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PROSTORSKO-ČASOVNA RAZPOREDITEV HUDOURNIŠKIH POPLAV V SLOVENIJI

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Izvleček
Prispevek preučuje prostorsko razporeditev pogostnosti hudourniških poplav ter njihovo razporeditev preko leta. V prostorsko-časovnih analizah preteklega hudourniško-poplavnega dogajanja je zajetih 124 hudourniških poplav, ki so med letoma 1550 in 2015 prizadele območje Slovenije. Hudourniške poplave so najpogostejše v goratem in hribovitem delu severne Slovenije, ki vključuje alpski ter večji del predalpskega sveta. Jesenske hudourniške poplave se pojavljajo v pretežnem delu države, poletne hudourniške poplave pa predvsem na vzhodu. V večjem delu države prevladujejo jesenske hudourniške poplave.

Ključne besede: naravne nesreče, hidrogeografija, prognostična geografija, hudourniške poplave, porečja, hidrografska območja, Slovenija

1 UVOD

V Sloveniji se ob vodotokih pojavljajo nižinske, kraške in hudourniške poplave (Natek, 2005). Posamezni tipi poplav se praviloma pojavljajo zgolj na določenih območjih zaradi različnega spleta hidrogeografskih dejavnikov odtoka (kot so pokrovnost, prst, matična podlaga in relief) na vodozbirnih območjih vodotokov. Ob večini vodotokov se v Sloveniji pojavljajo hudourniške poplave (Brilly, Mikoš, Šraj, 1999). K njim prištevamo razdiralno divjanje ekstremnih količin vode v večjih in manjših hudourniških strugah, stranskih grapah, na vršajih in poplavnih ravnicah, pa tudi drobirske in blatne tokove (Gams, 1991).

V Sloveniji se v povprečju pojavijo 1,3 hudourniške poplave na leto (Trobec, 2015), a se, kot je razvidno iz regionalnega pregleda poplav (Komac, Natek, Zorn, 2008), v posameznih porečjih pojavljajo različno pogosto. Zaradi specifičnih sezonsko značilnih vremenskih vzorcev, ki pogojujejo nastanek obilnih in intenzivnih padavin (Furlan, 1961; Pristov, 1982; Petkovšek, Trontelj, 1996; Vrhovec, 2002; Ogrin, 2008) ter z njimi

povezanih hudourniških poplav, se slednje v Sloveniji pojavljajo predvsem med junijem in novembrom, tj. v času meteorološkega poletja in meteorološke jeseni (Trobec, 2015). Vendar se tudi pri razporeditvi poplav preko leta zaradi različnih podnebnih značilnosti (Ogrin, 1996; 2002) med porečji na različnih območjih Slovenije kažejo pomembne razlike. Regionalne razlike v pogostnosti in razporeditvi hudourniških poplav preko leta ter pojavljanje hudourniških poplav zgolj na določenih območjih je značilno tudi za preostale države alpskega loka (Merz, Blöschl, 2003; Parajka in sod., 2010).

Koncept sodobnega varstva pred poplavami vključuje različne vzvode obvladovanja poplavnega tveganja, med katerimi je vse pomembnejše preventivno delovanje s poudarkom na ozaveščanju prebivalcev o poplavni nevarnosti ter napovedovanju poplav (Direktiva, 2007). Poznavanje območij pojavljanja hudourniških poplav lahko pomembno prispeva k ozaveščanju prebivalcev o poplavni nevarnosti na teh območjih. Zelo verjetno je namreč, da se bodo poplave tudi v prihodnje pojavljale na območjih, ki so jih v preteklosti že prizadele. Glede na predpostavko prognostične geografije, da so poplave na določenem območju stalnica in s tem odraz naravnogeografskih značilnosti tamkajšnjega površja (Radinja, 1983; Šifrer, 1983; Natek, 1992; 2002; 2003; 2007), lahko iz preteklih hudourniških poplav sklepamo, kakšna bosta prostorski vzorec in dinamika prihodnjih hudourniških poplav. Slednje pa že predstavlja korak v smeri napovedovanja poplav.

Namen prispevka je opredelitev območij pojavljanja hudourniških poplav ter poskus rekonstrukcije preteklega hudourniško-poplavnega dogajanja na podlagi prostorsko-časovnih analiz za 124 hudourniških poplav, ki so med letoma 1550 in 2015 prizadele Slovenijo. V prispevku sta predstavljeni prostorska razporeditev hudourniških poplav v Sloveniji glede na njihovo pogostnost pojavljanja ter njihovo razporeditev preko leta – oboje na ravni hidrografskih območij različnih redov (Hidrografska območja, 2016).

2 METODE

Pri pridobivanju podatkov za izvedbo prostorsko-časovnih analiz hudourniško-poplavnega dogajanja v Sloveniji smo se oprli na različne popise, opise in preučitve preteklih hudourniških poplav. Upoštevali smo torej le tiste poplave, za katere je bilo moč razbrati ali vsaj posredno sklepati, da se nanašajo na poplave hudourniškega tipa. Kraške in nižinske poplave niso bile predmet našega preučevanja, zato smo jih iz analize izvzeli, čeprav so slednje občasno, predvsem ob dolgotrajnih jesenskih deževjih, z nekoliko časovne zamude lahko sledile hudourniškim. Ker izvedene analize vsebujejo tudi prostorsko komponento, smo vanje zajeli le tiste poplave, ki smo jim lahko določili okviren obseg poplavljanja.

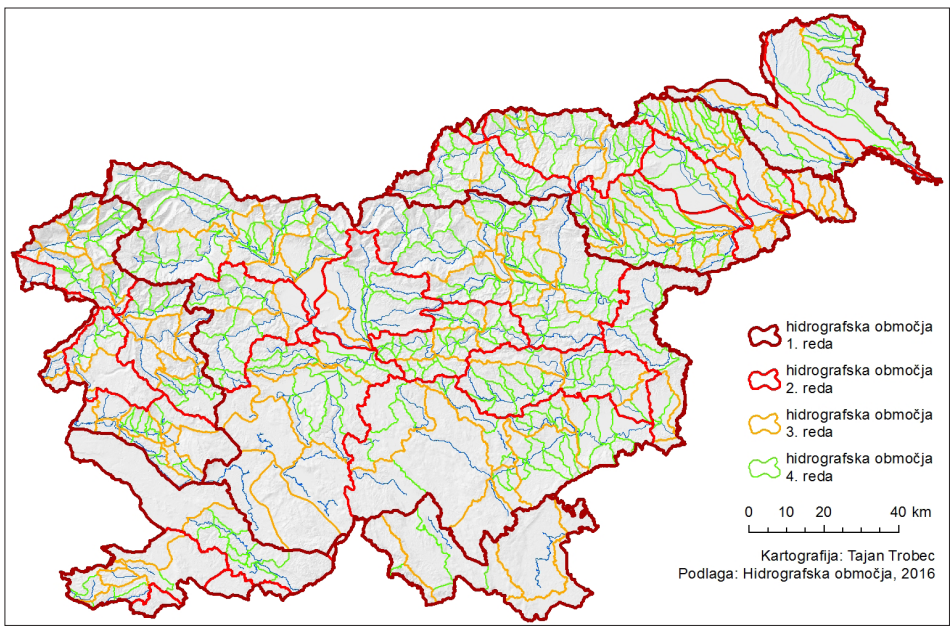
Podatke o starejših poplavah smo črpali predvsem iz sekundarnih virov (Kolbezen, 1991; 1992; 1993; 1994; 1995; Jesenovec, 1995; Trontelj, 1997). Primarnih virov (javna občila, zapisniki deželnih političnih korporacij, arhivski zapiski dnevnega časopisja, kronike, arhiv Hidrometeorološkega zavoda RS - današnji ARSO ipd.), na katere se ti viri sklicujejo, zato ne navajamo. Za poplave, ki so se pojavile v obdobju nekaj zadnjih desetletij smo se oprli tudi na primarne vire, in sicer predvsem na posamezne prispevke v znanstvenih in strokovnih revijah ter zbornikih, kot so Geografski vestnik, Geografski

zbornik, Ujma, Mišičev vodarski dan idr., ter na različna poročila in publikacije s spletne strani ARSO (Analize izrednih …, 2016).

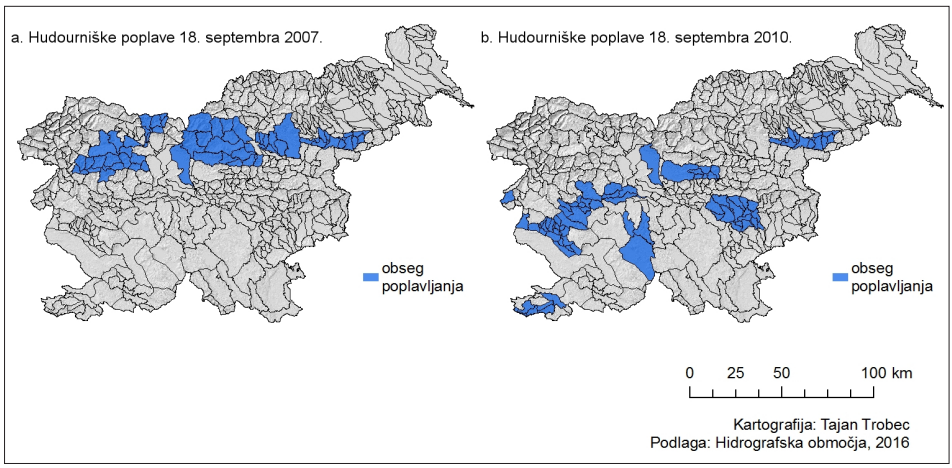
Pri manj obsežnih poplavah, ki so nastopile ob kratkotrajnih padavinah (navadno v toplejšem delu leta ob konvektivno pogojenih ali okrepljenih padavinah), smo zaradi manjšega časovnega zamika med padavinami in posledičnimi poplavami posamezne poplave lahko pripisali dnevu, v katerem so se le-te tudi dejansko pojavile. Drugače je bilo z nekaterimi poplavami, ki so nastale kot posledica počasnega prehoda obsežnih frontalnih ali ciklonalnih sistemov, kadar so ti povzročili dolgotrajne padavine z različno in spremenljivo lokalno intenzivnostjo (praviloma v hladnejšem delu leta). Pri njih smo vse poplave, pa čeprav so se lahko pojavile v različnih dneh in/ali v različnih porečjih, šteli kot en poplavni dogodek in jih pripisali dnevu, ki je bil znotraj tedanje sinoptične situacije z vidika poplav najbolj buren. Na ta način smo povečali preglednost podatkovne baze, saj smo posamezne razpršene poplave povezali s skupnim vzrokom za njihov nastanek, torej s padavinami znotraj širšega padavinskega sistema, ki je poplave povzročil.

