Poplavna ravnica Ižice in prazgodovinska kolišča

Mihael BUDJA in Dimitrij MLEKUŽ

Izvleček

V prispevku predstavljamo del rezultatov raziskovalnega projekta, ki je bil usmerjen v študij poplavne ravnice Ižice na Ljubljanskem barju, v katero sta umeščeni arheološki najdišči Maharski in Resnikov prekop. Z LiDAR meritvami površja in neposrednim datiranjem opuščenih rečnih korit dokazujemo, da je najdišče Maharski prekop stalo na rečnem bregu in ne na 'mostiščarskem' jezeru.

Ključne besede: Slovenija, Ljubljansko barje, prazgodovina, poplavna ravnica, rečna korita, Ižica, Maharski prekop, Resnikov prekop, LiDAR, absolutno datiranje

Abstract

Paper presents part of the research project results focused on the Ižica floodplain and archaeological sites Maharski and Resnikov prekop in Ljubljana Marshes. LiDAR (Light Detection and Ranging) imagery and radiocarbon dates of stratigraphic sequences from the Maharski prekop site and of a network of palaeochannels around the site clearly suggest that settlement was located in the floodplain, next to the active rivers, and not in the lake.

Keywords: Slovenia, Ljubljana Marshes, prehistory, floodplain, channels, Ižica, Maharski prekop, Resnikov prekop, LiDAR, radiocarbon dates

UVOD

Na povabilo glavne urednice predstavljamo del rezultatov raziskovalnega projekta 'Spreminjanje arheološke krajine Ljubljanskega barja – J6-6013-0581-04' pri Javni agenciji za raziskovalno dejavnost republike Slovenije. Ti prinašajo vrsto novih podatkov, ki omogočajo relevantne in aktualne pojasnitve prazgodovinskih poselitvenih vzorcev in paleookolja na jugovzhodnem delu Ljubljanskega barja. Z LiDAR (*Light Detection and Ranging*) meritvami površja in neposrednim datiranjem opuščenih rečnih korit dokazujemo, da je najdišče Maharski prekop stalo na rečnem bregu in ne na 'mostiščarskem' jezeru. Naš raziskovalni pristop in doseženi rezultati vnašajo v diskusijo o arheološki krajini na Ljubljanskem barju (Velušček 2007) vrsto novih, relevantnih argumentov. Omogočajo tudi neposredno primerljivost raziskovalne uspešnosti dveh arheoloških projektov, ki sta bila v zadnjih letih usmerjena v jugovzhodni del Ljubljanskega barja.

Interpretativna ozadja

Zanimanje za prazgodovinsko krajino Ljubljanskega barja sega v leto 1875, ko je Dragotin Dežman (Karl Deschmann), kustos Kranjskega deželnega muzeja v Ljubljani začel z arheološkimi izkopavanji ob Ižanski cesti blizu Iga. Najdišče je že med izkopavanji interpretiral kot prazgodovinsko kolišče in se pri tem skliceval na odkritje ob Züriškem jezeru. Tu je namreč švicarski naravoslovec Ferdinand Keller že leta 1854 odkril podobne lesene strukture in jih s pomočjo etnografskih vzporednic na Malezijskem arhipelagu interpretiral kot prazgodovinsko vas na jezeru. Postavljena

naj bi bila na lesenih ploščadih na kolih, zabitih v jezersko dno. Interpretativni model se je najprej uveljavil v nemškem nacionalnem okolju. Koncept kulturne krajine z jezerom in kolišči je kmalu zatem postal arhetip in interpretativna matrika za večino neolitskih, eneolitskih in bronastodobnih najdišč v francoskih, avstrijskih in italijanskih Alpah (Menotti 2001).

V Sloveniji ju je takoj po koncu druge svetovne vojne aktualiziral geograf in zgodovinar Anton Melik. V kontekstu preoblikovanja krajine Ljubljanskega barja je, preden bi to *"prešlo v barje zgodovinskih časov"*, dokazoval *"Zadnje jezero ... v Barski kotlini, ki se je držalo še v dobi stavb na koleh ... "* (Melik 1946, 9). Pri dokazovanju jezera in kolišč je uporabil poenostavljeno sekvenco geoloških plasti in arheoloških struktur ter njihovo navidezno sočasnost. Zaporedje plasti, o katerih je poročal Dežman, je konvertiral v stratigrafsko sekvenco, v kateri je prehajala *"polžarica v smeri navzgor v rjavo blato in zatem v šoto, v plasti, ki sta zapored ena za drugo nastajali na jezerskem dnu"*. Navpične lesene kole, najdene pri Igu, je interpretiral kot *"neolitska naselja na koleh"* in jih z jezerom povezal zato, ker so jih *"našli v l. 1875. zapičene v zgornji jezerski ilovici, torej v nekdanjem jezerskem dnu"* (Melik 1946, 50). Podobno percepcijo arheološkega zapisa in stratifikacije najdišč sta pri pojasnjevanju sedimentacijskih, vegetacijskih in klimatskih razmer v holocenu na področju Ljubljanskega barja uporabila tudi geolog in paleontolog Ivan Rakovec ter palinolog Alojz Šercelj. Njun pristop je rezultiral v dveh temeljnih trditvah: *"Zadnje jezero se je verjetno vzdržalo skozi vso približno 4500 let trajajočo atlansko dobo, to se pravi od mlajšega mezolitika ter skozi ves neolitik in bronasto dobo...Plahnenje jezera se je pričelo, če sklepamo po izkopaninah pri Igu, že pred bronasto dobo....Vsekakor se je jezero popolnoma odteklo že davno pred rimsko dobo, ker bi sicer Rimljani ne mogli regulirati Ljubljaničine struge med Podpečjo in Ljubljano, ki je potekala po najnižjem delu usahlega jezera."* (Rakovec 1955, 162) in *"Stratigrafija nekdanjih jezerskih in kasnejših barskih sedimentov je precej enotna: od kasnega glaciala do mostiščarske dobe je bilo tu razmeroma globoko jezero, v katerem se je neprekinjeno odlagal iz vode izločeni apnenec (jezerska kreda), ali kot jo še imenujemo, apnena gyttja, apneno blato, apneni lapor, odvisno pač od primesi in barve. V mostiščarski dobi je jezero začelo naglo plahneti in se je tedaj v že plitvem jezeru odložil organski detritus (Gyttja). V tej 20 do 40 cm debeli plasti organskega blata ležijo kulturni ostanki mostiščarskih naselij. Kmalu nato je šota prerasla barje. Tako vemo dokaj natančno, da je holocenska šota na Ljubljanskem barju mlajša od mostiščarske dobe, to se pravi, da je začela rasti pred približno 3700 leti ali še kasneje."* (Šercelj 1966, 443).

