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Plant Economies in the
Neolithic Eastern Adriatic:
Archaeobotanical Results from
Danilo and Pokrovnik

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The beginning of farming in Croatia (ca. 6000 cal BC) is little understood and few archaeobotanical studies have been conducted to explore the nature of subsistence economies at this time. This paper presents new archaeobotanical data from the middle Neolithic site of Danilo Bitinj and the early/middle Neolithic site of Pokrovnik, providing a significant contribution to the current evidence on early farming in the region.

Keywords: Early Farming, Impressed Ware, Croatia, Plant Cultivation

Biljne ekonomije u neolitiku
na istočnom Jadranu: rezultati
arheobotaničkih istraživanja u
Danilu i Pokrovniku

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Malo se zna o počecima poljodjelstva u Hrvatskoj (oko 6000. cal BC) i proveden je tek mali broj istraživanja usmjerenih na otkrivanje strategija preživljavanja u to doba. U ovom su članku predstavljeni novi arheobotanički podaci sa srednjoneolitičkog nalazišta Danilo Bitinj i ranoneolitičkog te srednjoneolitičkog nalazišta Pokrovnik, što je značajan doprinos dosadašnjim spoznajama o počecima poljodjelstva u tom području.

Ključne riječi: počeci poljodjelstva, impresso keramika, Hrvatska, uzgoj bilja

Introduction

The 'Early Farming in Dalmatia' project was initiated and directed by Professor Andrew Moore (Rochester Institute of Technology, NY). Excavations at the two Neolithic sites of Danilo Bitinj (hereafter named Danilo) and Pokrovnik, which formed the basis of the research, were carried out between 2004 and 2006. Middle Neolithic Danilo is located in a fertile valley ca. 8 km from the coast and the early-middle Neolithic site of Pokrovnik is in the next valley to the northeast, at a distance of ca. 30 km inland (Fig. 1). The settlement at Danilo is thought to extend over ca. 9 ha and is the eponymous site of the middle Neolithic Danilo culture.¹ Pokrovnik is estimated to be the smaller of the two sites covering ca. 3 ha and was occupied during the early (Impressed ware, 6000-5300 cal BC) and middle (Danilo culture, 5500-4900 cal BC) Neolithic.² As part of the excavations an extensive archaeobotanical recovery programme was conducted. The main aims of this study were to determine the range of domestic crops and wild plant resources utilised at the two sites and to assess the extent to which they contributed to overall subsistence economies. The intention also was to compare the development of crop-based agriculture, both at the local and regional scales. This paper therefore presents the archaeobotanical results from the 2004 and 2005 Danilo and 2006 Pokrovnik field seasons.

Earlier archaeobotanical studies at Danilo and Pokrovnik

Danilo and Pokrovnik had been excavated prior to the first season of the Early Farming in Dalmatia project. Danilo was excavated in the 1950s by Korošec³ and in 1992 by Menđušić,⁴ and Pokrovnik was excavated in 1979 by Brusić and Talić from the Museums of Split and Drniš.⁵

During the earlier excavations at Danilo fragments of daub with impressions of cereal grains and chaff were recovered.⁶ From latex casts of the impressions Hopf identified four spikelet fragments (e.g., spikelet forks and glumes) and a single broken grain of emmer (*Triticum dicoccum*) and three spikelet fragments of einkorn (*Triticum monococcum*). She also tentatively identified one spikelet fragment as naked barley (*Hordeum vulgare* var. *nudum*). The results of these early

Uvod

Projekt "Rano poljodjelstvo i stočarstvo u Dalmaciji" pokrenuo je i vodio prof. Andrew Moore (*Rochester Institute of Technology*, savezna država New York, SAD). Iskopavanja dvaju neolitičkih lokaliteta, Danila Bitinja (u daljnjem tekstu Danilo) i Pokrovnika, koja tvore temelj ovoga istraživanja, provedena su u razdoblju od 2004. do 2006. godine. Srednjoneolitičko nalazište Danilo nalazi se u plodnoj dolini oko 8 km udaljenoj od obale, dok se rano i srednjoneolitičko nalazište Pokrovnik smjestilo u susjednoj dolini u smjeru sjeveroistoka, otprilike 30 km udaljenoj od obale (sl. 1). Smatra se da se naselje u Danilu prostiralo na oko 9 ha, a ono je i eponimno nalazište srednjoneolitičke danilske kulture.¹ Procjenjuje se da je nalazište u Pokrovniku manje i da pokriva površinu od oko 3 ha, te da je bilo naseljeno tijekom ranog neolitika (kultura *impresso* keramike, 6000.-5300. cal BC) i srednjeg neolitika (danilska kultura, 5500.-4900. cal BC).² U sklopu iskopavanja proveden je i opsežan program prikupljanja arheobotaničkog materijala. Glavni cilj istraživanja bio je utvrđivanje raspona domesticiranih kultura i samonikloga bilja koje se upotrebljavalo na ova dva nalazišta te procjena do koje su mjere oni pridonosili sveukupnim gospodarskim strategijama preživljavanja. Nadalje, nakana je bila i usporediti razvoj poljodjelstva, kako na lokalnoj tako i na regionalnoj razini. Stoga su u ovome članku predstavljeni arheobotanički rezultati terenskog istraživanja u Danilu u sezonama 2004. i 2005. te u Pokrovniku u sezoni 2006.

Prethodna arheobotanička istraživanja u Danilu i Pokrovniku

Iskopavanja su se u Danilu i Pokrovniku provodila i prije prve sezone projekta "Rano poljodjelstvo i stočarstvo u Dalmaciji". Danilo je 50-ih godina 20. stoljeća iskopavao Korošec,³ a 1992. godine Menđušić,⁴ dok su Pokrovnik 1979. godine iskopavali Brusić i Talić iz muzeja u Splitu i Drnišu.⁵

Tijekom prethodnih iskopavanja u Danilu pronađeni su komadi kućnoga lijepa s utisnutim tragovima zrna i posija žitarica.⁶ U odljevu tih tragova u lateksu Hopf je prepoznala četiri fragmenta klasa (npr. viličastu strukturu klasa i pljevu), jedno slomljeno zrno dvozrne pšenice (*Triticum dicoccum*) te tri fragmenta