Vsaki poplavi smo določili okviren obseg poplavljanja. Pri tem se nismo omejili zgolj na ožja poplavna območja ob vodotokih, temveč smo praviloma zajeli celotna porečja (območja manjših povirnih krakov, grap, stranskih pritokov in vršajev), od koder se poplavne vode stekajo v struge. Pri izbiri prostorskih enot za ponazoritev poplav smo izhajali iz ARSO-vega podatkovnega sloja »hidrografska območja« (Hidrografska območja, 2016), ki ozemlje Slovenije deli na 4 hierarhično urejene rede (slika 1). Po prvem oziroma najvišjem redu je Slovenija razdeljena na 6 osnovnih hidrografskih območij, ki

Slika 1: Hidrografska območja različnih redov v Sloveniji.



Slika 2: Določitev obsega poplavljanja hudourniških poplav na ravni hidrografskih območij za septembrske poplave leta 2007 (a) in 2010 (b).



Vir: Kobold, 2008; 2011; Polajnar, 2008; 2011; Večje nesreče ..., 2008; Kuzmič in sod., 2010; Sodnik, Mikoš, 2010; Poplave in zemeljski plazovi med ..., 2011; Hidrografska območja, 2016.

sovpadajo s porečji večjih slovenskih rek (porečje Save, Drave, Mure, Soče in Kolpe), vključeno pa je tudi jadransko povodje brez Soče. Drugi red obsega 31, tretji 155 in četrti 582 hidrografskih območij. Hidrografska območja četrtega reda predstavljajo osnovne prostorske enote omenjenega sloja. V povprečju so velika približno 35 km^2 (na kraškem svetu in na ravnini občutno več, na normalnem rečnem reliefu ter v vzpetem svetu občutno manj). S svojimi mejami se prilegajo hidrografskim razvodnicam manjših porečij oziroma njihovim delom. Vsako hudourniško poplavo smo glede na obseg prizadetega območja ponazorili z odgovarjajočim izborom hidrografskih območij (slika 2).

Mlajše poplave (nekako od konca 80-ih let 20. stoletja naprej) so v literaturi praviloma dovolj dobro in razmeroma natančno dokumentirane, zaradi česar tudi pri ponazarjanju njihovega obsega nismo imeli večjih težav. Težavnejše je bilo določanje obsega nekaterih starejših, slabše dokumentiranih poplav. Zaradi pomanjkljivih informacij o obsegu tovrstnih poplav smo bili pri njihovem prostorskem ponazarjanju občasno prisiljeni sklepati kompromise ter jih ponazoriti s hidrografskimi območji višjega reda. Pri tem smo tvegali, da smo zajeli tudi kakšno dejansko neprizadeto območje ali pa smo kakšno izmed prizadetih območij izpustili. Vrzeli v pomanjkljivih virih smo ponekod lahko dopolnili z izkušnjami iz ostalih dokumentiranih poplav na teh območjih. Pri tem so nam bile v veliko pomoč podrobne geografske preučitve in njihova spoznanja o poplavah in poplavnih območjih v Sloveniji, ki so med letoma 1972 in 1985 nastale pod okriljem projekta »Geografija poplavnih področij na Slovenskem« (Radinja in sod., 1974). Občasno smo si pri določanju obsega poplavljanja posredno pomagali tudi s podatki o pretočnih konicah na vodotokih v Sloveniji (Arhivski …, 2016).

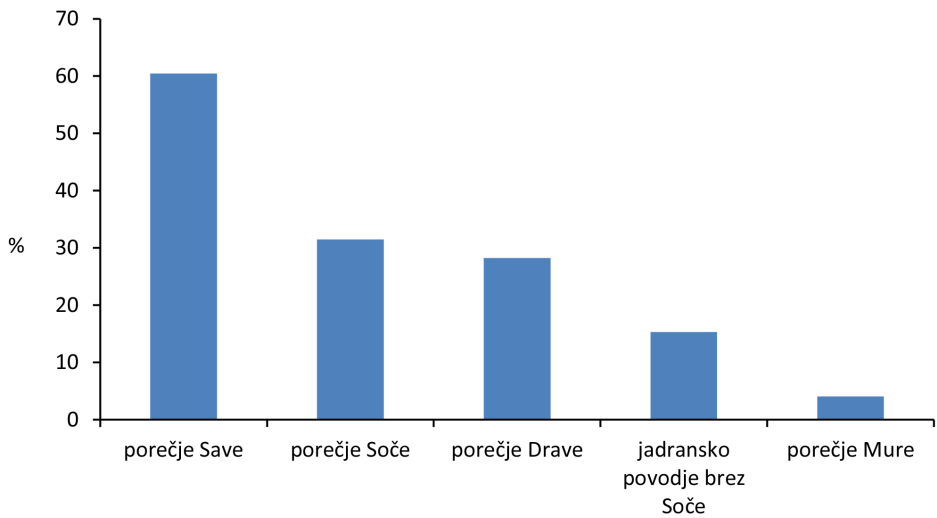
Prostorsko-časovne analize hudourniško-poplavnega dogajanja v Sloveniji smo izvedli za obdobje med letoma 1550 in 2015. V analize nismo zajeli vseh 138 hudourniških poplav, ki so bile v tem obdobju evidentirane v literaturi. Nekaterim izmed njih namreč bodisi nismo mogli določiti okvirnega obsega poplavljanja bodisi zanje nismo razpolagali z mesecem pojavitve, kar sta bila ključna podatka za izvedbo nadaljnjih analiz. Prostorske analize pogostnosti hudourniških poplav smo tako izvedli na podvzorcu 124 poplav z znanim okvirnim obsegom poplavljanja, prostorske analize razporeditve hudourniških poplav preko leta pa na podvzorcu 116 poplav, za katere smo poleg tega razpolagali še s podatkom o mesecu pojavitve. Slednjim smo določili tudi meteorološki letni čas, v katerem so se pojavile. Meteorološki letni časi so glede na poimenovanja enaki astronomskim (običajnim) letnim časom, v časovnem smislu pa se nanašajo na tromesečja. Meteorološka zima zajema tromesečje med decembrom in februarjem, meteorološka pomlad tromesečje med marcem in majem, meteorološko poletje tromesečje med junijem in avgustom ter meteorološka jesen tromesečje med septembrom in novembrom. Za uporabo meteoroloških letnih časov smo se odločili zato, ker ti v nasprotju z astronomskimi občutno bolj sovpadajo z značilnimi sezonsko pogojenimi sinoptičnimi vremenskimi situacijami, ki lahko privedejo do nastanka obilnih in intenzivnih padavin in s tem do pojava hudourniških poplav (Trobec, 2015).

3 PROSTORSKA RAZPOREDITEV HUDOURNIŠKIH POPLAV GLEDE NA NJIHOVO POGOSTNOST

Kot je razvidno na pregledni karti območij pojavljanja hudourniških poplav (slika 5a), se slednje v Sloveniji pojavljajo v vzpetem svetu, ki obsega praktično celoten alpski svet (Julijske in Kamniško-Savinjske Alpe ter Karavanke), večji del predalpskega sveta (Idrijsko, Cerkljansko, Škofjeloško, Polhograjsko in Posavsko hribovje, Zgornja Savinjska dolina, Pohorje in Kozjak), pa tudi gričevja v obsredozemski (Brkini, Koprska brda, obronki Vipavske doline in Goriška brda) in obpanonski Sloveniji (Krško, Bizeljsko, Sotelsko, Voglajnsko, Ložniško in Hudinjsko gričevje, Dravinjske in Slovenske gorice, Haloze in Goričko). Hudourniške poplave se pojavljajo tudi v posameznih porečjih znotraj dinarskokraškega sveta, na primer ob Iški, Borovniščici, Cerkniščici, (Sodraški) Bistrici ter (Podboški) Sušici. V preostalem dinarskokraškem svetu ter na Krasu se glede na dosedanje izkušnje hudourniške poplave ne pojavljajo. Za ta območja sta značilna vodoprepustna matična podlaga in prevlada kraškega sveta s podzemnim pretakanjem vode, zaradi česar marsikje sploh ni izoblikovana sklenjena površinska rečna mreža, ki je nenazadnje eden izmed pogojev za pojavljanje hudourniških poplav. V dinarskokraškem svetu se na območjih podolij in ravnikov zaradi zadrževanja presežnih količin vode v kraškem podzemlju namesto hudourniških pojavljajo kraške poplave (Natek, 2005). Hudourniške poplave se ne pojavljajo niti na območjih nekaterih obsežnejših ravnin ob večjih vodotokih (Ljubljanska kotlina, Krška kotlina, Dravska in Murska ravan). Zaradi relativno velikih vodozbirnih območij za te vodotoke niso značilne hudourniške poplave, se pa na izpostavljenih območjih pojavljajo nižinske poplave (Natek, 2005).