Arheološka interpretacija stratigrafskih sekvenc je bila manj enoznačna in bolj skladna z osnovnimi načeli stratigrafije. Dragocen je Koroščev povzetek stratigrafskih sekvenc z najdišč pri Igu in Blatni Brezovici. Na vseh *"je bilo mogoče ugotoviti, da leže kulturne ostaline stratigrafsko na tisti plasti, ki jo moremo tolmačiti kot nekdanje jezersko dno, delno pa celo v sami tej plasti. Glede na ta moment bi bilo mogoče tolmačiti, da so kolišča bila v resnici postavljena na vodno gladino, kjer so kulturne ostaline, ki so bile odvržene v vodo, delno prekrite s peskovito glino, ki predstavlja jezersko dno. Toda večji del najdb je v plasti nad peskovito glino. Ta druga plast je v glavnem humozna, mešana z ostanki barskih rastlin, raznega lesa, lubja itd. Tako bi druga plast govorila za to, da je tedaj, ko se je kolišče postavilo ali pa kmalu za tem mesto že bilo zamočvirjeno. Razne tanjše plasti gline v kulturni plasti govore za delno poplavljanje teh predelov v nekih časovnih periodah."* (Korošec 1954, 16).

Posebno zanimiv je Dežmanov opis kompleksne stratigrafske sekvence s Part, ki jo povzema Rajko Ložar (1942, 87) v pogosto spregledanem članku *'Stratigrafija in kronologija stavb na kolih pri Studencu'*. Predstavlja sekvenco, v kateri je *"zgoraj plast zelo trde ilovice (a), sledi 1,3 m močna ilovnata plast brez organskih primesi (b); pod njo plast, ki vsebuje dobro ohranjene, brez reda stoječe počrnele hrastove kole, sestoječe iz klanih štorov, ti pa tiče v 40 cm debeli plasti naplavljene zemlje, pomešane s peskom, številnimi vejami jelše, listjem, koreninami in stebli močvirskih rastlin (c). Šele pod to plastjo je šota 0,40 m (d), pod to je 0,20 m debela vegetabilična plast z listjem hrasta in drugega drevja (e), pod to plastjo je sloj gosto postavljenih kolov iz lesa listnatih dreves, plast je okrog 0,50 m debela (f). Do jezerskega blata (g) so tu prišli šele pri 3 m globine ..."*.

Ob zapisanem bi seveda lahko sklepali, da je oznaka *"kolišče"* izgubila interpretativni pomen. Vendar so raziskovalci vztrajali, da ni *"... nikakršnega vzroka, da bi barjanskim doslej znanim naselbinam odrekali pomen kolišč..."*, kajti *"... doslej raziskana kolišča imajo pa značaj pravih kolišč, ki so identična s kolišči na vodi ..."* (Korošec 1955, 80), čeprav so na Ljubljanskem barju ta postavljena *"na suhem ali vsaj nekoliko osušenem zemljišču v bližini tekoče reke"* (Korošec 1964, 40). S tem interpretativnim nastavkom se je strinjala tudi Tatjana Bregant (1964, 19), ki je po končanih izkopavanjih najdišča ob Resnikovem prekopu zapisala, *da "... imamo na Ljubljanskem barju*

prava kolišča, čeprav samo na zamočvirjenih ali suhih tleh". Dvajset let kasneje, ko je že končala izkopavanja in meddisciplinarne raziskave na Maharskem prekopu, ocene poselitve in paleookolja na Ljubljanskem barju ni spremenila: *"Kolišča so stala na suhem in le občasno poplavljenem terenu (Resnik, Notranje Gorice) ali pa na zamočvirjenem področju (kolišče Maharski prekop, Parti, Blatna Brezovica)."* (Bregant 1984, 23).

Polžarica in navpični koli sta v zgodovinskih in paleobotaničnih interpretativnih okoljih tako postala substituta za prazgodovinsko jezero in koliščarska naselja. V njih sta vedno povezana s pomezolitsko, domnevno neolitsko, selitvijo naselij s kopnega na vodo in oblikovanjem majhnih in razpršenih ploščadi s hišami na jezeru. V arheoloških pojasnitvah so skupine navpičnih kolov delovale kot substitut za kolišča na suhih, ponekod močvirnih in občasno poplavljenih tleh. Pomenske mreže, v katerih nastopata, smo podrobneje predstavili že večkrat (Budja 1994; 1997; Mlekuž et al. 2006). Nanju je vezana tudi interpretativna redukcija, ki nize navpičnih lesenih kolov dosledno povezuje le z nosilnimi stebri domnevnih ploščadi.

V tem kontekstu so bile spregledane pojasnitve, v katerih je geomorfološki razvoj Ljubljanskega barja v holocenu povezan s klimatskimi anomalijami in hidrografskimi dinamikami na Dinarski kraški planoti in v alpskem predgorju. Ti predstavljata obširno hidrografsko zaledje (1850 km^2), s katerega so se v južni in zahodni del Ljubljanske kotline stekale vode in oblikovale sedimentacijsko sekvenco, ki jo je mogoče na Ljubljanskem barju povezati z delovanjem rek ter občasnimi poplavami in daljšimi zastajanji voda (Šifrer 1983) na eni in neotektonskim posedanjem sedimentov na drugi strani (Brenčič 2007).

Dežmanovo percepcijo prazgodovinske kulturne krajine Ljubljanskega barja in nanjo vezano ikonografijo je v arheološke pojasnitve v zadnjih letih ponovno vpeljal Anton Velušček. Temeljna interpretativna postulata sta zopet postala kolišče in jezero. Kolišča, pravi, *"so obkrožala tedanje jezero"* (Velušček 2006, 9), ki je bilo še v *"4. tisočletju pr. Kr."* umeščeno kar v *"poplavno ravnico na Ljubljanskem barju"* (Velušček 2004, 307).

Poplavna ravnica Ižice in LiDAR

Ižica izvira na južnem robu Ljubljanskega barja. Njeno obširno kraško porečje obsega Dinarske kraške planote južno od Ljubljanskega barja. Ižica je v vsem svojem toku reka z majhno energijo, nizkim padcem in obširno poplavno ravnico, kjer je odlagala drobnozrnate sedimente. Ižica je bila mobilna reka, ki je na svoji poplavni ravnici pustila sledove starejših rečnih korit. Te je na letalskih posnetkih mogoče prepoznati kot obsežne anomalije vegetacijskih znakov. Letalski posnetki tako razkrivajo kompleksen palimpsest opuščenih rečnih korit, ki prekrivajo poplavno ravnico in pričajo o pretekli rečni dinamiki.

Da bi dobili jasnejšo podobo o geomorfologiji poplavne ravnice Ižice smo opravili LiDAR meritve območja dimenizj 1300 × 600 m (78 hektarov). Območje vključuje tudi prostora najdišč Maharski in Resnikov prekop. LiDAR je orodje, ki ga že desetletje uporabljajo pri geomorfoloških prospekcijah in preučevanju poplavnih ravnic ter napovedih poplav (Lohani, Mason 2001; Charlton et al. 2003; Cobby et al. 2001; Marks, Bates 2000, Challis 2005; 2006).