1 Moore *et al.* 2007a.

2 Moore *et al.* 2007b; McClure *et al.* 2014.

3 Korošec 1958; Korošec 1964.

4 Menđušić 1998.

5 Brusić 2008.

6 Hopf 1964.

1 Moore *et al.* 2007a.

2 Moore *et al.* 2007b; McClure *et al.* 2014.

3 Korošec 1958; Korošec 1964.

4 Menđušić 1998.

5 Brusić 2008.

6 Hopf 1964.

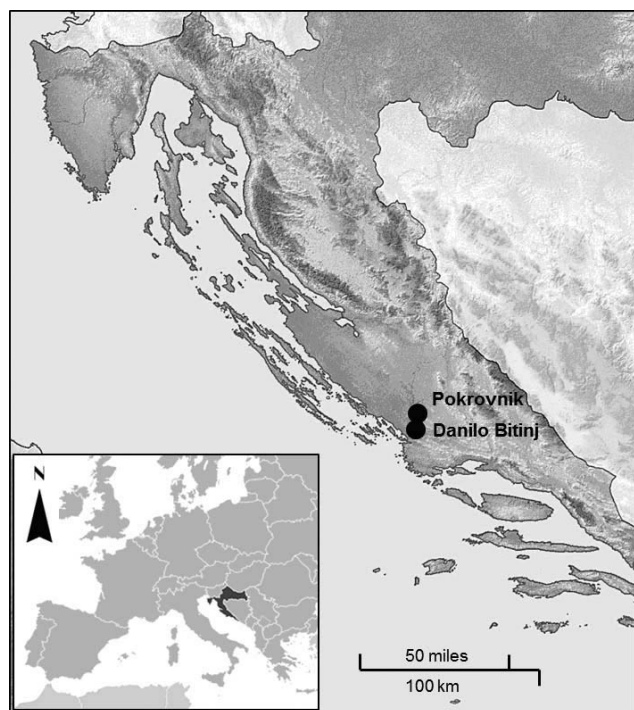


Fig. 1. Location of Danilo and Pokrovnik
 Sl. 1. Položaj Danila i Pokrovnika

findings are merely descriptive and no quantitative analysis was possible on the basis of so few remains.

During the 1979 excavation at Pokrovnik one small sample (weighing 327g) was collected from a middle Neolithic destruction layer (layer C in trench VI) interpreted as a possible fireplace, although the contextual association is unclear.⁷ The sample was dry and wet sieved to maximise recovery of charred plant materials and 1,698 cereal grains or grain fragments and chaff items were identified (table 1).

	grains & fragments / zrna i fragmenti	chaff (glume bases) / posije (baze pljeva)
<i>Triticum dicoccum</i>	660	68
<i>Triticum monococcum</i>	52	1
<i>Triticum monococcum/dicoccum</i>	908	9

Table 1. Summary of archaeobotanical evidence recovered from Pokrovnik by Karg, Müller 1990
 Tablica 1. Sažeti prikaz arheobotaničkih nalaza iz Pokrovnika, Karg, Müller 1990

The potential for recovery of a more diverse range of taxa was obviously restricted at both of the sites

klasa jednozrne pšenice (*Triticum monococcum*). Povrh toga, jedan je fragment klasa preliminarno determinirala kao ječam s golim zrnom (*Hordeum vulgare* var. *nudum*). Rezultati tih prvih nalaza samo su opisni, a kvantitativnu analizu nije bilo moguće provesti na temelju tako malog broja nalaza.

Tijekom iskopavanja u Pokrovniku 1979. godine prikupljen je mali uzorak (težine 327 g) iz srednjoneolitičkog sloja uništenja (sloj C u sondi VI), koji je protumačen kao moguće vatrište, iako kontekstualna poveznika nije jasna.⁷ Uzorak je suho i mokro prosijan kako bi se iz njega izdvojila najveća moguća količina pougljenjenih biljnih ostataka, te je determinirano 1.698 zrna ili fragmenata zrna žitarica i dijelova posija (tablica 1).

Mogućnost prikupljanja raznovrsnijih svojiti na oba je lokaliteta bila ograničena zbog specifičnog podrijetla i veličine uzoraka. Unatoč tomu, priopćena nazočnost dviju pšenica (a možda i ječma s golim zrnom) u srednjoneolitičkom Pokrovniku važna je, budući da prethodno nije bilo zabilježenih arheobotaničkih nalaza ni sa kojeg nalazišta toga razdoblja u Dalmaciji.⁸

Nova iskopavanja u Danilu i Pokrovniku

Tijekom istraživanja 2004. i 2005., u Danilu je iskopano pet sondi. U njima su zabilježeni različiti objekti. Primjerice, u sondi A nalazio se kameni zid, ognjišta i dva dječja ukopa; u sondi B velik je jarak prelazio preko kamenog popločenja; u sondi C nalazili su se ostaci pravokutne građevine, u sondi D gotovo i nije bilo tragova naseljavanja osim dvaju ognjišta; dok su u sondi E pronađene dvije velike jame i možebitni zidovi pravokutne kuće. Kako su iskopavanja u Danilu odmicala, postalo je razvidno da se tlo razlikuje od sonde do sonde. Primjerice, u sondi B, zemlja je bila tamna, s više organskih tvari, dok se u sondi D nalazila teška glina, što je upućivalo na različite procese odlaganja koji su izazvali različite edafske uvjete.

U Pokrovniku su 2006. godine otvorene četiri sonde. Samo su u tri sonde pronađeni tragovi naseljavanja, i to i iz razdoblja kulture *impresso* keramike i iz razdoblja danilske kulture (A, C i D). U sondama A i D nalazilo se više slojeva naseljavanja s ognjištima i jamama, dok je u sondi C pronađeno nekoliko vanjskih zidova.

⁷ Karg, Müller 1990.

⁸ Za regionalni pregled, vidi Borojević *et al.* 2008, str. 296-298.

⁷ Karg, Müller 1990.

	no. of samples / broj uzoraka	volume floated (l) / flotirana količina (l)	mean sample size (l) / pro- sječna veličina uzorka (l)	no. of identified plant taxa / broj determiniranih biljnih svojti	mean/10 litres / prosjeck/10 litara
Pokrovnik: EN	29	3,635	125	902	2.40
Pokrovnik: E/MN	9	1,415	157	603	4.26
Pokrovnik: MN	25	3,345	134	409	1.22
Danilo: MN	44	11,120	253	1,161	1.04

Table 2. Sampling volumes and summary of the identified plant items from the 2004-2006 excavations at Danilo and Pokrovnik. EN=Early Neolithic, E/MN=Early/Middle Neolithic, MN=Middle Neolithic

Tablica 2. Veličine uzoraka i sažeti prikaz determiniranih biljnih ostataka iz iskopavanja u Danilu i Pokrovniku 2004.-2006. godine. EN=Rani neolitik, E/MN=Rani/Srednji neolitik, MN=Srednji neolitik

due to the specific nature of the provenance and the size of the samples. The reported presence during the middle Neolithic of two glume wheats (and possibly naked barley) at Pokrovnik was nevertheless important given that archaeobotanical remains had previously not been recorded from any sites of this period in Dalmatia.⁸

Recent excavations at Danilo and Pokrovnik

Five trenches were excavated at Danilo during the 2004 and 2005 seasons. Different features were recorded in the trenches for example, trench A contained a stone wall, hearths and two child burials; in trench B a large ditch overlay a stone paved area; in C there were traces of a rectangular building; in D there was little occupation evidence apart from two hearths; and E contained two large pits and possible walls of a rectangular house. As excavation proceeded at Danilo it became clear that soil types varied from trench to trench, for example, in B the soil was dark and more organic while in trench D there was heavy clay, thus suggesting the depositional processes that gave rise to the different edaphic conditions were also varied.