Na ravni hidrografskih območij 1. reda je od skupno 124 hudourniških poplav največ poplav (75 poplav oziroma 60 %) prizadelo porečje Save (sliki 3 in 5b). Slednje ne preseneča, saj je porečje Save največje in zavzema 53 % državnega ozemlja ter hkrati največji del območij, ki so glede na naravnogeografske razmere dovzetna za pojavljanje ekstremnih odtokov in hudourniških poplav. Le slaba tretjina hudourniških poplav je prizadela Posočje (39 poplav) in Podravje (35 poplav). 15 % oziroma 19 hudourniških poplav je bilo na območju jadranskega povodja brez Soče. Najmanj hudourniških poplav (5 poplav oziroma 4 %) je prizadelo Pomurje. Slednje je po eni strani posledica specifičnih naravnogeografskih razmer (relativno majhen padec porečij, majhni strmci vodotokov in njihovo raztekanje v različne manjše rečne sisteme, manj intenzivne padavine), ki zmanjšujejo dovzetnost za pojavljanje hudourniških poplav, po drugi strani pa tudi razmeroma majhne površine vodozbirnega območja Mure znotraj meja Slovenije. Vsota navedenih odstotkov presega vrednost 100, ker se je 37 hudourniških poplav (30 %) hkrati pojavilo na dveh ali več hidrografskih območjih 1. reda.

Slika 3: Delež hudourniških poplav v Sloveniji po hidrografskih območjih 1. reda za obdobje 1550–2015.

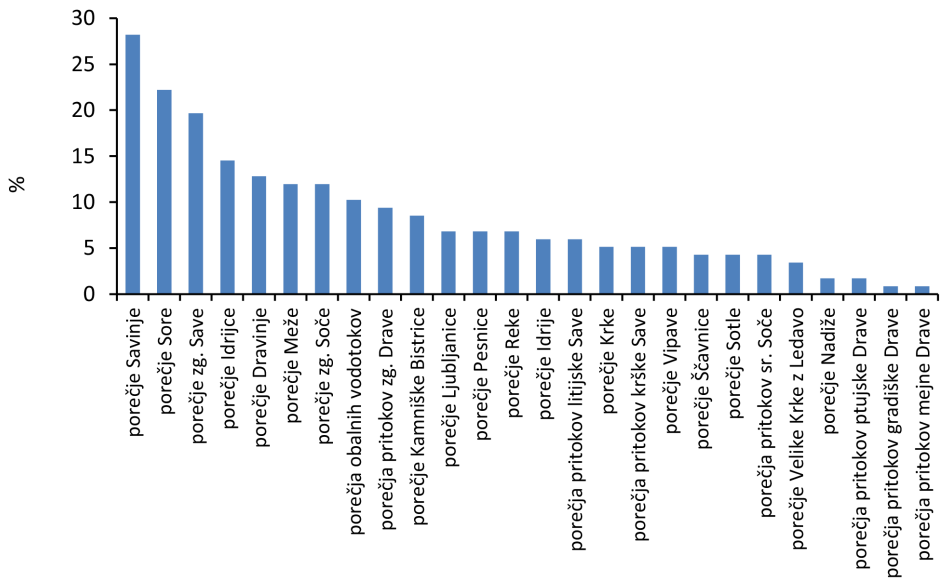


Vir: lastna raziskava.

Na ravni hidrografskih območij 2. reda (slike 5c, 5d, 5e) največ hudourniških poplav odpade na porečje Savinje (33). Sledita mu porečji Sore (26) ter zgornji del porečja Save (23), ki poleg Save Bohinjke in Save Dolinke vključuje še Tržiško Bistrico in Kokro (slika 5c). Porečje Savinje in zgornji del porečja Save sta v primerjavi z ostalimi hidrografskimi območji 2. reda, kjer se pojavljajo hudourniške poplave, občutno večji. Posledično nanju že v osnovi odpade nekoliko več poplav, ki so se pojavljale v različnih delih porečja. Med preostalimi hidrografskimi območji na ravni 2. reda velja po pogostnosti

hudourniških poplav izpostaviti še porečje Idrijce (17), Dravinje (15), Meže z Mislinjo ter zgornji del porečja Soče (14), porečja obalnih vodotokov (12), porečja hudourniških pritokov Drave med Dravogradom in Mariborom (11) ter porečje Kamniške Bistrice (10). Porečja, kjer se hudourniške poplave pojavljajo najpogosteje, tako zajemajo razmeroma sklenjeno območje gorate in hribovite severne Slovenije, ki vključuje alpski ter večji del predalpskega sveta. Zaradi ogroženega pridobivanja soli v Sečoveljskih solinah, predvsem pa na račun zelo podrobne evidence poplav na Dragonji, ki sega daleč v preteklost (Zorn, 2008; Orožen Adamič, 1980), se med območja s pogostimi hudourniškimi poplavami uvršča tudi del Slovenske Istre.

Slika 4: Delež hudourniških poplav v Sloveniji po hidrografskih območjih 2. reda za obdobje 1550–2015.



Vir: lastna raziskava.

Še nadrobneje je pogostnost hudourniških poplav prikazana na ravni hidrografskih območij 3. reda (slika 5d), kjer je največ poplav evidentiranih v porečjih Poljanske Sore (21), Savinje nad sotočjem s Pako (16) ter Save Dolinke (14). 10 ali več hudourniških poplav je prizadelo še porečja Selške Sore (13), Dragonje (12), Mislinje, Voglajne s Hudinjo in Dravinje (11), Kamniške Bistrice z Račo in Pšato ter Koritnice (10). Razmeroma visoko se po številu poplav uvrščajo še porečje Bolske (9) ter povirji Idrijce in Soče, Ložnica s pritoki in Reka (8). Po 7 hudourniških poplav je bilo evidentiranih v porečjih Bače, Pake, Reke v Goriških brdih ter Meže nad sotočjem z Mislinjo. Nobeno izmed navedenih porečij po pogostnosti poplav ne preseneča, saj se domala vsa izmed

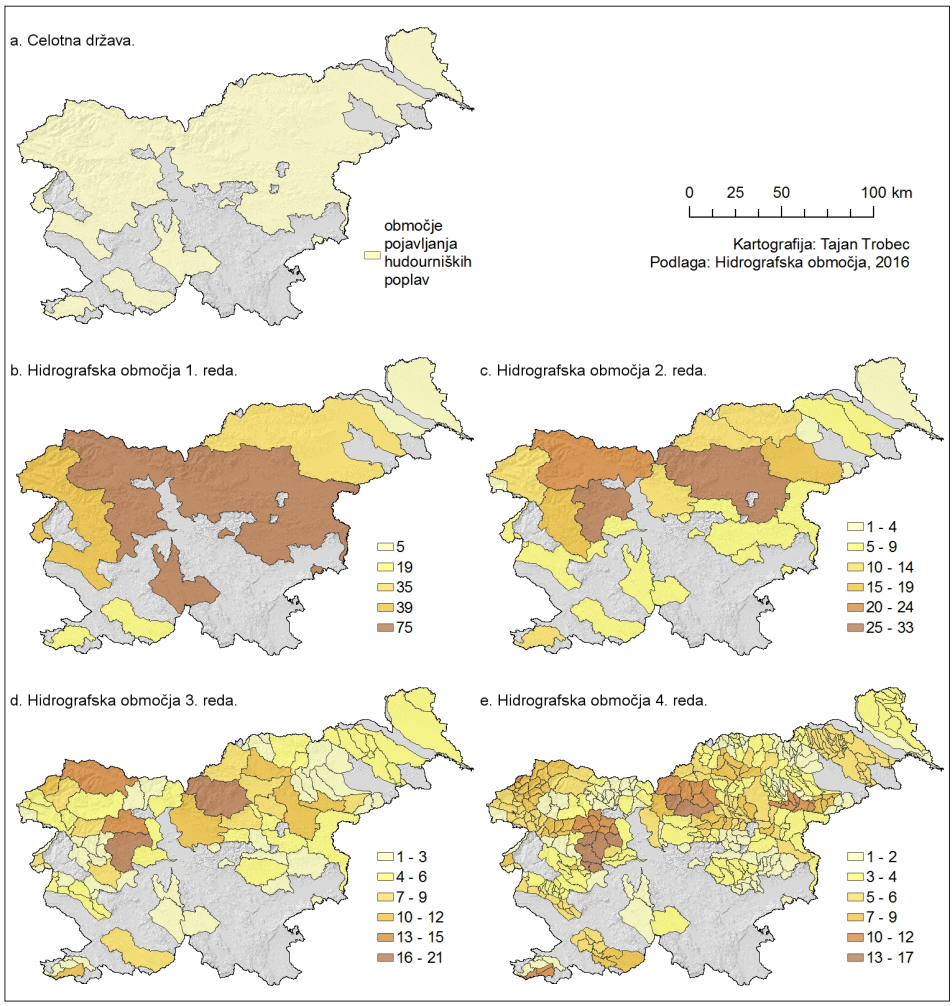
njih uvrščajo med dobro poznana hudourniška območja (Jesenovec, 1995; Komac, Natek, Zorn, 2008). Ostala porečja na ravni hidrografskih območij 3. reda beležijo manjše število hudourniških poplav.