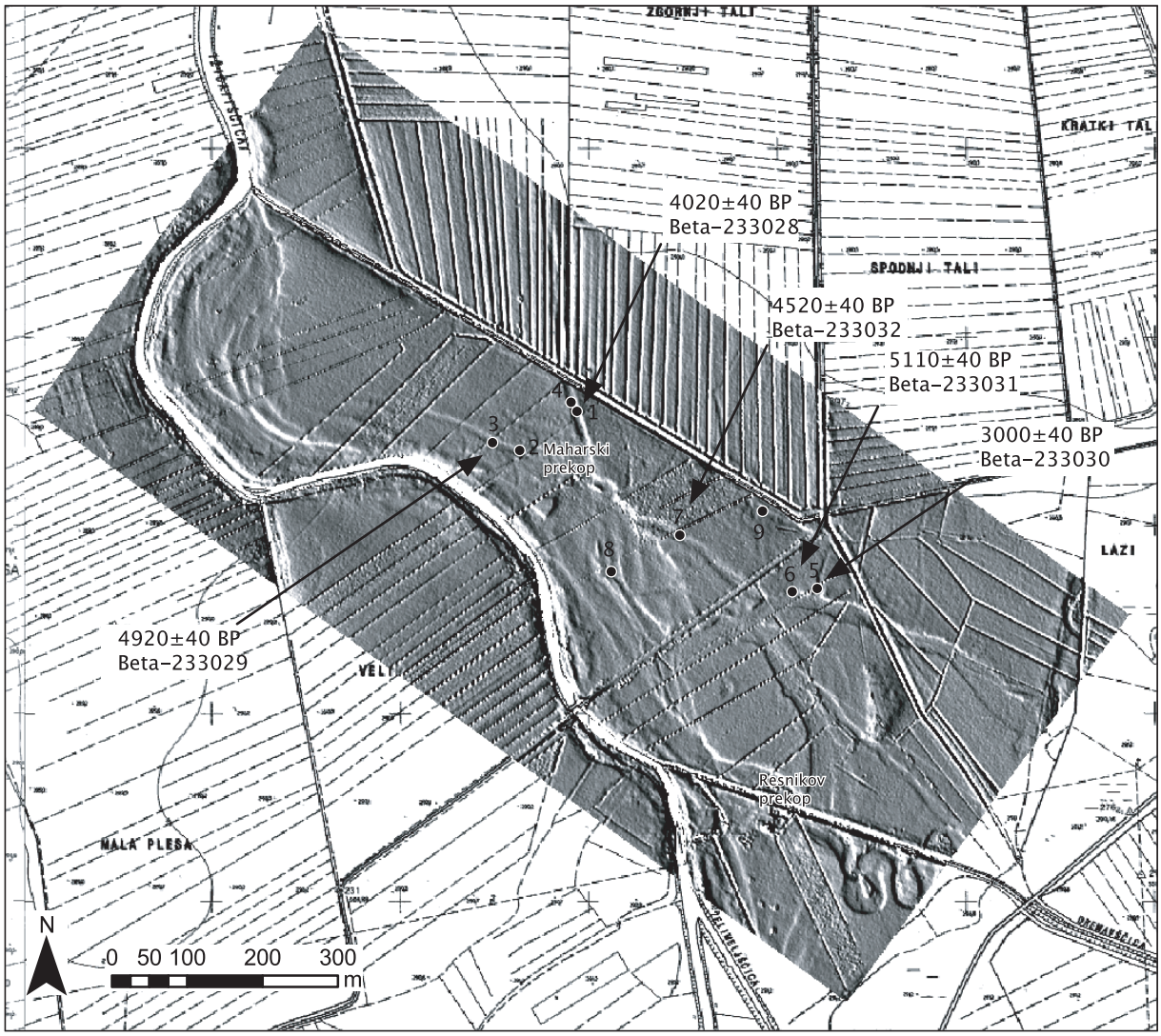
Rezultati LiDAR meritev jasno in natančno prikažejo geomorfologijo študijskega območja in omogočajo prepoznati in razločiti detajle značilnosti poplavne ravnice in teras (*sl. 1*). Tridimenzionalni podatki o površju omogočajo razločevanje njihovih stratigrafskih odnosov in izdelavo presekov čez pokrajino ter opuščena korita. LiDAR ponuja bolj popolno in natančno sliko o geomorfologiji površja kot tradicionalna aerofotografija.

S pomočjo rezultatov LiDAR meritev lahko študijsko območje razdelimo na dve različno stari geomorfološki enoti, nižjo in mlajšo aktivno poplavno ravnico in višjo in starejšo teraso. Razlika v višini med teraso in poplavno ravnico je do 40 cm.

Najočitnejša značilnost študijskega območja so plitve linearne depresije in ostanki opuščenih korit, ki so ohranjena tako na terasi kot v poplavni ravnici. Opuščena korita so različnih oblik in dimenzij. Nekatera so v očitni superpoziciji in pričajo o časovni strukturiranosti rečne aktivnosti. Opazne so tudi druge značilnosti poplavne ravnice, kot so obrežni nasipi, meandrske sipine in žlebovi poplavnih voda.

S pomočjo stratigrafskih odnosov med opuščenimi koriti in ježo terase lahko prepoznamo vsaj štiri faze rečne aktivnosti. Za prvo, najstarejšo fazo, ohranjeno na terasi, so značilna ozka, malo vijugava, skoraj ravna korita, ki pričajo o anastomoznem[1] toku Ižice in pritokov. Za drugo fazo so značilna široka in manj vijugava korita anastomoznega rečnega toka, ki sekajo korita prve faze. Tudi ta faza je ohranjena le na terasi. Prehod v tretjo fazo zaznamuje globinska erozija (degradacija) poplavne ravnice Ižice in nastanek aktivne nižje

[1] Preplet strug, ki se cepijo in spajajo.



Sl. 1: Geomorfologija študijskega območja ob Ižici. Označen je položaj vrtin za vzorčenje polnil opuščenih korit in rezultati 14C AMS datiranj organskih sedimentov v koritih (podlaga: TTN5, © Geodetska uprava Republike Slovenije).
Fig. 1: Geomorphology of the studied area along the Ižica River. Boreholes, where samples for AMS radiocarbon datation were collected from the bottom of organic channel infills, are marked in the abandoned palaeochannels (base map: TTN5, © The Surveying and Mapping Authority of the Republic of Slovenia).

poplavne ravnice. Poglobitev poplavne ravnice je uničila del površine starejše terase z morebitnimi arheološkimi zapisi in sledovi kulturne krajine. Rezultat procesa je dobro vidna ježa terase. Tok Ižice je postal bolj vijugav, celo meandrirajoč, korita so bočno erodirala po poplavni ravnici. Najočitnejša sled tega procesa so meandrske sipine in žlebovi poplavnih voda.

Zadnja, najmlajša faza je moderna rečna mreža, rezultat regulacijskih del zadnjih stoletij.

Spremembe toka reke iz anastomoznega v vijugav in meandrirajoč ter degradacija poplavne ravnice Ižice kažejo na velike spremembe v hidrološkem režimu v porečju Ižice v preteklosti.

DATIRANJE OPUŠČENIH REČNIH KORIT

Sistematično kartiranje poplavne ravnice s pomočjo LiDAR meritev nam je omogočilo izbor točk za neposredno absolutno datiranje opuščenih rečnih korit in faz rečne aktivnosti. Točke za vrtine smo izbrali na podlagi LiDAR posnetka in terenskih ogledov. Vzorčili smo z motornim svedrom premera 8 cm.

Vzorčili in dokumentirali smo 9 vrtin in datirali pet vzorcev iz petih vrtin (*sl. 1*). Stratigrafsko sosledje v vseh vrtinah je enako. Ornici sledi organska meljasta ilovica zelo temne barve, ki vsebuje veliko makrobotaničnih ostankov. Na njenem dnu

je oster prehod med organskim depozitom in polžarico. Vzorce za AMS 14C datacije smo izbrali z dna organskih depozitov, 5 do 20 cm nad mejo s polžarico. Datumi tako predstavljajo čas opustitve in zapolnjevanja rečnih korit, torej *terminus ante quem* za opustitev korita. Rečna korita so bila aktivna pred datumi vzorcev organskega sedimenta iz opuščenih korit.