Four trenches were opened at Pokrovnik in 2006. Only three of the trenches provided evidence of occupation from both the Impressed ware and Danilo culture periods (A, C and D). Trenches A and D contained multiple occupation layers with hearths and pits; trench C contained a number of large boundary walls.

Materials and Methods

For the recent excavations at Danilo and Pokrovnik sampling strategies were designed to facilitate maximum retrieval of environmental materials (e.g.,

Materijal i metode

Za nedavna iskopavanja u Danilu i Pokrovniku strategije uzorkovanja osmišljene su tako da omogućе prikupljanje najveće moguće količine nalaza koji potječu iz prirode (npr. spaljenih makro-ostataka, mikro-faune, školjaka, itd.). Na oba su se nalazišta upotrebljavala dva uređaja za flotaciju, što je omogućilo obradu velikih količina iskopanoga materijala tijekom iskopavanja 2004.-2006. (tablica 2). Određena je najmanja dopuštena veličina uzorka od 100 litara po kontekstu/sloju, dok gornja granica nije zacrtana pa su s nekih dijelova nalazišta uzeti mnogo veći uzorci (npr. čak i 1.290 litara: Danilo 2004., sonda A, sloj 14). Sitna frakcija izdvojena je uporabom mreže od 250 μ m a krupna uporabom mreže od 1mm.

Svi biljni ostaci bili su karbonizirani, a determinirani su pomoću binokularnog mikroskopa male snage i povećanja 7-40 x, i usporedbama sa suvremenim referentnim zbirkama Instituta za arheologiju Sveučilišnog koledža u Londonu. Nomenklatura znanstvenog nazivlja bilja usklađena je prema Zohary i Hopf (2000.) za kultivare.

Primijenjena je standardizirana metoda brojenja, unutar koje se svako zrno broji kao jedan, a za fragmente zrna procjenjuje se ekvivalent cijeloga zrna. Fragmenti baze pljeva brojeni su kao jedan, osim ako nije bilo očigledno da su dio nekog drugog fragmenta, a čitav viličasti dio klasa brojao se kao dvije baze pljeva. Plodovi i sjemenke trava brojali su se kao jedan, čak i kad je pronađen tek njihov fragment, osim ondje gdje je velika sjemenka bila slomljena i očigledno se radilo o dijelovima iste sjemenke, kao u slučaju drijenka (*Cornus mas*).

Rezultati i rasprava

Biljne svojte koje su se nalazile u uzorcima iz Danila i iz triju faza nalazišta u Pokrovniku prikazane su u tablici 3. Najprimjetnija je dominacija gospodarski značajnih biljnih svojti: žitarica, mahunarki i uljarica,

8 For a regional review see Borojević *et al.* 2008, pp. 296-298.

charred macro-remains, micro-fauna, molluscs, etc.). Two flotation machines were employed at both sites and this enabled large volumes of excavated deposits to be processed during the 2004-2006 seasons (table 2). A minimum sample size of 100 litres per context/level was set but no upper limit was defined and much larger volumes were taken in certain areas of the sites (e.g., as large as 1,290 litres: Danilo 2004 trench A, level 14). The flots were collected using a 250µm mesh and the residue with a 1mm mesh.

All plant remains were carbonised and were identified using a low power 7-40x binocular microscope and comparisons made from the modern reference collections at the Institute of Archaeology, University College London. The nomenclature of scientific plant names follows Zohary and Hopf (2000) for cultivars.

A standardised counting method was used, where each grain counts as one and the whole grain equivalent (WGE) was estimated for fragments of grains. Glume base fragments were counted as one unless clearly representing more than half a spikelet fork, while whole spikelet forks were counted as two glume bases. The fruit and weed seeds were counted as one, even when only a fragment was found, except where large seeds were broken and clearly represented parts of the same seed, such as *Cornus* mas.

Results and Discussion

Taxa present in the samples at Danilo and the three phases at Pokrovnik are presented in table 3. Most noticeable is the dominance of economic taxa; cereals, pulses and oil plants, in addition wild fruits and nuts were also recovered from both sites. This demonstrates that plant foods represented a significant component of the subsistence regimes and, perhaps more importantly, that crop-based agriculture was established by the early Neolithic. Weeds and ruderal plants were also identified in samples from both sites.

Preservation

The quality of preservation of the charred materials varied at both sites (e.g., from poor: lack of outer cell layers, extreme distortion, etc., to good: cell patterns visible on the testa, minimal deformation, etc.) as did the extent of fragmentation, but the majority of the remains was identifiable to the level of genus and species. The numbers of plant items (including whole and fragmentary remains) recovered from each site are given in table 2 (totals are exclusive of non-seed items, e.g., parenchymatous tissues, wood charcoal, etc.); only trench B at Pokrovnik yielded no identifiable remains other than wood charcoal.

a na oba je lokaliteta pronađeno i samoniklo voće i orašasti polodovi. To pokazuje da je biljna hrana imala značajan udio u strategiji preživljavanja te, što je možda još važnije, da se u ranom neolitiku razvija poljodjelstvo utemeljeno na uzgoju bilja. U uzorcima s obaju nalazišta pronađeni su i korovi i ruderalne biljke.

Stanje očuvanosti

Stanje očuvanosti pougljenjenih ostataka na oba je nalazišta bilo različito (npr. od lošeg: nedostaju vanjski slojevi stanica, ostaci su iznimno izobličeni, itd., do dobrog: uzorci stanica vidljivi su na sjemennoj čahuri, minimalna deformacija, itd.), a različit je bio i stupanj fragmentacije, iako je većinu ostataka bilo moguće determinirati do razine roda i vrste. Broj biljnih ostataka prikupljenih na svakome od nalazišta (uključujući i cjelovite i fragmentirane ostatke) naveden je u tablici 2 (u ukupan broj nisu uključeni ostaci koji nisu sjemenke, kao što su npr. parenhimatozna tkiva, drveni ugljen itd.). Samo u sondi B u Pokrovniku nije bilo ostataka koji su se mogli determinirati, osim drvenoga ugljena.

Gustoća pougljenjenih ostataka (izmjerena kao broj prepoznatljivih ostataka u 10 litara flotiranog sedimenta) na nalazištu Pokrovnik bila je veća nego u Danilu (tablica 2). Taj se trend odražava i na prosječan broj svojti (npr. različitih vrsta, rodova itd.) pronađenih na pojedinom nalazištu, pa je tako broj po jedinici volumena u Danilu manji nego u bilo kojoj pojedinoj fazi nalazišta u Pokrovniku (drugim riječima, materijal iz Danila manje je raznolik).