Po številnih hudourniških poplavah tudi na ravni hidrografskih območij 4. reda izstopata Poljanska dolina in Zgornja Savinjska dolina z Zadrečko dolino (slika 5e). Ob Poljanski Sori s pritoki je bilo med 14 in 17, ob Savinji v Zgornji Savinjski dolini s pritoki pa med 11 in 15 hudourniških poplav. Omenjeni porečji sta dobro poznani poplavni območji, ki sta bili tudi že podrobneje preučeni (Orožen Adamič, Kolbezen, 1984; Meze, 1978; Kladnik, 1991). Poleg naravnogeografskih značilnosti, ki stopnjujejo njuno dovzetnost za pojavljanje silovitih odtokov in hudourniških poplav, je za škodo v kulturni pokrajini ob visokih vodah v veliki meri odgovoren tudi človek. Ob Sori je razmeroma ozko dolinsko dno ponekod na gosto poseljeno in prepredeno s prometnicami ter industrijskimi obrati (Komac, Natek, Zorn, 2008). Zaradi tega je škoda ob visokih vodah vsakokrat večja, kot bi lahko bila ob ustreznejši prilagoditvi. Ob Dreti poplavno nevarnost še dodatno stopnjuje opustitev številnih mlinov in žag, porušitev dotrajanih jezov in posledično zasipavanje struge s prodom, pa tudi širjenje gradenj in infrastrukture na poplavna območja (Meze, 1978; Kladnik, 1991).

Iz že navedenih razlogov z dvanajstimi hudourniškimi poplavami izstopajo hidrografska območja v porečju Dragonje. Z enajstimi oziroma desetimi poplavami sledijo porečje Selške Sore, osrednji del porečja Dravinje, porečje Predelice (desni pritok Koritnice) ter Celje z okolico. Selška Sora s pritoki je znan hudourniški vodotok, ob katerem so se v zadnjem času, pa tudi v bolj oddaljeni preteklosti, precej pogosto pojavljale hudourniške poplave različnih razsežnosti (Klabus, 2007; Komac, Natek, Zorn, 2008). Območje ob srednjem toku Dravinje je zaradi specifične izoblikovanosti dolinskega dna drugo največje poplavno območje po površini v Sloveniji (Natek, 2005). Zanj so značilna zelo pogosta in obsežna razlivanja poplavne vode, ki so posledica izrazitega zmanjšanja strmca Dravinje in njenih pritokov, ko s Pohorja pritečejo na območje Dravinjskih goric (Šifrer, 1978). Predelica se po številu hudourniških poplav uvršča tako visoko tudi na račun upoštevanja drobirskih tokov, ki sta dolino prizadela v letih 1891 (Zorn, Komac, 2002) in 2000 (Komac, 2001). Celje z okolico pa je zaradi svoje lege na poplavnem območju ob sotočju hudourniških vodotokov Savinje, Voglajne in Hudinje poplavno zelo ogroženo območje (Radinja, 1993), zaradi česar ne preseneča, da je bilo v preteklosti tako pogosto poplavljeno.

Po 9 hudourniških poplav je bilo ob Savi Dolinki oziroma njenih hudourniških pritokih med Kranjsko Goro in Mojstrano (Hladnik, Belca idr.) ter v porečju Suhodolnice (levi pritok Mislinje). 8 hudourniških poplav je prizadelo območja ob osrednjih vodotokih ali hudourniških pritokih Koritnice in Soče ter Reke. Med 7 in 8 hudourniških poplav je prizadelo območja ob osrednjih vodotokih ali hudourniških pritokih preostalega povirja Save Dolinke, Kamniške Bistrice nad Nevljico, Bolske in Mislinje. Po sedem hudourniških poplav je bilo še v porečju Bače, ob (briški) Reki ter idrijskem hudourniku Nikova. V preostalih porečjih se je na ravni hidrografskih območij 4. reda pojavilo manj poplav.

Slika 5: Razporeditev in število hudourniških poplav po hidrografskih območjih različnih redov v Sloveniji za obdobje 1550–2015.



Vir: lastna raziskava.

Kartografski prikaz pogostnosti hudourniških poplav na ravni hidrografskih območij 3. in 4. reda omogoča tudi odkrivanje razlik in neskladij med posameznimi območji oziroma manjšimi porečji. Neposredna primerjava med njimi je sicer mestoma otežena, saj za nekatera območja obstajajo tudi že opisi zelo starih, za druga pa šele opisi precej mlajših poplav. Poleg tega so poplave ponekod bolje, drugje slabše evidentirane. Določeno omejitev predstavlja tudi dejstvo, da je zaznavanje poplav (še zlasti starejših) odvisno predvsem od škode, ki jo te povzročijo v kulturni pokrajini. Tako je lahko neko območje

glede na naravnogeografske značilnosti sicer zelo dovzetno za pojavljanje izjemnih odtokov, a če tam človek s svojimi dejavnosti ni prisoten, oziroma se je nevarnosti ustrezno prilagodil, tudi izjemni odtoki in poplave v literaturi niso dokumentirane. Ne glede na opisane omejitve pa je tudi na ravni hidrografskih območij 3. in 4. reda moč potegniti določene zaključke, hkrati pa se ob tem odpirajo tudi nekatera vprašanja.

S kartografskega prikaza na ravni hidrografskih območij 3. in 4. rada (sliki 5d in 5e) je razvidno, da najvišje ležeča porečja v Alpah, kljub siceršnji veliki dovzetnosti za pojavljanje izjemnih odtokov (velika količina intenzivnih padavin, ekstremni nakloni, veliki strmci in prisotnosti erozijsko aktivnih območij) po pogostnosti hudourniških poplav v splošnem bistveno ne prednjačijo pred ostalimi območji. Največ hudourniških poplav se je tako pojavilo v nekaterih že omenjenih porečjih v predalpskem hribovju. Razlog za to gre iskati v pretežno kraških alpskih vodozbirnih območjih, kjer tudi ob obilnih in intenzivnih padavinah še vedno prevladuje podzemno pretakanje vode, ki vsaj nekoliko umirja velike pretočne konice. Na drugi strani večji del predalpskega hribovja sestoji iz vododržne matične podlage, ki pospešuje površinski odtok in s tem dovzetnost za pojavljanje hudourniških poplav. Poleg tega je predalpsko hribovje v primerjavi z večino odročnih alpskih dolin tudi gosteje poseljeno in prepredeno z infrastrukturo in tako tudi bolj ranljivo. Hudourniške poplave v predalpskem svetu tako težje ostanejo neopažene in neevidentirane; v alpskem svetu, še zlasti na vodotokih nižjega reda, tudi prihaja do poplav, a jih pogosto ne beležimo in o njih nimamo podatkov. Glede na evidentirane hudourniške poplave je v primerjavi z bližnjimi sosednjimi območji nesorazmerno malo poplav prizadelo odročno in redko poseljeno kraško povirje Save Bohinjke, pa tudi porečje Tržiške Bistrice. Pri tem se zastavlja vprašanje, v kolikšni meri lahko slednje dejstvo pripišemo specifičnim naravnogeografskim razmeram, v kolikšni meri pa gre zgolj za odraz opisanih metodoloških omejitev pri tovrstnem preučevanju pogostnosti hudourniških poplav.

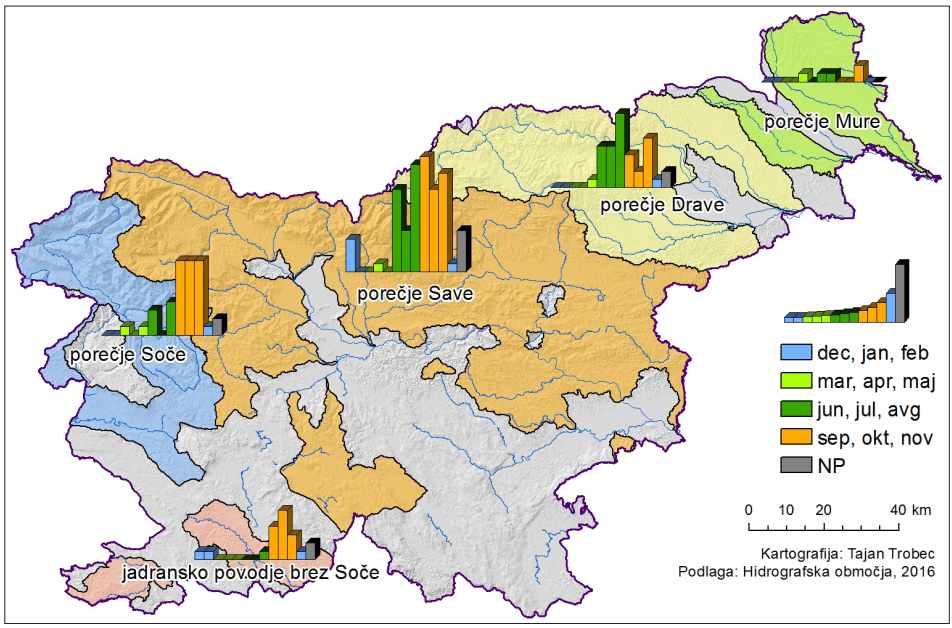
Porečja oziroma skupine porečij z relativno majhnim številom hudourniških poplav ali celo povsem brez njih se pojavljajo tudi v predalpskem hribovju. Nesorazmerno malo hudourniških poplav je bilo tako na primer na območju Kozjaka, še zlasti če ga primerjamo z bližnjimi Slovenskimi goricami. Tudi jugozahodni del Posavskega hribovja izkazuje nesorazmerno malo hudourniških poplav. Glede na naravnogeografske značilnosti skoraj ni verjetno, da bi bile poplave na Kozjaku manj pogoste kot v Slovenskih goricah ali na Goričkem. Ravno tako je malo verjetno, da hudourniške poplave niso prizadele jugozahodnega dela Posavskega hribovja. Oboje je tako verjetno vsaj deloma moč pripisati opisanim metodološkim omejitvam, ki izhajajo iz pomanjkljive evidence poplav na teh območjih.