Vrtino 1 smo izvrtali v opuščeno korito v neposredni bližini najdišča Maharski prekop. Linearna depresija v tleh, sled opuščenega korita, je dobro vidna tudi na terenu. V globini 120 cm je oster prehod med organskim sedimentom in polžarico. Vzorec organskega depozita iz globine 110 cm je datiran v čas 4020 ± 40 BP (Beta - 233028) (*sl. 2*).

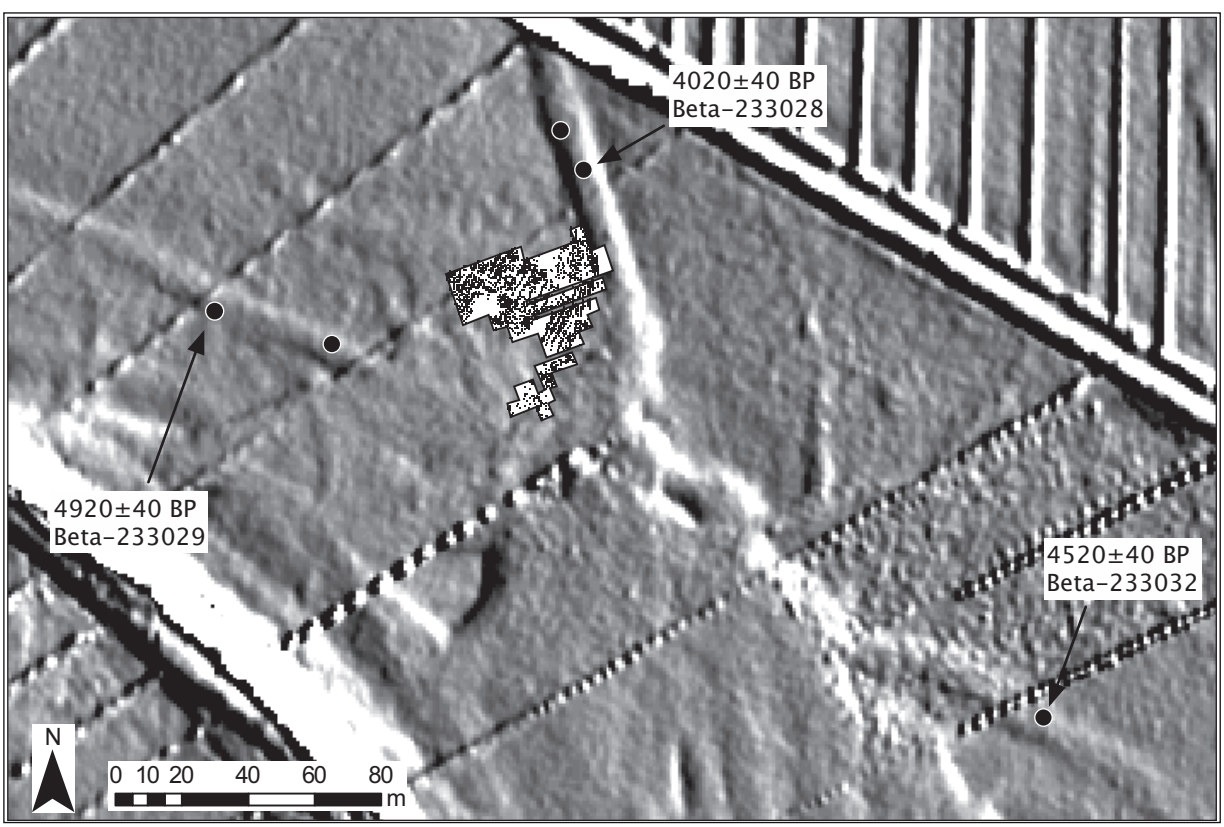
Vrtino 3 smo izvrtali v opuščeno korito prve faze jugozahodno od Maharskega prekopa. Meja med organskim depozitom in polžarico je v globini 115 cm. Vzorec iz organskega sedimenta iz globine 110 cm je datiran v čas 4920 ± 40 BP (Beta - 233029) (*sl. 2*).

Vrtino 7 smo izvrtali v opuščeno korito prve faze jugovzhodno od Maharskega prekopa. Prehod v polžarico je v globini 55 cm. Vzorec organskega sedimenta iz globine 50 cm je datiran v čas 4520 ± 40 BP (Beta - 233032) (*sl. 2*).

Vrtino 5 smo izvrtali na stiku med ravnim in ozkim koritom prve faze in širšim koritom druge faze. Prehod iz organskega depozita v polžarico v globini 125 cm. Vzorec organskega sedimenta iz globine 105 cm je datiran v čas 3000 ± 40 BP (Beta - 233030).

Vrtino 6 smo izvrtali na rob širokega opuščenega korita druge faze, 50 m zahodno od vrtine 5. Meja med organskim depozitom in polžarico je v globini 120 cm. Vzorec organskega sedimenta iz globine 100 cm je datiran v čas 5110 ± 40 BP (Beta - 233031).

Ta datum se zdi prestar za korito druge faze. Korito, na robu katerega je izvrtana vrtina 6, stratigrafsko seka korito prve faze, datirano z vzorcem iz vrtine 7 v 4520 ± 40 BP. Datum iz vrtine 5, za katerega menimo, da datira to korito, kaže da



Sl. 2: Najdišče Maharski prekop v kontekstu poplavne ravnice Ižice. Označena so mesta izkopnega polja Tatjane Bregant (1970–1977), vrtine za vzorčenje polnil opuščenih korit in njihovi 14C AMS datumi.
Fig. 2: Maharski prekop in the context of Ižica floodplain. Area excavated by Tatjana Bregant (1970–1977) and the positions of sampling boreholes are marked, and the C14 (AMS) dates are presented.

lahko čas opustitve korita postavimo v 3000±40 BP. Menimo, da smo vrtino izvrtali preveč na robu korita, tako da nismo zadeli organskega sedimenta v koritu, temveč površino obrežne ravnine. To oceno potrjuje tudi fragment prazgodovinske lončenine, ki smo ga našli v globini 110 cm. Tako menimo, da datum 5110 ± 40 BP datira površino starejše terase.

Datumi umeščajo najstarejšo fazo opuščenih korit pred leto 4920 BP. Že pred letom 3500 BC je bila na tem delu Ljubljanskega barja aktivna poplavna ravnica in ne plitvo jezero.

Tab. 1: Absolutni 14C datumi z najdišča Maharski prekop in prve faze paleostrug na poplavni ravnici Ižice.
Tab. 1: C14 dates from the Maharski prekop site and of the first phase of palaeochannels in Ižica floodplain.