Postoje i varijacije u gustoći i raznolikosti nalaza između pojedinih sondi unutar svakog nalazišta, a njih bi se moglo objasniti pojedinim djelatnostima u kojima su se upotrebljavali biljni resursi.⁹

Žitarice

Žitarice na oba lokaliteta predstavljaju dominantnu kulturu, kako u smislu broja ostataka tako i u smislu njihove sveprisutnosti (postotak nazočnosti po nalazištu ili fazi; sl. 2). Tri osnovne žitarice, ječam (*Hordeum vulgare*), jednozrna pšenica (*Triticum monococcum*) i dvozrna pšenica (*Triticum dicoccum*), najučestalije su vrste. U Pokrovniku i u ranom i u srednjem neolitiku prevladava dvozrna pšenica (koja se pojavljuje u više od 70% uzoraka), dok su zrna ječma i jednozrne pšenice nazočna u otprilike pola uzoraka. U Danilu se zrna svih triju vrsta pojavljuju u više od 20% uzoraka. Zrna jednozrne pšenice

9 Reed 2006.

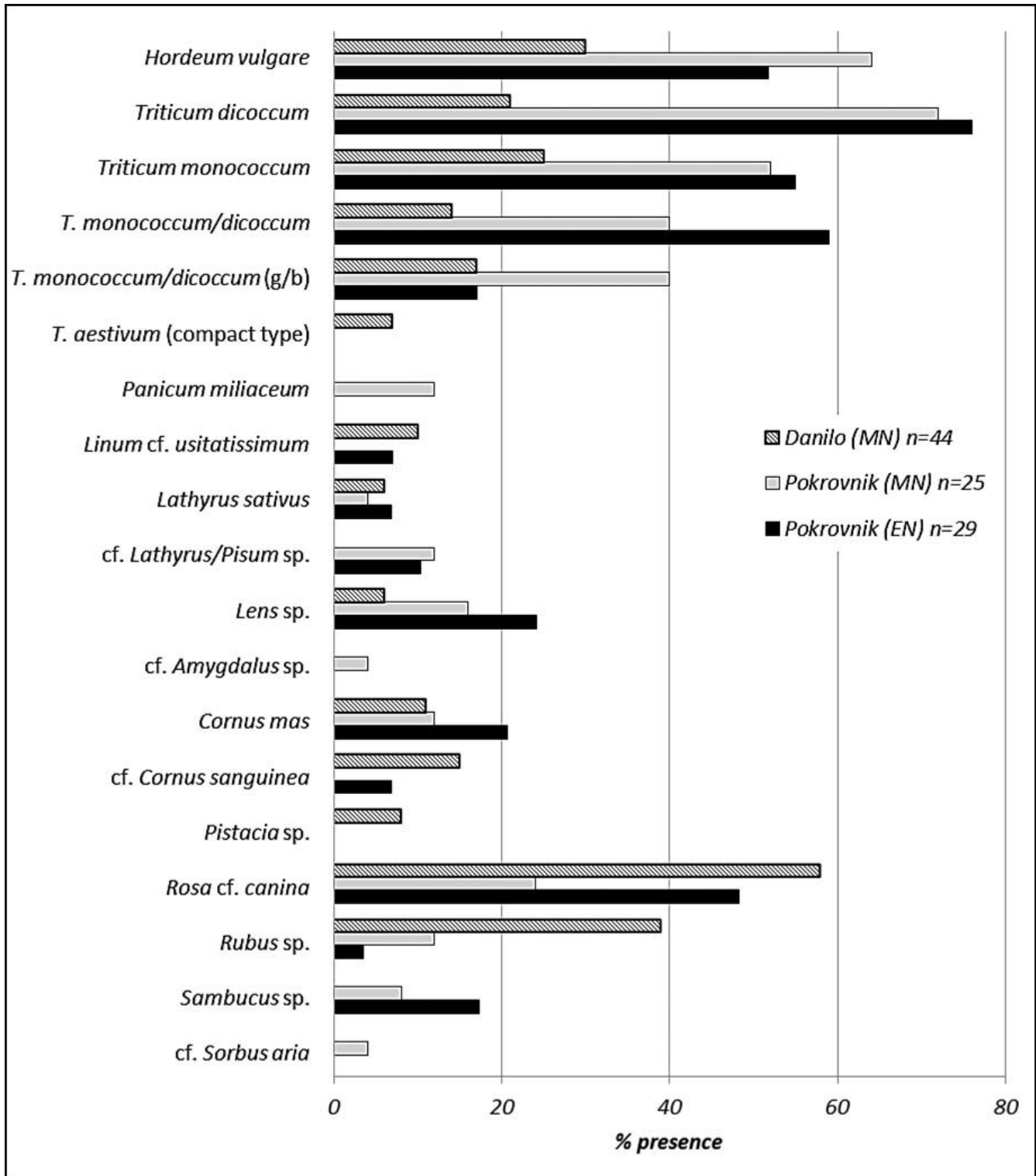


Fig. 2. Ubiquity comparison of crops and fruit species for early Neolithic (EN) Pokrovnik and middle Neolithic (MN) Danilo and Pokrovnik. (n=number of samples, g/b= glume base)

Sl. 2. Usporedba rasprostranjenosti vrsta žitarica i voća za ranoneolitičko nalazište (EN) Pokrovnik i srednjoneolitička nalazišta (MN) Danilo i Pokrovnik. (n=broj uzoraka, g/b= baza pljeva)

The densities of charred material (i.e. measured in terms of numbers of identifiable items per 10 litres of sediment floated) are greater at Pokrovnik than at Danilo (table 2). This trend is reflected in the mean number of taxa (e.g., different species, genera, etc.) recovered from each site, and Danilo has fewer per

pronađena su u velikim količinama u sondi E u Danilu, i samo ih je u tom kontekstu bilo više nego zrna ječma i jednozrne pšenice prikupljenih iz svih drugih sondi na tom nalazištu. Pšenične posije, koje nije bilo moguće determinirati ni kao jednozrnu ni kao dvozrnu pšenicu, pronađene su tek u malom broju uzoraka, i to u vrlo maloj količini (tablica 3, sl. 2), ali one upućuju

unit volume than for each phase at Pokrovnik (i.e., the assemblages are less diverse at Danilo).

There are also variations in density and diversity between the different trenches within each site and it is suggested that these can be explained in terms of specific activities involving the use of plant resources.⁹

Cereals

Cereals are the dominant crop type at both sites, both in terms of numbers of remains and ubiquity (percentage presence per site or phase; figure 2). The three founder crop cereals, hulled barley (*Hordeum vulgare*), einkorn (*Triticum monococcum*) and emmer (*Triticum dicoccum*), are the most frequently occurring species; at Pokrovnik, in both early and middle Neolithic phases, emmer is predominant (occurring in over 70% of samples) and grains of hulled barley and einkorn are present in approximately half the samples, and at Danilo the grains of all three species were identified in more than 20% of the samples. Einkorn grains were found in large quantities in trench E at Danilo and in this context alone are more numerous than those of emmer and barley recovered from all other trenches at the site. Glume wheat chaff, which could not be identified to either einkorn or emmer, was found in only a minority of samples and in very low numbers (table 3, figure 2), but is indicative that processing of the cereals was probably carried out at, or nearby both sites.