4 PROSTORSKA RAZPOREDITEV HUDOURNIŠKIH POPLAV GLEDE NA NJIHOVO RAZPOREDITEV PREKO LETA

Na ravni hidrografskih območij 1. reda (slika 6) je razvidno, da so v porečju Soče in v preostalem delu jadranskega povodja hudourniške poplave najpogostejše med septembrom in novembrom. V porečju Save in Drave se večina hudourniških poplav pojavi med junijem in novembrom. Kljub majhnemu skupnemu številu poplav je njihova sezonskost izražena

tudi v porečju Mure, kjer se hudourniške poplave pojavljajo med majem in novembrom. V povodju Jadranskega morja se tako večina poplav pojavlja v nekoliko ožjem obdobju leta kot v povodju Črnega morja. Slednje nakazuje na različne režime hudourniškega poplavljanja v posameznih delih države, kar je posledica različnih podnebnih vplivov (Ogrin, 1996; 2002).

Slika 6: Razporeditev hudourniških poplav glede na mesec pojavljanja po hidrografskih območjih 1. reda v Sloveniji za obdobje 1550–2015.

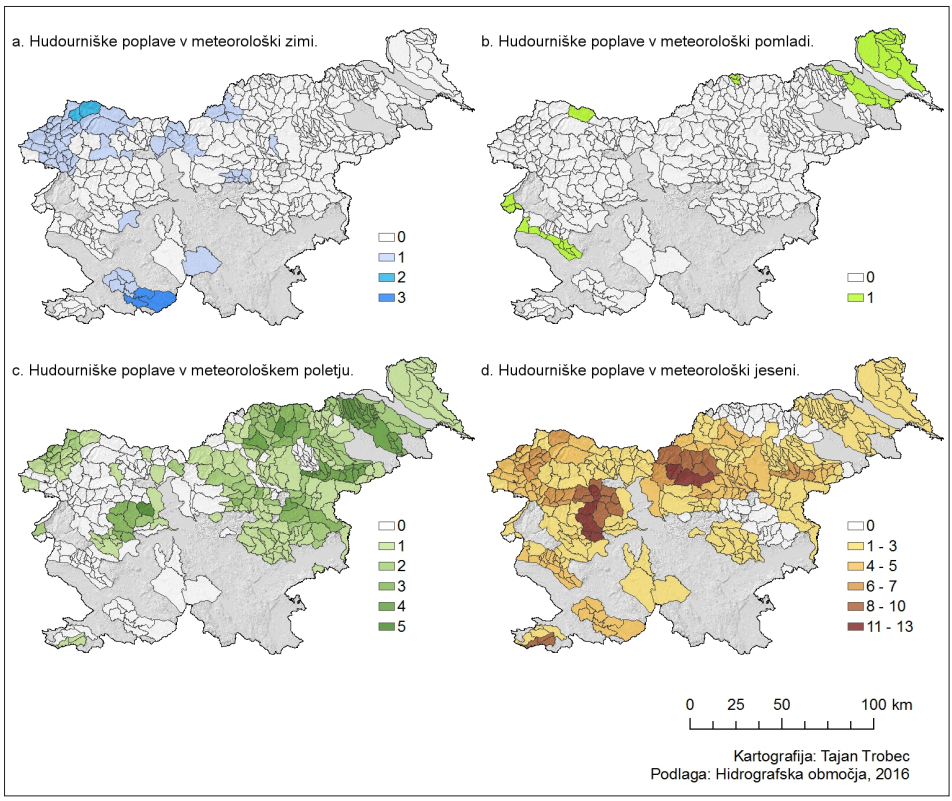


Vir: lastna raziskava.

Na ravni hidrografskih območij 4. reda (sliki 7a in 7b) je razvidno, da so hudourniške poplave v času meteorološke zime in pomladi v Sloveniji redke in se pojavljajo na zelo majhnem območju. Večji del poplavnega dogajanja je osredotočen na čas meteorološkega poletja in meteorološke jeseni. Jesenske hudourniške poplave se pojavljajo v pretežnem delu države in jih ni bilo le ob hudourniških pritokih Drave med Dravogradom in Mariborom ter ob hudourniških pritokih Save in Savinje v osrednjem delu Posavskega hribovja (slika 7d). V splošnem so hudourniške poplave jeseni pogostejše v goratem in hribovitem svetu ter na zahodu države, na vzhodu pa jih je manj. Obdobje meteorološkega poletja izkazuje povsem drugačno podobo. V tem času se hudourniške poplave pojavljajo predvsem na vzhodu države, na zahodu pa se tako v absolutnem, še bolj pa v relativnem smislu, pojavljajo redkeje (slika 7c). Slednje ne pomeni, da so na zahodu države poletni nalivi manj pogosti ali manj intenzivni kot na vzhodu, temveč da na zahodu praviloma ne dosežejo take intenzivnosti in količine padavin, kot jih tam lahko dosežejo jesenski nalivi. Po drugi strani so na vzhodu države jesenski nalivi bistveno manj izdatni in intenzivni kot na

zahodu, zaradi česar pridejo na vzhodu poletni nalivi bolj do izraza in so tudi odgovorni za večje število hudourniških poplav.

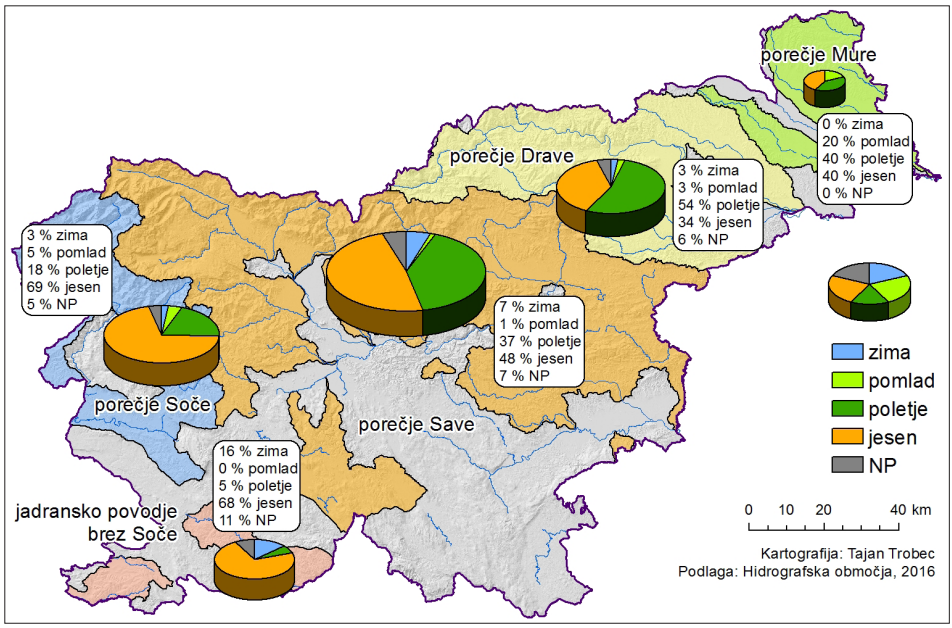
Slika 7: Razporeditev in število hudourniških poplav znotraj posameznega meteorološkega letnega časa po hidrografskih območjih 4. reda v Sloveniji za obdobje 1550–2015.



Vir: lastna raziskava.

Slovenijo lahko glede na meteorološki letni čas, v katerem se pojavlja največ hudourniških poplav, na ravni hidrografskih območij 1. reda razdelimo na dva dela. V osrednjem in zahodnem delu, ki obsega jadransko povodje in porečje Save, se največ hudourniških poplav pojavlja v času meteorološke jeseni. V vzhodnem delu, ki obsega porečji Drave in Mure, pa se jih največ pojavlja v času meteorološkega poletja (slika 8). Evidentirane hudourniške poplave v porečju Mure sicer izkazujejo medsebojno izenačenost meteorološkega poletja in meteorološke jeseni, a zaradi majhnega števila poplav (5) statistična analiza ni upravičena. Glede na stopnjevanje celinskih podnebnih vplivov proti vzhodu Slovenije (Ogrin, 1996; 2002) sklepamo, da je na daljši rok v porečju Mure dejanski letni čas z največ hudourniškimi poplavami meteorološko poletje.

Slika 8: Razporeditev hudourniških poplav glede na meteorološki letni čas pojavljanja po hidrografskih območjih 1. reda v Sloveniji za obdobje 1550–2015.