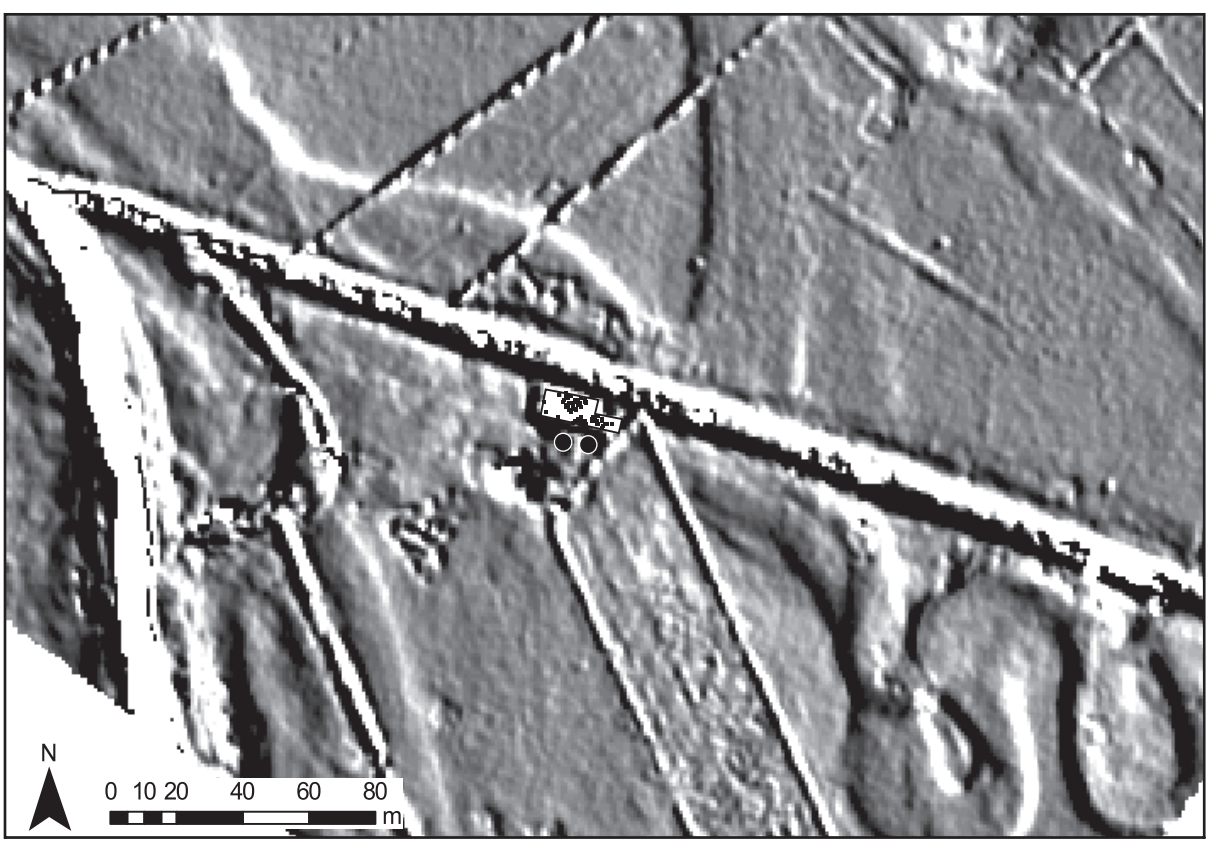
Laboratorijska koda / Labcode	Konvencionalna ^{14}C starost BP / Conventional ^{14}C BP age	Kalibrirana starost BC / Calibrated BC age (2σ)	Material / Material	Kontekst / Context	Citat / Reference
Maharski prekop					
Z-278	4633 ± 117	3645–3025	les / wood (Quercus?)	izkopavanja / excavations 1972 kvadrant / grid 12?, kol / pile 40	Srdoć et al. 1975, 152
Z-305	4345 ± 113	3356–2668	les / wood (Fraxinus)	Izkopavanja / excavations 1973 kvadrant / grid 15, kol / pile 1	Srdoć et al. 1975, 152
Z-314	4964 ± 99	3970–3533	les / wood		Srdoć et al. 1975, 152
Z-315	4701 ± 104	3695–3106	les / wood (Sorbus)	Izkopavanja / excavations 1972 kvadrant / grid 15, kol / pile 4	Srdoć et al. 1975, 152
Z-351	5080 ± 110	4225–3645	les / wood (Sorbus)	izkopavanja/excavations 1974 kvadrant / grid 42, kol / pile 156	Srdoć et al. 1977, 465–475
Z-353	4330 ± 120	3351–2631	les / wood	izkopavanja/excavations 1974 sonda / trench 4	Srdoć et al. 1977, 465–475
AA-27182	4680 ± 55	3632–3362	oglje / charcoal	MP1 profil v jarku, plast oglja sediment exposure, charchoal layer 61–63 cm	Gardner 1999, Tab. 5.1
Beta - 219606	4740 ± 40	3637–3377	kost / bone (Ovis)	kvadrant / grid square 42	Mlekuž et al. 2006
Beta - 219607	4720 ± 40	3634–3374	kost / bone (Ovis)	kvadrant / grid square 42	Mlekuž et al. 2006
Beta - 219608	4710 ± 40	3633–3372	kost / bone	kvadrant / grid square 42	Mlekuž et al. 2006
Beta - 219609	6570 ± 40	5614–5475	kost / bone	kvadrant / grid square 34	Mlekuž et al. 2006
Beta - 219610	4750 ± 50	3640–3376	kost / bone	kvadrant /grid square 34	Mlekuž et al. 2006
Beta - 219611	4740 ± 40	3637–3377	kost / bone	kvadrant /grid square 32	Mlekuž et al. 2006
Opuščena korita					
Beta - 233028	4020 ± 40	2833–2465	organski sediment organic sediment	vrtina / borehole 1, 110 cm	
Beta - 233029	4920 ± 40	3776–3642	organski sediment organic sediment	vrtina / borehole 3, 110 cm	
Beta - 233030	3000 ± 40	1386–1123	organski sediment organic sediment	vrtina / borehole 5, 105 cm	
Beta - 233031	5110 ± 40	3980–3797	organski sediment organic sediment	vrtina / borehole 6, 100 cm	
Beta - 233032	4520 ± 40	3361–3097	organski sediment organic sediment	vrtina / borehole 7, 50 cm	

Maharski prekop v kontekstu poplavne ravnice

Absolutni ^{14}C datumi prve faze paleostrug se prekrivajo z datumi z najdišča Maharski prekop (*tab.1*). Naselje je torej živelo v času prve faze nekdanjega toka reke Ižice in stalo na rečnem bregu (*sl. 2*). Tatjana Bregant je rečno korito, teklo je ob vzhodnem delu najdišča, že med izkopavanji identificirala in dokumentirala na več presekih, kjer je vidno kot očitna destrukcija v kulturni plasti, zapolnjena z organskim depozitom ('gyttjo'). Rečno korito je povezovala z leseno strukturo, dvema ali tremi vrstami gosto zabitih kolov, ki tečejo vzporedno z robom korita. V primerjavi z ostalimi na najdišču imajo koli v tej strukturi veliko manjši premer, cepljeni koli se skoraj ne pojavljajo. Razlikujejo se tudi vrste uporabljenega lesa. Čeprav je strukturo interpretirala kot 'valobran', jo je povezala z zaščito rečnega brega pred erozijo (cfr. Budja 1994, 172; Mlekuž et al. 2006, 259). Struktura je sočasna z rečnim koritom. Kol 1 iz kvadranta 15, ki je del te strukture, je datiran v 4345 ± 113 BP (Z-305), datum vzorca iz vrtine 1 pa postavlja čas opustitve te struge pred 4050 ± 40 BP.