Other cereals are far less common in the assemblages; for example, free threshing wheat (*Triticum aestivum* compact type) was found in three samples at Danilo; millet (*Panicum miliaceum*) is present at Pokrovnik in one early/middle Neolithic transition phase and three middle Neolithic levels, again in small numbers (table 3, figure 2). Free threshing wheat is a secondary domesticate (i.e. it evolved at some time after the primary domesticates¹⁰) and it was integrated in the European Neolithic crop package after the initial dispersal of the founder crops. Some have suggested this was also the case for millet;¹¹ however, recent C14 dating of millet grains by Motuzaite-Matuzeviciute et al. found that grains previously thought to have dated to the Neolithic actually dated to between the Bronze and Medieval period questioning the cultivation of this species in Europe during the Neolithic.¹²

na to da su se žitarice vjerojatno obrađivale na samim nalazištima ili u njihovoj blizini.

Drugi je žitarica među nalazima bilo mnogo manje. Primjerice, krušna pšenica (*Triticum aestivum*, kompaktni tip) pronađena je u tri uzorka iz Danila; proso (*Panicum miliaceum*) je bilo nazočno u Pokrovniku, u jednom sloju s prijelaza iz ranog u srednji neolitik i u tri sloja iz srednjeg neolitika, i to u malom broju (tablica 3, sl. 2). Krušna pšenica sekundarno je domesticirana vrsta (što znači da se razvila neko vrijeme nakon primarno domesticiranih biljaka¹⁰) a u europski neolitički paket uključena je nakon početnog širenja primarno domesticiranih kultura. Ima onih koji smatraju da isto vrijedi i za proso.¹¹ Međutim, nedavnim datiranjem zrna prosa metodom C14 koje su napravili Motuzaite-Matuzeviciute i dr. utvrđeno je da zrna za koja se prethodno smatralo da potječu iz neolitika zapravo pripadaju razdoblju između brončanog doba i srednjega vijeka, čime se dovodi u pitanje uzgoj te vrste u Europi u neolitiku.¹²

Ostale kulture

Mahunarke se pojavljuju u malom broju uzoraka s oba nalazišta (tablica 3, sl. 2), a raspon zastupljenih svojti je ograničen: sa sigurnošću su determinirani samo sjetvena kukavičica (*Lathyrus sativus*) i leća (*Lens* sp.). U uzorcima su pronađene samo pojedinačne supke (ili dijelovi supki) a ne čitave sjemenke, pa je razlikovanje pojedinih rodova bilo problematično. Stoga je u popis svojti za ranoneolitički i srednjoneolitički sloj u Pokrovniku uvrštena kategorija *Lathyrus/Pisum* sp. (graholika/grašak). Na oba je nalazišta stanje očuvanosti biljnih ostataka bilo loše, kao što je vidljivo iz velike količine fragmenata "nedeterminiranih velikih mahunarki" (npr. fragmenata koje nije bilo moguće raspoznati dalje od razine porodice) koji su pronađeni u mnogim uzorcima. Na arheološkim nalazištima mahunarke su obično manje zastupljene, primjerice, u usporedbi sa žitaricama, a pretpostavlja se da razlog tome uglavnom leži u različitim načinima pripreme dviju vrsta biljnih kultura i u učestalosti kojom proizvodi i nusproizvodi njihove prerade mogu doći u dodir s vatrom (na ognjištima ili u pećima) i tako postati pougljenjeni.¹³

Sjetvena kukavičica ne nalazi se na popisu primarno domesticiranih biljnih vrsta, ali u repertoar biljnih kultura koje su se uzgajale na neolitičkim nalazištima

9 Reed 2006.

10 Zohary, Hopf 2000, pp. 51-58.

11 Hunt et al. 2008.

12 Motuzaite-Matuzeviciute et al. 2013.

10 Zohary, Hopf 2000, str. 51-58.

11 Hunt et al. 2008.

12 Motuzaite-Matuzeviciute et al. 2013.

13 Dennell 1972, str. 151; vidi i Guarino, Sciarrillo 2004.

		Pokrovnik	Pokrovnik	Pokrovnik	Danilo
		EN	EN / MN	MN	MN
CEREALS / ŽITARICE					
<i>Hordeum vulgare</i>	grain / zrno	57	27	32	52
<i>Triticum dicoccum</i>	grain / zrno	87	58	61	23
<i>Triticum monococcum</i>	grain / zrno	53	25	31	228
<i>Triticum monococcum/dicoccum</i>	grain / zrno	72	32	23	22
<i>T. monococcum/dicoccum</i>	glume base / baza pljeva	7	2	20	12
<i>Triticum aestivum</i> (compact type)	grain / zrno				4
<i>Triticum</i> spp. (indeterminate)	grain / zrno	102	45	26	39
<i>Panicum miliaceum</i>	grain / zrno		1	4	
Cerealia	grain / zrno	362	283	143	127
OTHER CROPS / OSTALI USJEVI					
<i>Linum</i> cf. <i>usitatissimum</i>	seed / sjemenka	2	1		5
<i>Lathyrus sativus</i>	seed / sjemenka	2	4	1	3
cf. <i>Lathyrus/Pisum</i> sp.	seed / sjemenka	5	8	3	
<i>Lens</i> sp.	seed / sjemenka	11	10	4	2
Large legumes indeterminate / Nede-terminirane velike mahunarke	seed / sjemenka	18	16	9	11
FRUITS & NUTS / VOĆE I ORAŠASTI PLODOVI					
<i>Pistacia</i> sp.	nut / oraščić				5
<i>Sambucus</i> sp.	fruit / plod	6		2	
<i>Cornus mas</i>	fruit / plod	6	2	3	9
cf. <i>Cornus sanguinea</i>	fruit / plod	2			2
cf. <i>Amygdalus</i> sp.	nut / oraščić			1	
<i>Rosa</i> cf. <i>canina</i>	fruit / plod	24	4	15	72
<i>Rubus</i> sp.	fruit / plod	1	1	4	251
cf. <i>Sorbus aria</i>	fruit / plod			1	
<i>Vitis</i> sp.	fruit / plod		1		
WEEDS AND RUDERAL PLANTS / KOROV I RUDERALNE BILJKE					
cf. <i>Avena</i> sp.	seed / sjemenka	1		2	6
cf. <i>Brassica/Sinapis</i> spp.	seed / sjemenka				1
<i>Caryophyllaceae</i>	seed / sjemenka				2
<i>Chenopodium</i> sp.	seed / sjemenka				200
Chenopodiaceae	seed / sjemenka	9	55	3	1
<i>Lolium</i> sp.	seed / sjemenka				1
Gramineae	seed / sjemenka	10	3	1	6
<i>Hypericum</i> sp.	seed / sjemenka	6	4	8	10
<i>Teucrium</i> sp.	seed / sjemenka	44	13	7	6
Leguminosae - small / male	seed / sjemenka	1	1		2
Liliaceae	seed / sjemenka	2	2		45
<i>Plantago</i> sp.	seed / sjemenka	1	1		
<i>Polygonum</i> sp.	seed / sjemenka	6	1	1	1
<i>Potentilla</i> sp.	seed / sjemenka		1	1	6
cf. <i>Verbascum</i> sp.	seed / sjemenka				1
cf. <i>Hyoscyamus niger</i>	seed / sjemenka	3	1	3	
<i>Urtica urens</i>	seed / sjemenka				6
cf. <i>Viola</i> sp.	seed / sjemenka	1	1		
INDET / NEDETERMINIRANI		1058	326	217	874