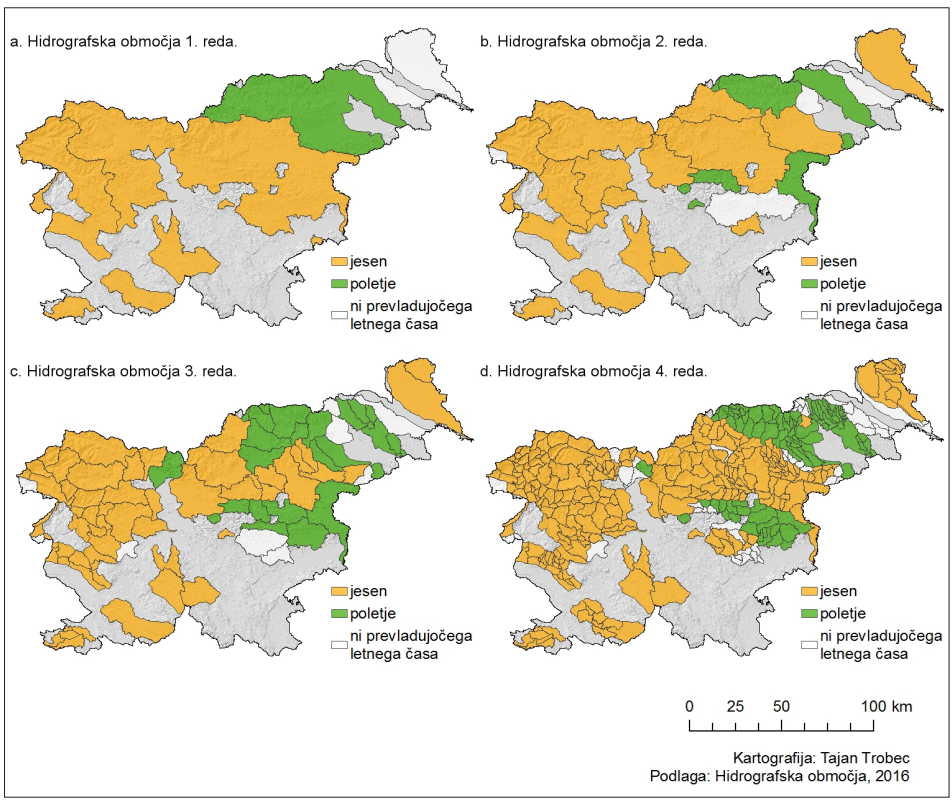
Vir: lastna raziskava.

Prevlada jesenskih hudourniških poplav nad poplavami v preostalem delu leta je najbolj očitna na območju jadranskega povodja. V porečju Soče s pritoki se je v tem letnem času pojavilo 69 % hudourniških poplav, v porečjih preostalih vodotokov jadranskega povodja pa 68 % (slika 9a). Na drugi strani je prevlada poletnih hudourniških poplav nad jesenskimi nekoliko manj izrazita, a s 54 % še vedno očitno izražena v porečju Drave. Porečje Save v podnebnem smislu predstavlja prehodno območje. Zaradi njegove lege in obsežnosti se tako odražajo celinski podnebni vplivi z vzhoda ter sredozemski podnebni vplivi z zahoda. Posledično sta, kljub še vedno rahli prevladi jesenskih hudourniških poplav (48 %) nad poletnimi (37 %), oba meteorološka letna časa precej izenačena.

Na ravni hidrografskih območij 2. reda (slika 9b) je moč razbrati, da v večjem delu države (predvsem v alpski, obsredozemski in dinarskokraški Sloveniji ter v zahodnem predalpskem hribovju) bolj ali manj izrazito prevladujejo jesenske hudourniške poplave. Na preostalih območjih, ki deloma obsegajo obpanonska gričevja, dele Posavskega hribovja in Pohorje, prevladujejo poletne hudourniške poplave, ali pa si meteorološko poletje in meteorološka jesen vlogo vodilnega letnega časa delita. Poletne hudourniške poplave na ravni hidrografskih območij 2. reda prevladujejo le v porečjih Pesnice, Rogatnice, Sotle, na nekaterih hudournikih v Zasavju ter v porečjih hudourniških pritokov Drave med Dravogradom in Mariborom.

Ob nadaljnjem drobljenju hidrografskih območij na ravni 3. reda izstopijo še nekatera porečja s prevlado poletnih hudourniških poplav (slika 9c). Na Pohorju so to porečja Polskave in Ložnice (pritoka Dravinje) ter Pake in Mislinje. V Posavskem hribovju pa izstopajo porečja številnih manjših hudourniških vodotokov (Gračnica, Rečica, Lahomnica, Sevnična, Blanščica, Brestanica idr.), ki odmakajo predvsem osrednji del hribovja. Med porečja, kjer se večina hudourniških poplav pojavlja v času meteorološkega poletja, se predvsem zaradi nekaj manjših, lokalnih poletnih poplav (Jesenovec, 1995; Pavšek, 1995), presenetljivo uvršča tudi porečje Kokre. Razporeditev hudourniških poplav preko leta na ravni hidrografskih območij 4. reda (slika 9d) je podobna razporeditvi na ravni hidrografskih območij 3. reda, a so med njima zaradi prepletanja različno obsežnih poletnih in jesenskih hudourniških poplav vseeno določene razlike. Pri hidrografskih območjih 4. reda izmed območij, kjer prevladujejo poletne hudourniške poplave, tako izpadeta porečji Mislinje in Pake ter zgornji del porečja Sotle.

Slika 9: Razporeditev in delež hudourniških poplav znotraj posameznega meteorološkega letnega časa po hidrografskih območjih 1. reda v Sloveniji za obdobje 1550–2015.



Vir: lastna raziskava.

Opisano prostorsko razporeditev hudourniških poplav med posameznimi meteorološkimi letnimi časi je moč pojasniti s prepletanjem različnih podnebnih vplivov. Območja s prevladujočimi jesenskimi hudourniškimi poplavami v veliki meri sovpadajo z območji, za katera so značilne orografske padavine. Slednje so običajno najmočnejše ravno ob prehodu front in ciklonov v času meteorološke jeseni, ko lahko privedejo tudi do hudourniških poplav. Orografske padavine pridejo najbolj do izraza ob jugozahodnih vetrovih v hribovitem delu zahodne in jugozahodne Slovenije. Proti severovzhodu njihov vpliv postopno slabi, a lahko seže vse do vzhodnih Karavank in Pohorja (Pristov, 1982; Vrhovec, 2002; Ogrin, 2008). Do tja pa, kot je razvidno s kartografskega prikaza na ravni hidrografskih območij 3. in 4. reda (sliki 9c in 9d), sežejo tudi območja s prevlado jesenskih hudourniških poplav. V vzhodnem delu države so zaradi celinskih podnebnih vplivov v primerjavi z jesenskimi frontalnimi in ciklonalnimi padavinami bolj izražene poletne konvektivno pogojene padavine, ki jih v pregretem ozračju običajno izzove prehod hladne fronte ali višinski ciklon (Petkovšek, Trontelj, 1996). Posledično v tem delu države poletne hudourniške poplave marsikje prevladujejo nad jesenskimi, ali pa so vsaj enako pogoste.

Zaradi precejšnje uravnoteženosti med jesenskimi in poletnimi hudourniških poplavami v Sloveniji (Trobec, 2015) bi pričakovali, da bodo tudi območja s prevlado enega oziroma drugega meteorološkega letnega časa zasedala približno enak prostorski obseg. Namesto tega se na vseh ravneh hidrografskih območij kaže občutno večja površina območij s prevladujočimi jesenskimi hudourniškimi poplavami. Razlog za nesorazmerno večjo zastopanost območij s prevladujočimi jesenskimi hudourniškimi poplavami je v tem, da so te v povprečju obsežnejše od poletnih. Večina poletnih hudourniških poplav je namreč povezanih z lokalnimi nalivi, ki povzročijo tudi lokalno omejene poplave. Na drugi strani so jesenske hudourniške poplave običajno posledica izrazitih frontalnih motenj, ob katerih se padavine razporedijo na širšem območju in tako povzročijo tudi obsežnejše poplave. Manj obsežne poletne hudourniške poplave so torej v povprečju ponazorjene z manjšim številom hidrografskih območij, kar se odraža tudi v njihovi manjši zastopanosti v prostorskem smislu na ravni hidrografskih območij različnih redov.

5 SKLEP

V Sloveniji se hudourniške poplave pojavljajo v vzpetem svetu, ki obsega skoraj celoten alpski svet, večji del predalpskega sveta, gričevja v obsredozemski in obpanonski Sloveniji ter porečja posameznih hudourniških vodotokov dinarskokraškega sveta. Na preostalih območjih se hudourniške poplave bodisi ne pojavljajo ali pa se namesto njih pojavljajo drugi tipi poplav. Na ravni hidrografskih območij 1. reda je največ hudourniških poplav (60 %) v preučevanem obdobju 1550–2015 prizadelo porečje Save. V Posočju in Podravju se je pojavila približno tretjina poplav. Na območje jadranskega povodja brez Soče je odpadlo 15 %, na Pomurje pa le 4 % hudourniških poplav. Na ravni hidrografskih območij nižjih redov so bile hudourniške poplave najbolj pogoste v porečju Savinje (33), še posebej v Zgornji Savinjski dolini z Zadrečko dolino (16). Porečju Savinje po številu hudourniških poplav sledi porečje Sore (26), kjer so bile poplave najbolj pogoste ob

Poljanski Sori s pritoki (21). Zelo pogoste so bile hudourniške poplave v porečju Save do vključno sotočja s Kokro (23), kjer jih je največ odpadlo na Savo Dolinko s pritoki (14). Porečja, kjer se hudourniške poplave pojavljajo najpogosteje, zajemajo razmeroma sklenjeno območje gorate in hribovite severne Slovenije, ki vključuje alpski ter večji del predalpskega sveta.

Hudourniške poplave v času meteorološke zime in pomladi so pri nas redke in se pojavljajo na majhnem območju. Za razliko od njih se jesenske hudourniške poplave pojavljajo v pretežnem delu države. Pogoste so v goratem in hribovitem svetu ter na zahodu države, na vzhodu pa jih je manj. V času meteorološkega poletja se hudourniške poplave pojavljajo predvsem na vzhodu države, na zahodu pa redkeje. V večjem delu države tako bolj ali manj izrazito prevladujejo jesenske hudourniške poplave. Ta območja se v veliki meri ujemajo z območji, za katera so značilne orografske padavine. V vzhodnem delu države (obpanonska gričevja, del Posavskega hribovja ter Pohorje) pa bodisi prevladujejo poletne hudourniške poplave, ali pa sta si meteorološko poletje in meteorološka jesen po številu hudourniških poplav enakovredna. Večji delež poletnih hudourniških poplav na teh območjih pogojujejo predvsem poletne konvektivno pogojene padavine.