Arheološki zapis na Maharskem prekopu z distribucijami kolov, ostankov glinastih podov, žrmelj in večjih ploščatih kamnov smo že reinterpretirali kot ostanke skupine hiš ob reki (Budja 1994; Mlekuž et. al 2006). Ključni element za prepoznavanje oblike in strukture hiš so vzporedne vrste kolov, vrste so dolge približno 10 m in med seboj oddaljene približno 1,5 do 2,5 m. Vrste v tla zabitih kolov niso spodnji deli lesenih ploščadi, ampak strukturnih elementov hiš, nosilnih soh. Centralna vrsta kolov predstavlja ostanke slemenskih soh, medtem ko lateralni vrsti kolov predstavljata ostanke stenskih soh. Ostanki glinastih tlakov kažejo, da so bila tla tlakovana z zbito glino, na glinastih tleh so se ohranile tudi gruče večjih kamnov, ki so najbrž ostanki termalnih struktur. Gruče kamnov se pogosto pojavljajo v sprednjih delih hiš, med kamni so pogoste tudi žrmlje.

Tako skupine lesenih kolov, glinastih podov, kamnov in žrmelj na Maharskem prekopu predstavljajo ostanke vsaj devetih hiš približne velikosti 10 × 4 m. Hiše so orientirane z daljšo stranico vzporedno z rečnim koritom; vsaj ena hiša je orientirana pravokotno na ostale (Mlekuž et al. 2006).



Sl. 3: Najdišče Resnikov prekop v kontekstu poplavne ravnice Ižice. Označen je položaj Koroščevega izkopnega polja (1962), ki se dobro vidi tudi v morfologiji tal in Velušč kovih sond (2002).
Fig. 3: Resnikov prekop site in the context of Ižica floodplain. Areas excavated by Korošec (1962) and Velušček (2002) are marked.

ZAKLJUČEK

Poplavna ravnica Ižice je bila v preteklih tisočletjih dinamična, zaradi delovanja rek močno preoblikovana pokrajina. Na LiDAR posnetku je mogoče jasno razločiti površino starejše terase in sledove stratificiranih opuščenih rečnih korit.

Absolutni datumi najstarejše faze rečnih korit se prekrivajo z datumi prazgodovinskega naselja ob Maharskem prekopu. Rezultati so potrdili oceno Josipa Korošca in Tatjane Bregant, da so bila naselja na tem delu Ljubljanskega barja postavljena na suhem ob tekočih vodah. Z veliko gotovostjo lahko trdimo, da vsaj v času poselitve najdišča Maharski prekop ta del Ljubljanskega barja ni prekrivalo jezero.

Rekonstruirano dogajanje v poplavni ravnici in podatkovni niz, ki ga predstavljamo, dobro pojasnjujeta "sedimentacijski hiatus" (Velušček 2007, 426), s katerim so se soočili kolegi in kolegice v projektu 'Arheološke in palinološke raziskave na Ljubljanskem barju – J6-6348-0618-04'. Prepričani smo, da nanj vezana pojasnitev: *"Razvoj pokrajine in vegetacije v naslednjih nekaj tisočletjih ni znan, ker sedimentološki zapis za čas ok. 6.000–200 pr. n. št. na Resnikovem prekopu manjka"* (Andrič 2006,109) gotovo ne prispeva k relevantnim in aktualnim pojasnitvam podobe Ljubljanskega barja v prazgodovini. LiDAR posnetek namreč kaže, da je majhno izkopno polje ob Resnikovem prekopu postavljeno sredi opuščenega korita tretje faze (*sl. 3*), ki je uničila del stratigrafske sekvence. Sedimentacijski hiatus je tako rezultat destrukcije najdišča, ocena o neznanem razvoju pokrajine pa posledica pojasnjevanja fragmentarnih in nekontekstualiziranih podatkovnih nizov, pridobljenih z neustreznim raziskovalnim pristopom.

Ljubljansko barje je bilo v prazgodovini kompleksen in dinamičen mozaik različnih okolij, ki je vključeval tako poplavne ravnice kot večja območja stoječih voda. Spreminjal se je v okviru letnega cikla in v kontekstu daljših ciklov globalnih klimatskih anomalij v holocenu (Budja, Mlekuž 2008).

Naši rezultati tako dokazujejo hipotezo, da so eneolitska in bronastodobna najdišča stala v poplavni ravnici, na bregovih rek, ki so krajino Ljubljanskega barja pogosto preoblikovale že v prazgodovini (Budja 1994; Budja 1997; Mlekuž 1998; 2001; Budja, Mlekuž 2001).

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The Ižica floodplain and 'pile-dwellings' in prehistory*

Translation

INTRODUCTION

The purpose of the paper is twofold. We present basic results of the research project 'Ljubljansko barje – archaeological landscape in flux – J6-6013-0581-04' that was funded by the Slovenian Research Agency. We focus on the landscape and settlement dynamics in the Ljubljana Marshes on the micro-regional scale by exploring settlement patterns and LiDAR (*Light Detection and Ranging*) imagery, and on the settlement scale by analysis and radiocarbon dating of stratigraphic sequences from the Maharski prekop site and of a network of palaeochannels around the site. We bring into discussion (see Velušček 2007) series of new data and relevant arguments that allow us to compare the research efficiency, and the quality of results of two archaeological projects, that have run parallel in the same area and followed similar goals. The interdisciplinary analyses demonstrate clearly that the site was located on dry ground beside the active stream. The old concept of dwellings built on piles in a lake thus remains unrealistic.

Interpretative backgrounds

Archaeological interest in the Ljubljana Marshes rose dramatically in the second half of the 19th century when the first remains of prehistoric wooden structures were discovered. The discovery has run parallel to research on lake-settlement in the Swiss, French, Austrian and Italian Alps, where similar wooden pile-dwellings have been investigated. Keller's (1854) perception of the prehistoric cultural landscape, and the concept of pile-dwellings that was grounded on the Malaysian ethnographic parallels of villages standing on piles above the water with a general platform supporting various houses, has been applied as a model for interpreting the Neolithic and Bronze Age settlement patterns on marshes and swamps elsewhere in Europe (Menotti 2001).

This interpretative model was adopted in Slovenian prehistoric archaeology immediately after the discovery of ca 7,000 vertical wooden posts in the Ljubljana Marshes. The clusters of posts and the associated Bronze Age artefact assemblages were recorded and collected during intensive but unsystematic digging conducted by Dragotin Dežman (Karl Deschmann), the curator at Kranjski deželni muzej. He had dug an area of 9400 m^2 over three years (1875–1877).

Seventy years later Anton Melik (1946), eminent geographer and historian, postulated in the area the sequence of *'prehistoric lake'* and *'period of pile-dwellings'* which was followed by the *'marshes in historical periods'*. The sequence was based on simplified interpretation and fictive contemporaneity of geological layers and archaeological structures. Vertical piles have been understood as lake-dwelling structures just because the piles have been hammered into the 'chalky lacustrine clays and marls' superimposed by 'organogenic muds' and finally 'peat'.