Table 3. Summary of the plant remains recovered from Danilo and Pokrovnik (EN – Early Neolithic, MN – Middle Neolithic)

Tablica 3. Sažeti prikaz biljnih ostataka pronađenih u Danilu i Pokrovniku (EN – rani neolitik, MN – srednji neolitik)

Other crops

Pulses occur in few samples at both sites (table 3, figure 2) and the range of taxa represented is limited: only grass pea (*Lathyrus sativus*) and lentils (*Lens* sp.) were identified with certainty. Single cotyledons (or fragments of cotyledons) rather than whole pulses were recovered in the assemblages and thus distinction between genera was problematic, hence the category *Lathyrus/Pisum* sp. (vetchling or vetch/pea) is included in the list of taxa for early and middle Neolithic levels at Pokrovnik. Preservation was poor at both sites as indicated by the large quantities of 'large legume indeterminate' fragments (e.g., fragments unidentifiable beyond family level) recorded in many samples. Pulses are often under-represented on sites, for example in comparison with cereals, and it has previously been assumed this is due largely to the different methods of preparation of the two crop types and the frequency (or otherwise) with which the products or by-products of processing are likely to come into contact with fire (in hearths or ovens), thus becoming charred.¹³

Grass pea is not included in the list of founder species, but was added to the crop repertoire on Neolithic sites in southeast Europe at an early date¹⁴ and so evidence for its presence in samples from the earliest levels at Pokrovnik is as relevant to the consideration of the beginnings of agriculture in Dalmatia as the finds of lentil and flax.

Flax seeds (*Linum* cf. *usitatissimum*) are present at both sites and they occur in only a minority of samples (table 3, figure 2).

Fruits and nuts

The array of fruits and nuts represented at Pokrovnik and Danilo suggests that wild plant resources were also important components of the diet during the early and middle Neolithic (figure 2), all would have been growing locally and therefore could have been easily harvested.¹⁵ Wild fruits, which could be eaten raw, dried, cooked or in processed form to remove toxins, were identified in the assemblages from both sites, including: elder (*Sambucus* sp.), Cornelian cherry (*Cornus mas*), common dogwood (*Cornus sanguinea*), dog rose/rosehip (*Rosa* cf. *canina*), blackberry/raspberry (*Rubus* sp.) and common whitebeam (cf. *Sorbus aria*). *Rosa* and *Rubus* species are the most

u jugoistočnoj Europi ušla je rano,¹⁴ pa je njezina nazočnost u uzorcima iz najstarijih slojeva u Pokrovniku jednako važna za razmatranje početaka poljodjelstva u Dalmaciji kao i nalazi leće i lana.

Sjemenke lana (*Linum* cf. *usitatissimum*) nazočne su na oba lokaliteta, no pojavljuju se u malom broju uzoraka (tablica 3, sl. 2).

Voće i orašasti plodovi

Mnoštvo voća i orašastih plodova koji su zastupljeni među nalazima iz Pokrovnika i Danila upućuju na to da su samonikle biljke bile važan dio prehrane u ranom i srednjem neolitiku (sl. 2), pri čemu su sve rasle u lokalnom okruženju i stoga ih se lako moglo skupljati.¹⁵ Divlje voće, koje se moglo jesti sirovo, sušeno, kuhano ili u prerađenom obliku kako bi se oslobodilo od toksina, pronađeno je u uzorcima s oba nalazišta. To su: bazga (*Sambucus* sp.), drijenak (*Cornus mas*), svib (*Cornus sanguinea*), šipak (*Rosa* cf. *canina*), kupina/malina (*Rubus* sp.) i mokinja (cf. *Sorbus aria*). Vrste *Rosa* i *Rubus* najčešći su taksoni u Pokrovniku i u Danilu. Obje vrste u svakom plodu imaju mnoštvo sjemenki (npr. u šipku ima više od 100 sjemenki, a u kupini/malini ima ih više od 50), pa razmjerno velik broj ovih svojiti u uzorcima nije nužno odraz njihove preferirane uporabe u odnosu na drugo voće, koje sadrži samo jednu sjemenku ili tek nekoliko njih u jednome plodu.

Fragmenti ljuski badema (*Amygdalus* sp.) pronađeni su u srednjoneolitičkim slojevima u Pokrovniku, a fragmenti plodova (oraščića) smrdljike/tršnje/pistacije (*Pistacia terebinthus/lentiscus/atlantica* sp.) u srednjoneolitičkim slojevima u Danilu. Divlji bademi sadrže glikozid amigdalinalin, koji se, ako se jedu svježe sjemenke (oraščići), pretvara u cijanovodik; kako bi bile jestive, potrebno je ukloniti toksine, što se može postići sušenjem, prženjem ili ispiranjem.¹⁶ Plodovi vrste *Pistacia* mogu se jesti sirovi ili prženi, a smole koje sadrže imaju ljekovita svojstva.¹⁷

U prijelaznim slojevima između ranog i srednjeg neolitika u Pokrovniku je pronađena jedna sjemenka grožđa (*Vitis* sp.), za koje nije bilo moguće odrediti je li divlje ili kultivirano. Sjemenke divljeg grožđa prethodno su nađene na ranoneolitičkim, srednjoneolitičkim i kasnoneolitičkim nalazištima u Grčkoj,¹⁸

13 Dennell 1972, p. 151; see also Guarino, Sciarrillo 2004.

14 Zohary, Hopf 2000, p. 120; Colledge, Conolly 2007a.

15 C. Palmer pers. Comm.

14 Zohary, Hopf 2000, str. 120; Colledge, Conolly 2007a.

15 C. Palmer osobno priopćeno.

16 Martinoli 2004; Zohary, Hopf 2000, str. 187.

17 Jeffrey 1959, str. 494-495.

18 Hansen 1991; Housley, Hubbard 2000; Kroll 1979; Renfrew 1989.

commonly occurring taxa at Pokrovnik and at Danilo. Both have numerous seeds (achenes) per single fruit (e.g., rosehips contain more than 100 seeds and blackberries/raspberries have over 50 seeds) and the relative abundance of these taxa in the samples is therefore not necessarily an accurate reflection of their preferential use in comparison with the other fruits, each of which comprises single or very few seeds.