Izsledki izvedenih prostorsko-časovnih analiz hudourniško-poplavnega dogajanja lahko predstavljajo strokovno podlago za preventivno ukrepanje na posameznih območjih oziroma v posameznih porečjih Slovenije. V skladu s spoznanji prognostične geografije (Radinja, 1983) namreč lahko pričakujemo, da se bodo hudourniške poplave tudi v prihodnje pojavljale na območjih, kjer so se pojavljale že do sedaj, in sicer s podobno prostorsko-časovno dinamiko. Prispevek predstavlja tudi podlago za preučevanje morebitnih sprememb v prihodnji dinamiki hudourniškega poplavljanja, ki jih bodo glede na predvidevanja klimatskih modelov krojile podnebne spremembe.

Literatura in viri

Glej angleško različico prispevka.

SPATIO-TEMPORAL DISTRIBUTION OF FLASH FLOODS IN SLOVENIA

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Abstract
This paper examines the spatial distribution of frequency of flash floods along with their seasonal distribution. The spatio-temporal analysis of past flash flooding covered 124 flash floods affecting areas of Slovenia between 1550 and 2015. Flash floods are most common in the mountainous and hilly area of northern Slovenia, which consists of alpine and a large part of subalpine landscapes. Autumnal flash floods occur across most of the country, while summer flash floods are seen mainly in the east. In most parts of the country autumnal flash floods predominate.

Keywords: natural disasters, hydrogeography, prognostic geography, flash floods, river catchments, hydrographic area, Slovenia

1 INTRODUCTION

Slovenia experiences riverine, karst and flash floods (Natek, 2005). Because of the various combinations of hydrogeographic factors underpinning runoff (such as land cover, soil, bedrock, and relief) in water catchment areas of watercourses, individual types of floods generally occur in certain areas only. Flash floods in Slovenia occur along most watercourses (Brilly, Mikoš, Šraj, 1999). They can present in the form of destructive raging of extreme volumes of water in large or small torrent channels and ravines, as well as debris and mud flows on alluvial fans and floodplains (Gams, 1991).

On average, 1.3 flash floods occur annually in Slovenia (Trobec, 2015), although in individual basins they occur with varying frequency, as is evident from the regional overview of flooding (Komac, Natek, Zorn, 2008). Due to specific seasonal weather patterns that lead to the formation of heavy and intense precipitation (Furlan, 1961; Pristov, 1982; Petkovšek, Trontelj, 1996; Vrhovec, 2002; Ogrin, 2008) and consequent flash floods, in Slovenia these occur mainly between June and November (during meteorological summer and autumn; Trobec, 2015). Also in terms of the seasonal distribution of floods, there

are significant differences between different river catchments in various areas of Slovenia as a result of different climatic characteristics (Ogrin, 1996; 2002). Regional differences in the frequency and seasonal distribution of flash floods with flash flooding occurring only in certain areas is also characteristic of other countries in the Alpine arc (Merz, Blöschl, 2003; Parajka et al., 2010).

The concept of modern flood protection involves various levers for managing flood risks, including increasingly important preventive actions focusing on flood forecasting and raising awareness of the population about flood risks (Direktiva, 2007). Knowing the areas where flash flooding occurs can significantly contribute to raising the awareness of the population about flood risks in these areas. Namely, it is very likely that areas that were previously affected by floods will again experience flooding in the future. Given the prognostic geographic assumption that flooding in specific areas is normal and indicative of the natural geographical characteristics of the local terrain (Radinja, 1983; Šifrer, 1983; Natek, 1992; 2002; 2003; 2007), it is possible to deduce from past flash floods the spatial patterns and dynamics of future flash flooding. The latter already represents a step toward predicting floods.

The purpose of this paper is to determine in which areas flash floods occur and attempt to reconstruct past flash flooding events on the basis of spatio-temporal analysis of 124 flash floods that affected Slovenia between 1550 and 2015. It presents the spatial distribution of flash floods in Slovenia with reference to their frequency and seasonal distribution - both at the level of hydrographic areas of different orders (Hidrografska območja, 2016).

2 METHODS

Data used to perform the spatio-temporal analysis of flash flood events in Slovenia were obtained from various records, descriptions and previous studies of flash floods. Thus, we included only those floods for which it was possible to discern, or at least indirectly infer that they would be classed as flash floods. As karst and lowland floods were not the object of our research, we excluded them from the analysis, despite the fact that the latter occasionally followed flash flooding, albeit with a lag, particularly following extended autumnal rainfalls. Since the analysis performed also incorporated a spatial component, the analysis only included those floods for which we were able to determine the approximate extent of flooding.

Data on earlier floods were mainly gathered from secondary sources (Kolbezen, 1991; 1992; 1993; 1994; 1995; Jesenovec, 1995; Trontelj, 1997). Primary sources (public media, records of provincial administrative bodies, archival records of daily newspapers, chronicles, archives of the Hydrometeorological Institute of the Republic of Slovenia - nowadays ARSO, etc.) which were referenced by the mentioned sources have not been listed. For floods, which occurred in recent decades, we also relied on primary sources, particularly on certain contributions to scientific and professional journals and anthologies, such as Geografski vestnik (Geographical Bulletin), Geografski zbornik (Journal of Geography), Ujma (Magazine on the protection against natural and other disasters), Mišič Water Day (forum and newsletter), and others, as well as on various reports and publications from the ARSO website (Analize izrednih ..., 2016).

During less severe floods, which occurred in connection with short duration precipitation (usually in the warmer part of the year when precipitation is induced or enhanced by convection) there was a shorter time lag between precipitation and consequent flooding. Therefore, we were able to attribute individual floods to the exact day when they actually occurred. In contrast, when it comes to flooding that occurred as a result of slow travelling large frontal or cyclonic systems causing prolonged precipitation with different and varying local intensity (usually in the colder part of the year), several individual floods were considered as a single flood event, despite them occurring on different days and/or in different river catchments, and they were all attributed to the day when, in view of the current synoptic situation, flooding was most severe. In this way, we increased the accuracy of the database, as individual scattered flooding was linked to a common cause, i.e. precipitation as part of the broader precipitation system.

For each flood, we determined the approximate extent of flooding. In doing so, we did not limit our attention solely to the narrow floodplain areas along watercourses, but rather we actually examined entire river catchments (areas with small headwater streams, ravines, tributaries and alluvial fans), from where flood waters drain into river beds. In choosing the spatial unit to illustrate floods we relied on ARSO's data layer "Hydrographic areas" (Hidrografska območja, 2016), which divides Slovenia into four hierarchically arranged orders (Figure 1). The first, highest, order demarcates Slovenia into six main hydrographic areas that coincide with the river basins of major Slovenian rivers (Sava, Drava, Mura, Soča, and Kolpa). The Adriatic drainage basin (excluding the Soča

Figure 1: Different orders of hydrographic areas in Slovenia.

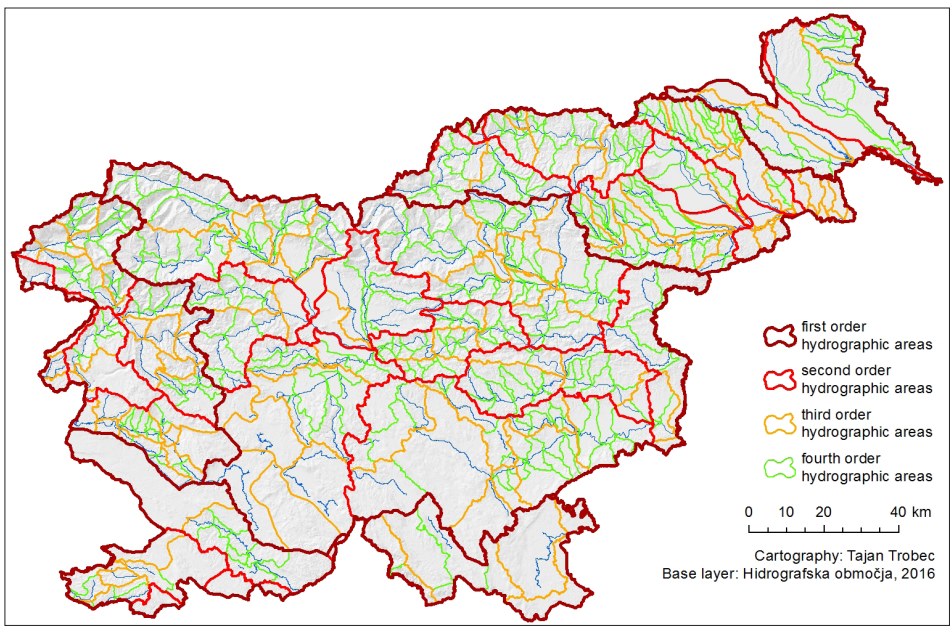
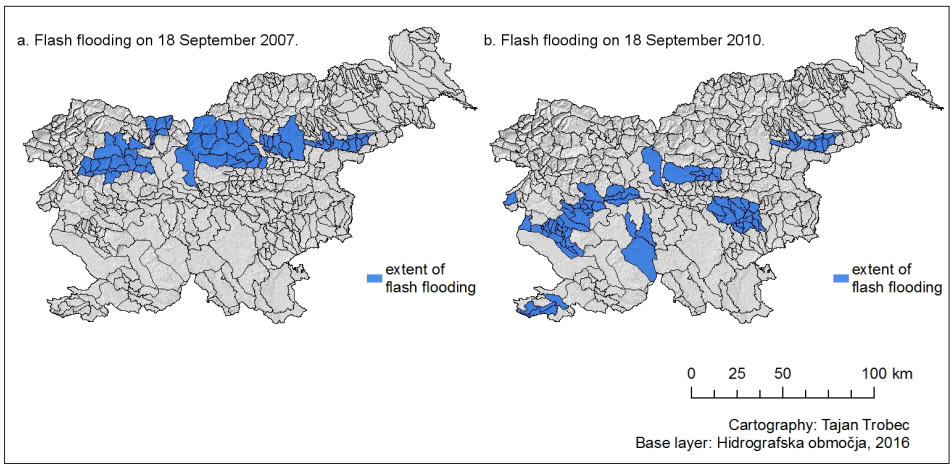


Figure 2: Determining the extent of flash flooding according to hydrographic areas for floods in September of 2007 (a) and 2010 (b).