Palaeontologist Ivan Rakovec and palynologist Alojz Šercelj have grounded the interpretation of sedimentology, vegetational history and climatic dynamics in the microregion on the similar perception of archaeological site stratification. They hypothesised that *"The last lake was probably existed in the Atlantik period, lasting approximately 4500 years, that means from the Late Mesolithic throughout the Neolithic and the Bronze Age... The excavations at the Ig show that the lake water levels have decreased before the Bronze Age... It is certain, however, that the lake had completely drained away long before the Roman period, for otherwise the Romans would not have been able to regulate the course of the Ljubljanica River between Podpeč and Ljubljana, that ran along the lowest part of the drained lake."* (Rakovec 1955, 162), and: *"The stratigraphy of the former lake and later marshes sediments is considerably uniform: from the Late Glacial to the lake-dwelling period, there was a relatively deep lake, into which the limestone (lake chalk) or calcareous gyttja, calcareous mud and lacustrine marl (as they were named depending upon the admixture and colour) have been deposited. In the lake-dwelling period, the lake began suddenly to dry out,*

* We present this paper at the invitation of the editor-in-chief.

and the organic detritus (gyttja) was deposited into the shallow lake. Within this 20–40 cm thick layer of the organic mud lie the cultural remains of the lake-dwelling settlements. Soon after the marshes have became overgrown by the turf. We know therefore that the Holocene peat on the Ljubljana marshes is younger then the lake-dwelling period. It began to form at about 3700 years ago, or even later." (Šercelj 1966, 443).

Archaeological interpretation was less simplistic. Josip Korošec pointed out a series of complex stratigraphic sequences that were recorded at Blatna Brezovica and Ig. He hypothesised that the artefacts had not been deposited on the *"surface of the lake chalk"* but within the peat layers, and the settlements were located in the marshy area that was periodically flooded (Korošec 1954, 16).

An interesting description of complex stratigraphic sequence was presented by Rajko Ložar (1942, 87) in the article *"Stratigrafija in kronologija stavb na kolih pri Studencu"*. In this he actualized an old Dežman's description of the stratigraphic column at the Parte site which, consists of *" ...an upper layer of very firm clay (a) which was followed by a 1.3 m stratum of strong clay layer without organic admixture (b); below it is a layer which contains well-preserved blackened oak piles, positioned without order, and composed of felled tree-stumps deposited into 40 cm thick layer of alluvial soil, mixed with sand, numerous alder branches, leaves, and the roots and stems of peat (d), and below this a 0.20 m thick layer of vegetation with leaves of oak and other tress (e), and further below, a layer of densely placed piles made of the deciduous trees, which is approximately 0.50 m in depth (f). At the depth of 3 m the lake mud (g) was found... "*.

Keeping this in mind we would expect that the interpretative significance of pile-dwellings would have become irrelevant. But to the contrary, researchers have maintained the concept, hypothesising *"...there is no reason not to interpret the settlements in marshes as pile-dwellings..."* as *"...they show the characteristic identical to those built on lakes..."* (Korošec 1955, 80), and that in Ljubljana marshes the dwellings were built *"on dry land or at least on drain land close to the river"* (Korošec 1964, 40). Tatjana Bregant (1964, 19) accepting this interpretive postulate pointed out that at the end of digging at Resnikov prekop site *"...we do have pile-dwellings in Ljubljana marshes, even though built on semi-dry terrains or dry land."*. Decades later when she completed extensive excavations and interdisciplinary researches over many years at Maharski prekop site her interpretation was not changed: *"The pile-dwellings were built on dry land and seasonally flooded terrain (Resnik, Notranje Gorice) or on semi-dry areas (kolišče Maharski prekop, Parti, Blatna Brezovica)."* (Bregant 1984, 23).

Thus within the historical and plaeobotanical interpretative contexts the 'lake chalk' and 'vertical piles' became representamens of the prehistoric lake and pile-dwellings built in it. They were hypothesised to mark the shift of post-Mesolithic, supposedly Neolithic settlements from the land to the lake, and to the pattern of small, dispersed platforms and houses built on them. In archaeological interpretations, on the contrary, the clusters of vertical piles were believed to be the remnants of pile-dwellings built on terrestrial, seasonally flooded land. We have pointed out already the interpretative reduction that series of vertical piles relates to the function of platform holders exclusively (for the details see Budja 1994; 1997; Mlekuž et al. 2006). Along with this, the geomorphology, neotectonic subsidence, sedimentology and hydrology of the Ljubljana marshes have been neglected as much as the Holocene climate anomalies that may have affected the Ižica, Iška and Gradaščica river catchments in karstified Dinaric Mountains and Julian Prealps and may have caused extensive and long-term floods in the Ljubljana basin (Šifrer 1983; Brenčič 2007).

Dežman's perception of prehistoric cultural landscape in Ljubljana Marshes and associated iconography was recently reactualised by Anton Velušček. He put forward a contradictory images of *"pile-dwellings built on the lake"* (Velušček 2006, 9), which was *"in 4. millennium BC"* embedded in *"Ljubljana marshes flood plain"* (Velušček 2004, 307).

Ižica floodplain and LiDAR

The Ižica is a river with an extensive karstic watershed in the Dinaric plateau south of the Ljubljana Marshes. It is a low energy river characterized by a very low gradient, broad floodplain and dominant fine-grained sedimentation. Ižica was mobile river and has left earlier channels scattered across the floodplain. They can be identified on aerial photos as cropmarks, mainly as faint, broad anomalies, which do not enable identification of individual channels. Aerial photographs reveal a very complex palimpsest of palaeochannels.

In order to get a more complete picture of the Ižica floodplain a LiDAR survey of the part of the Ižica floodplain was commissioned. An area of 1300 × 600 m (78 hectares) was surveyed. LiDAR is frequently used as a tool for examining aspects of river floodplains, most often for geomorphological or flood prediction purposes (Lohani, Mason 2001; Charlton et al. 2003; Cobby et al. 2001; Marks, Bates 2000; Challis 2005; 2006).

The LiDAR digital terrain model exposes extensive geomorphological detail of the study area and allows us to resolve fine details of the floodplain and terrace (fig. 1).Threedimensional elevation data enable us to discern stratigraphic relations between floodplain features and to create cross-channel profiles. LiDAR gives us a much more complete and detailed picture of the geomorphology than do aerial photographs.

The results of LiDAR allow us to discern two main geomorphological units on the study area: older terrace and younger and lower active floodplain. The difference in elevation between units is up to 40 cm. The most obvious feature of the study area are palaeochannels, visible as slight depressions in the landscape, however, LiDAR reveals also other features, such as levees, and ridge and swale.

Based on the relative stratigraphic positions of palaeochannels at least four distinctive phases of fluvial activity can be discerned. The first phase is characterized by a number of thin, relatively straight channels, preserved on the terrace, suggesting a past anastomosing regime. The second phase is represented by wide anastomosing channels in direct superposition with some phase one channels. Third phase is marked by the degradation of the Ižica and creation of an active floodplain. This process created a well-developed terrace edge and preserved phase 1 and 2 channels on the terrace. The Ižica became a more sinuous river. The most distinctive features of this phase are ridge and swale features in the floodplain with thalwegs, indicating significant lateral channel migration and meander core growth. And last, the fourth phase is a modern network – the result of flood-control and irrigation works in the 19th and 20th centuries.

The change from straight and anastomosing to sinuous/meandering channels and degradation of the Ižica river shows that there were significant changes in the hydrological regime of the streams draining the Ižica floodplain, which might be connected to the Holocene climate anomalies (Budja 2007).

