithikum, Mesolithikum, Radiokarbondatierung, Ostadria, Keramikstile  
Impressokeramik