Fragments of almond (*Amygdalus* sp.) nutshell and of fruits (nutlets) of the terebinth/mastic tree (*Pistacia terebinthus/lentiscus/atlantica* sp.) were found in middle Neolithic levels, the former at Pokrovnik and the latter at Danilo. Wild almonds contain the glycoside amygdalin, which is converted into hydrogen cyanide if the fresh seeds (nuts) are eaten, and to render them edible the toxins have to be removed by drying, roasting or leaching.¹⁶ The fruits of *Pistacia* species can be eaten either raw or roasted and the resins they contain have medicinal properties.¹⁷

One grape pip (*Vitis* sp.), which could not be identified as either wild or cultivated, was found in the early/middle Neolithic transition levels at Pokrovnik. Wild grape pips have previously been recovered from early, middle and late Neolithic sites in Greece,¹⁸ Macedonia¹⁹ and Italy,²⁰ and at a slightly later date on an Eneolithic site in Slovenia.²¹ Zohary and Hopf note that the wild vines (*Vitis vinifera* subsp. *sylvestris*) are native to southern Europe and their map showing the distribution of the subspecies includes the Dalmatian coast,²² however, to date there has been no evidence for early finds from the region and so the Pokrovnik grape pip represents important evidence for wild grape in the Neolithic.

Weeds and ruderal plants

Wild taxa were also recovered from the samples at both sites. A majority of these were identified to genus or family level only thus precluding any definitive ecological interpretations. Several of the taxa represented are likely to have been growing in crop fields and would have been brought to site with the harvests (e.g., segetals: *Chenopodium* sp., *Lolium* sp., *Hypericum* sp., *Polygonum* sp.) others possibly inhabited

Makedoniji¹⁹ i Italiji,²⁰ te nešto kasnije na eneolitičkom nalazištu u Sloveniji.²¹ Zohary i Hopf navode da je divlja vinova loza (*Vitis vinifera* subsp. *sylvestris*) autohtona vrsta u južnoj Europi, a njihov zemljovid koji prikazuje distribuciju podvrsta obuhvaća i dalmatinsku obalu.²² Međutim, za sada još nema tako ranih nalaza iz ovog područja, pa sjemenka grožđa iz Pokrovnika predstavlja važan dokaz postojanja divljega grožđa u neolitiku.

Korovi i ruderalne biljke

U uzorcima s obaju lokaliteta pronađene su samonikle svojte. Najveći broj takvih ostataka determiniran je samo do razine roda ili porodice, što onemogućuje bilo kakvo konačno ekološko tumačenje. Nekoliko pronađenih svojti vjerojatno je raslo u poljima s usjevima te su dopremljene do nalazišta zajedno sa žetvom (npr. korovi koji rastu u ratarskim usjevima: *Chenopodium* sp., *Lolium* sp., *Hypericum* sp., *Polygonum* sp.) dok su druge možda nastanjivale pustopoljine u okolini naselja (npr. ruderalna biljka *Urtica urens*).

Danilo i Pokrovnik na istočnom Jadranu

Prije projekta "Rano poljodjelstvo i stočarstvo u Dalmaciji" malo se znalo o poljodjelstvu na istočnom Jadranu. S obzirom na važnost tog područja kao puta kojim su se usjevi, stoka, tehnike i tehnologije širili prema sjevernoj Italiji i dalje, iznenađuje da je provedeno tako malo istraživanja načina i vremena uspostave poljodjelstva u tom kraju. Chapman i dr. primijetili su da je uglavnom zbog nedostatka materijala za datiranje i paleontoloških podataka "Dalmacija regija u kojoj je tek rijetko ostvaren pun potencijal arheoloških i bioloških nalaza".²³ Čini se da je prije 90-ih godina 20. stoljeća pomanjkanje bioloških nalaza (npr. stvarnih ostataka domesticiranih biljaka i životinja) sa nalazišta u ovome području djelomično bilo rezultat nepostojanja integriranih programa uzorkovanja i flotiranja. Za određivanje najranije pojave neolitika koristila se keramika, i automatski se pretpostavljalo da je istodobno uveden ili prihvaćen i uzgoj biljaka i životinja.²⁴

Borojević i dr. navode da prije iskopavanja u Grapčevoj špilji 1996. godine nije bilo sustavnog pri-

16 Martinoli 2004; Zohary, Hopf 2000, p. 187.

17 Jeffrey 1959, pp. 494-495.

18 Hansen 1991; Housley, Hubbard 2000; Kroll 1979; Renfrew 1989.

19 Renfrew 1979.

20 Costantini, Stančanelli 1994; Pals, Voorrips 1979; Rottoli 1999; Rottoli, Pessina 2007.

21 Jeraj *et al.* 2009.

22 Zohary, Hopf 2000, pp. 151-159.

19 Renfrew 1979.

20 Costantini, Stančanelli 1994; Pals, Voorrips 1979; Rottoli 1999; Rottoli, Pessina 2007.

21 Jeraj *et al.* 2009.

22 Zohary, Hopf 2000, str. 151-159.

23 Chapman *et al.* 1996, str. 5-8.

24 Fohrenbaher, Miracle 2005.

waste ground, perhaps close to the settlements (e.g., ruderals: *Urtica urens*).

Danilo and Pokrovnik in the eastern Adriatic

Prior to the 'Early Farming in Dalmatia' project little was known about nature of crop-based agriculture in the eastern Adriatic. That so few studies have investigated how and when farming was established in the region is surprising given its importance as a route via which crops, livestock, techniques and technologies spread into northern Italy and beyond. Chapman et al. commented that due largely to the lack of dating evidence and palaeoeconomic data '*Dalmatia was a region where the full potential of the archaeological and environmental record had scarcely been realized*'.²³ Prior to the 1990s the absence of environmental evidence (e.g., the actual remains of domestic plants and animals) on sites in the region was, it seems, due in part to the lack of integrated programmes of sampling and flotation. Pottery was used to demarcate the earliest appearance of the Neolithic and by default it is assumed also that farming was introduced or adopted at the same time.²⁴

Borojević et al. report that before the 1996 excavations at Grapčeva Cave there had been no systematic recovery or investigation of archaeobotanical materials on an eastern Adriatic island.²⁵ Similarly, Tinj-Podlivade²⁶ and Crno Vrilo²⁷ in Dalmatia, and Kargadur-Ližnjan²⁸ in Istria are the only other Neolithic sites with reported archaeobotanical and zooarchaeological data. At Tinj-Podlivade, only ca. 15 cereal grains and 50 chaff items were identified, from emmer and einkorn, barley, spelt (*Triticum spelta*), free threshing wheat (*Triticum aestivum*), as well as wild einkorn (*Triticum boeoticum*) and seven possible oat (*Avena* sp.) awn fragments. Identifications, however, seemed rather tentative in the text, with no pictures or descriptions to confirm identifications. At Crno Vrilo only emmer, einkorn and barley grains were recorded. At Kargadur-Ližnjan preliminary analyses indicate evidence of barley, einkorn, emmer, and other wheats identified as free threshing and spelt wheat; however, no quantities were noted and no further contextual information was provided.