DATING OF PALEOCHANNELS

Systematic mapping of the study area allowed the selection of key localities for direct dating of the palaeochannels. Locations for boreholes were chosen on the basis of the LiDAR map and field inspections (*fig. 1*). Boreholes were drilled with a motorized auger of 8 cm diameter. Only substantial, spatially contiguous stratigraphic units were recorded. The model records the details of at least three sedimentary units: topsoil, organic deposits and lacustrine marls.

In total 9 boreholes were drilled and examined, five samples from five boreholes were directly dated in the first phase of the project (*fig. 3*). Samples for AMS radiocarbon dates were collected from the bottom of an organic channel infill, 5 to 20 cm above the lacustrine marl. This assumes that these dates post-date channel cutting and provide the maximum age (terminus ante quem) for channel infilling and abandonment.

Borehole 1 was located in a phase 1 palaeochannel near the site of Maharski prekop. On the ground, the depression is very evident: a borehole comprising of topsoil underlain by fibrous dark organic deposit. At 120 cm there is a sharp transition to the chalky lacustrine marls. A sample of the organic deposit collected from the depth of 110 cm yielded a radiocarbon date of 4020 ± 40 BP (Beta - 233028) (*fig. 2*).

Borehole 3 was drilled in a straight phase 1 channel southwest of the Maharski prekop site. It shows a very similar stratigraphy, with topsoil, organic rich sediment and sharp transition to lacustrine marls at the depth of 115 cm. A sample from the depth of 110 cm yielded a date 4920 ± 40 BP (Beta - 233029) (*fig. 2*).

Borehole 7 was recovered from the palaeochannel southeast of the Maharski prekop site. A sample was taken from the depth of 50 cm, 5 cm above marl and yielded the date of 4520 ± 40 (Beta - 233032) (*fig. 2*).

Borehole 5 was located at the junction of the straight channel and the wider, second phase channel. A sample of organic sediment from the depth of 125 cm, 20 cm above the lacustrine marl, yielded the date of 3000 ± 40 BP (Beta - 233030).

Borehole 6 was located at the edge of the wide, second phase palaeochannel, 50 m west of borehole 5. A sample from the depth of 100 cm, 20 cm above the marls yielded the date of 5110 ± 40 BP (Beta - 233031).

This date can be considered as too early for the infill of the second phase channel. The dated channel is in direct superposition with the first phase channel, dated with borehole 7 (see above) to 4520 ± 40 BP. The date from borehole 5 suggest that this, second phase channel could be dated to before 3000 ± 40 BP. We assume that the date pre-dates channel cutting and actually dates the terrace surface. This is supported by the piece of prehistoric pottery, found in the borehole, indicating that we dated an undisturbed surface, predating channel cutting. We therefore suggest that 5110 ± 40 BP is the age of the terrace surface.

Radiocarbon dates place the first phase of palaeochannels to before 4920 BP. Thus at latest at ca 3500 cal BC, this part of the Ljubljana Marshes was an active floodplain and not a shallow lake as the traditional view suggests.

Maharski prekop site in the context of the floodplain

Absolute radiocarbon dates of the first phase palaeochannels are contemporary with the Maharski prekop settlement (*tab. 1*). Settlement was therefore located next to the first phase Ižica (*fig. 2*). An abandoned channel was identified and excavated by Tatjana Bregant, who documented it on several sections, where it is visible as a cut in the cultural layer, filled with organic sediment ('gyttja'). Associated with the excavated channel is a wooden structure, composed of two or three dense rows parallel with the channel. Piles in the structure are of significantly smaller diameter and consist of different wood species than piles elsewhere on the site. This structure was interpreted as 'revetment' by Tatjana Bregant and interpreted as a protection of the site against erosion (cfr. Budja 1994, 172; Mlekuž et al. 2006, 259). The structure is contemporary with the channel. Pile 1 from the structure (grid 15) is dated to 4345 ± 113 BP (Z-305). The date of the channel infill from borehole 1 sets the abandonment of the channel to before 4050 ± 40 BP.

In the light of new data presented in the paper, it is difficult to interpret the site as the remains of pile-dwelling. We have already interpreted the archaeological record on the Maharski prekop, composed of a distribution of piles, remains of clay floors, large platy stones and querns as remains of group of houses, located on the river edge (Budja 1994; Mlekuž et. al 2006). The Maharski prekop settlement therefore consisted of a group of houses with sizes of around 10 × 3.5–4.5 m arranged parallel to each other. Each house is made of three rows of structural timbers, with a central row of centre-posts supporting a roof ridge pole; the lateral rows are wall posts. The floors were plastered with clay, and the stone features are probably the remains of thermal structures at the front/back of the house or might be paved surfaces. Houses were oriented with the longer side parallel to the channel. However, there is at least one house which is oriented perpendicularly to the others (Mlekuž et al. 2006).

CONCLUSION

The evidences presented here clearly suggest that the Ižica floodplain was a complex landscape, greatly affected by fluvial activity in the past millennia. LiDAR images of the micro-region clearly demonstrate an old terrace and the pattern of stratified palaeochannels.

Absolute dates of the first phase palaeochannels are contemporary with the dates from the Maharski prekop site. They confirm Korošec's and Bregant's hypothesis of dry land settlements located on river edges. We suggest that at least at the time of occupation (and probably even earlier) of the Maharski prekop site around 4000 cal BC, this part of the Ljubljana marshes was not covered by a shallow lake, as the traditional view suggests.

Our project results minimize the importance of a *"sedimentary hiatus"*, which was recognized as the main achievement within the project *'Archaeological and palynological research in the Ljubljansko barje - J6-6348-0618-04'* (Velušček 2007, 426). The explanation that relates to it: *"Landscape development in the following millennia is not known since sedimentological record for time period between 6.000 and 200 cal. BC is missing."* (Andrič 2006, 109), certainly does not contribute to actual and relevant interpretations of the landscape dynamics in the Ljubljana marshes. The LiDAR image of the study area clearly demonstrates that the small trench excavated at Resnikov prekop site was located at the centre of the abandoned palaeochannel, stratigraphically dated to the third phase (*fig. 3*), which had eroded part of the stratigraphical sequence of the site. The *"sedimentation hiatus"* is therefore result of the destruction of the site, and the hypothesised "unknown" development of the site, its environs and landscape is an outcome of fragmentary and uncontextualized datasets that have been acquired within the unsuitable research approach.

We believe that the Ljubljana Marshes in prehistory was neither floodplain nor lake exclusively, but a dynamic mosaic of different environments, including floodplains and large bodies of standing water. The mosaic was highly dynamic, both in seasonal as well as in long term temporal scales, in association with global and regional climatic anomalies in the Holocene (Budja, Mlekuž 2008).

Our project results presented in the paper clearly suggest that Eneolithic and Bronze Age settlements were located in the floodplain, next to the active rivers, which contributed to the development of the landscape in prehistory, as was already suggested before (Budja 1994; Mlekuž 1999; 2001; Budja, Mlekuž 2001).

Mihael Budja
Oddelek za arheologijo
Filozofska fakulteta
Univerza v Ljubljani
Aškerčeva 2
1000 Ljubljana
miha.budja@ff.uni-lj.si

Dimitrij Mlekuž
Oddelek za arheologijo
Filozofska fakulteta
Univerza v Ljubljani
Aškerčeva 2
1000 Ljubljana
dimitrij.mlekuz@ff.uni-lj.si