In continental Croatia recent excavations have provided the first evidence of archaeobotanical remains dating to the early Neolithic from two sites; Sopot and

kupljanja ni istraživanja arheobotaničkog materijala na istočnojadranskim otocima.²⁵ Na sličan način, nalazišta Tinj-Podlivade²⁶ i Crno vrilo²⁷ u Dalmaciji te Kargadur-Ližnjan²⁸ u Istri jedina su druga neolitička nalazišta s objavljenim arheobotaničkim i zooarheološkim podacima. Na nalazištu Tinj-Podlivade determinirano je samo oko 15 zrna žitarica i 50 ostataka posija, od dvozrne i jednozrne pšenice, ječma, pira (*Triticum spelta*), krušne pšenice (*Triticum aestivum*), kao i samonikle jednozrne pšenice (*Triticum boeoticum*) i sedam mogućih fragmenata pljeve zobi (*Avena* sp.). Međutim, čini se da su u tekstu determinacije navedene uz priličnu ogradu, bez fotografija ili opisa pomoću kojih bi se one mogle potvrditi. Na Crnom vrilu pronađena su samo zrna ječma, dvozrne i jednozrne pšenice. Na nalazištu Kargadur-Ližnjan, preliminarnu analizu upućuju na nalaze ječma, jednozrne i dvozrne pšenice, i drugih vrsta pšenica, koje su determinirane kao krušna pšenica i pravi pir. Međutim, nisu navedene količine niti bilo kakvi drugi podaci o kontekstu nalaza.

U kontinentalnoj Hrvatskoj, nedavna su istraživanja dala prve nalaze arheobotaničkih ostataka s dva neolitička nalazišta, Sopot i Tomašanci-Palača, a u njima su pronađeni ječam, dvozrna pšenica, jednozrna pšenica, leća, grašak i lan iz 6000. cal BC.²⁹

Na temelju malog broja nalaza iz ranog i srednjeg neolitika, neki su autori izrazili mišljenje da je tada već postojala dihotomija između špilja i naselja na otvorenom u pogledu biljnih kultura i životinjskih vrsta koje su se iskorištavale, ustvrdivši da je na špiljskim nalazištima pronađeno mnogo manje primarno domesticiranih vrsta (odnosno da se radi o smanjenom neolitičkom "paketu").³⁰ Čini se da ovo istraživanje potvrđuje tu tezu, bez obzira što se temelji na oskudnoj količini podataka iz jedne i druge navedene vrste lokaliteta s kojima su se rezultati mogli usporediti, a oni upućuju na to da su biljne kulture pronađene u Pokrovniku i Danilu pokazatelj prisutnosti naprednog poljodjelstva od samih početaka neolitika.

Raspon domesticiranih vrsta koje su se u Dalmaciji uzgajale u ranom neolitiku govori o znatnom smanjenju raznolikosti, u usporedbi s rasponom vrsta zabilježenim na najranijim nalazištima u Grčkoj, gdje se poljodjelstvo jugoistočne Europe najprije pojavilo. Primjerice, "paket" biljnih kultura koje su nazočne na grčkim nalazištima sličan je onome na nalazišti-

23 Chapman et al. 1996, pp. 5-8.

24 Fohrenbaher, Miracle 2005.

25 Borojević et al. 2008, p. 282.

26 Huntley 1996, pp. 187-189.

27 Šoštarić 2009.

28 Komšo 2005, pp. 212-214.

25 Borojević et al. 2008, str. 282.

26 Huntley 1996, str. 187-189.

27 Šoštarić 2009.

28 Komšo 2005, str. 212-214.

29 Reed 2015.

30 Fohrenbaher, Miracle 2005, str. 517; Borojević et al. 2008.

Tomašanci-Palača, providing evidence of barley, emmer, einkorn, lentil, pea and flax from 6000 cal BC.²⁹

On the basis of the limited evidence available for the early/middle Neolithic some authors have suggested that there was a dichotomy between caves and open air settlements in terms of the range of crops and livestock exploited, such that far fewer founder species (i.e., a reduced Neolithic 'package') were identified at the former site type.³⁰ The present study appears to confirm this, albeit on the basis of scant data from either site type with which to make comparisons, and suggests that the suites of crops found at Pokrovnik and Danilo are an indication of the advanced nature of farming from the earliest Neolithic.

The range of domestic species cultivated during the early Neolithic in Dalmatia shows a marked reduction in diversity in comparison with that recorded for the earliest sites in Greece, where farming first spread to southeast Europe; for example, the 'package' of crops present on the Greek sites is similar to that on Pre-Pottery Neolithic sites in southwest Asia, where the founder species evolved.³¹ The Dalmatian evidence reflects the status of the plant economies on early Neolithic sites to the north and east of the Dinaric Alps, in Bosnia and Herzegovina, Macedonia and Hungary.³² Bogaard et al. comment that the decrease in diversity indicates a regional trend, '*a progressive narrowing of the crop spectrum*', from south to north in southeast Europe.³³ Cultural and/or natural selection pressures may account for this reduced crop package.³⁴

Conclusion

Recent excavations at Danilo and Pokrovnik have provided new evidence of early to middle Neolithic agriculture in the eastern Adriatic. From the archaeobotanical evidence the crops grown at the two sites were likely barley, emmer, einkorn, lentil, grass pea and flax (i.e. five of the eight founder crops). Other wild fruit and nut species were also recovered showing a continued exploitation of the local environment for food.

ma iz razdoblja pretkeramičkog neolitika u jugozapadnoj Aziji, gdje su se i razvile primarno domestikirane vrste.³¹ Nalazi iz Dalmacije odgovaraju stanju u uzgoju biljaka na ranoneolitičkim nalazištima sjeverno i istočno od Dinarida, u Bosni i Hercegovini, Makedoniji i Mađarskoj.³² Bogaard i dr. navode da smanjenje raznolikosti predstavlja regionalni trend, "*sve veće sužavanje spektra kultura*", idući od juga prema sjeveru jugoistočne Europe.³³ Taj smanjeni paket biljnih kultura možda je rezultat kulturnih i/ili prirodnih selekcijskih pritisaka.³⁴

Zaključak

Nedavna iskopavanja u Danilu i Pokrovniku rezultirala su novim nalazima koji svjedoče o poljodjelstvu u razdoblju ranoga i srednjeg neolitika na istočnom Jadranu. Na temelju arheobotaničkih nalaza, kulture koje su se uzgajale na ta dva nalazišta vjerojatno su bile ječam, dvozrna pšenica, jednozrna pšenica, leća, sjetvena kukavičica i lan (odnosno pet od osam primarno domestikiranih kultura). Pronađeni su i ostaci drugih vrsta samoniklog voća i orašastih plodova, što upućuje na kontinuirano iskorištavanje mjesnog okoliša za potrebe prehrane.

29 Reed 2015.

30 Fohrenbaber, Miracle 2005, p. 517; Borojević et al. 2008.

31 Colledge, Conolly 2007a.

32 Colledge, Conolly 2007b, pp. 33-34.

33 Bogaard et al. 2007, p. 435.

34 Conolly et al. 2008.

31 Colledge, Conolly 2007a.

32 Colledge, Conolly 2007b, str. 33-34.

33 Bogaard et al. 2007, str. 435.

34 Conolly et al. 2008.

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