Source: Kobold, 2008; 2011; Polajnar, 2008; 2011; Večje nesreče …, 2008; Kuzmič et al., 2010; Sodnik, Mikoš, 2010; Poplave in zemeljski plazovi med …, 2011; Hidrografska območja, 2016.

River) is also included at this level. In the second order, there are 31 hydrographic areas, whilst there are 155 and 582 third and fourth order areas, respectively. Hydrographic areas of the fourth order form the basic territorial units of ARSO's data layer. Their average size is about 35 km^2 (in the Karst and on plains they are substantially larger, whereas in normal fluvial reliefs as well as in steeper terrain areas they are much smaller). Their borders conform to hydrographic watersheds of catchments and their parts. Depending on the extent of the area affected, each flash flood was depicted according to the corresponding hydrographic areas (Figure 2).

In general, more recent floods (since around the end of the 1980s) are rather well and relatively accurately documented in the literature, which also meant that we did not have any major problems illustrating their reach. Determining the extent of some older, less well documented floods was more difficult. Due to a lack of information about the extent of flooding, occasionally we were forced to make a compromise in illustrating their spatial reach and depicted them at higher order hydrographic areas. Because of this there is a risk that we also included areas that were actually unaffected, or else overlooked some flood affected areas. We could sometimes fill in the gaps where sources were lacking by examining experiences garnered from other documented floods in these areas. In this regard, we were greatly assisted by detailed geographical studies and their findings on floods and flood-prone areas in Slovenia, which were conducted between 1972 and 1985 as part of the "Geography of flood areas in Slovenia" project (Radinja et al., 1974). Occasionally we were also supported in determining the extent of flooding indirectly through examination of data on peak flows in Slovenian rivers (Arhivski …, 2016).

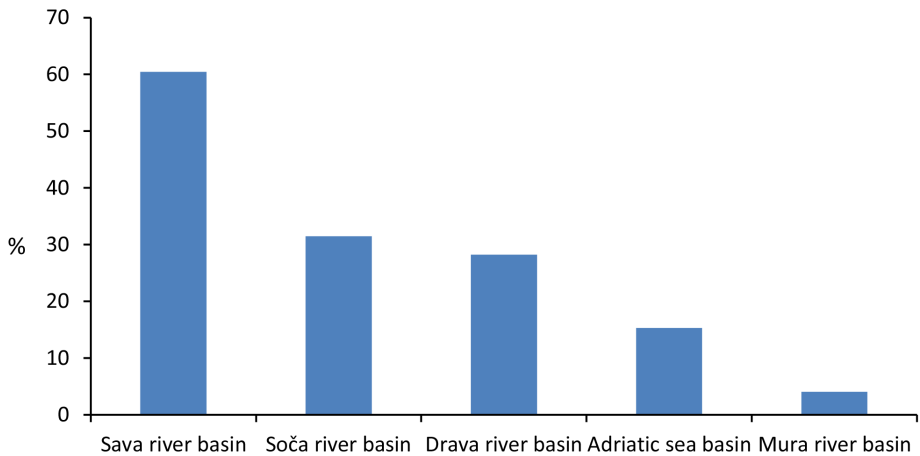
We performed spatio-temporal analysis of flash flood events in Slovenia for the period 1550 to 2015. The analysis did not include all of the 138 flash floods that were documented in the literature for this period. Namely, for some of them it was not possible to determine the general extent of flooding or otherwise we did not have records of the month of the event, both of which were key data for performing further analysis. Thus, spatial analysis of the frequency of flash floods was carried out on a sample of 124 floods where the general extent of flooding was known. Furthermore, spatial analysis of seasonal distribution of flash flooding was conducted on a subsample of 116 floods, for which it was additionally known in which month the event had occurred. The latter were classed by meteorological seasons in which they occurred. Meteorological seasons are named after astronomical (common) seasons, but they do not correspond to them in terms of when they begin and end. Rather, they cover discrete three-month periods. Meteorological winter represents the period between December and February, meteorological spring between March and May, meteorological summer between June and August and meteorological autumn between September and November. We decided to use meteorological seasons because, in contrast to astronomical seasons, they significantly better coincide with typical seasonal synoptic weather conditions that may lead to the formation of heavy and intense rainfall and subsequent flash flooding (Trobec, 2015).

3 SPATIAL DISTRIBUTION OF FLASH FLOODS BASED ON THEIR FREQUENCY

The overview map of flash flooding areas in Slovenia (Figure 5a) clearly depicts that such events occur in steeper terrain, encompassing virtually all of the Alpine areas (Julian and Kamnik-Savinja Alps and Karavanke Mountains), a large part of subalpine landscapes (Idrija, Cerkno, Škofja Loka, Polhov Gradec and Posavje Hills, Upper Savinja Valley, Pohorje and Kozjak), as well as the hills of Mediterranean (Brkini, the Koper Hills, the slopes of the Vipava Valley and Goriška Brda) and Pannonian Slovenia (Krško, Bizeljsko, Sotelsko, Voglajna, Ložnica and Hudinja hills, Dravinjske Gorice, Slovenske Gorice, Haloze and Goričko). Flash floods also occurred in individual catchments within Dinaric landscapes, for example, alongside Iška, Borovniščica, Cerkniščica, (Sodraška) Bistrica and (Podboška) Sušica. History tells us that in other Dinaric landscapes and in the Karst area flash flooding does not occur. These areas are characterised by a permeable bedrock and predominantly karst landscape with underground water flows. This also explains why in many places an interconnected network of surface watercourses is not even formed, which is one of the significant factors associated with flash flooding. In valleys and plains of Dinaric landscapes retention of excess amounts of water in the karst underground results not in flash flooding but rather karst flood events (Natek, 2005). Flash flooding also does not occur in certain expansive plains beside major rivers (Ljubljana and Krka basins, Drava and Mura plains). Since these rivers have relatively large water catchment areas, they typically do not see flash flooding, though in exposed areas they do experience riverine flooding (Natek, 2005).

Examining first order hydrographic areas, a majority (75 or 60%) of the 124 floods affected the Sava River Basin (Figures 3 and 5b). This is not surprising since the Sava River Basin is the largest and covers 53% of Slovenian territory. It also happens to include the largest proportion of areas susceptible, based on natural geographical conditions, to extreme flows and flash flooding. Less than one third of flash floods affected the Posočje and Podravje areas (39 and 35, respectively). 15% or 19 flash floods occurred in the Adriatic drainage basin, excluding the Soča River. The Pomurje area experienced the least number of flash floods (5 or 4%). On the one hand this is a result of specific natural geographical conditions (a relatively small drop in river catchments, low gradients of watercourses with a drainage regime into various smaller river systems, less intense precipitation), which reduce susceptibility to flash flooding. On the other hand, Mura catchment area represents only a relatively small portion of Slovenian territory. The sum of noted percentages exceeds 100 since 37 flash floods (30%) occurred simultaneously in two or more first order hydrographic areas.

Figure 3: Percentage of flash floods by first order hydrographic areas in Slovenia between 1550 and 2015.

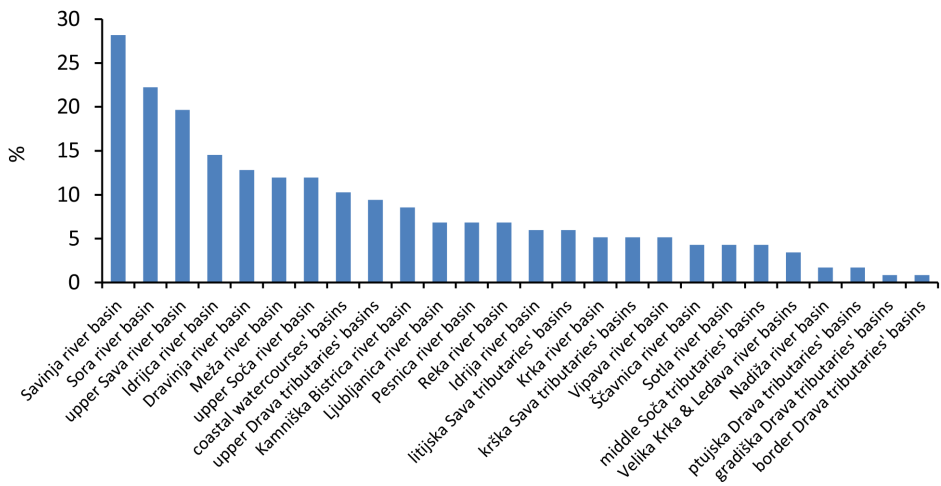


Source: Own survey.

Cartographic presentations of flooding by lower order hydrographic areas (Figures 5c, 5d, and 5e) provide a more detailed perspective on the frequency of flash flooding in smaller catchments. At the level of second order hydrographic areas the highest number of flash floods occurred in the Savinja River catchment (33), followed by the Sora River catchment (26), and the upper part of the Sava River catchment (23), the latter including Sava Bohinjka and Sava Dolinka as well as Tržiška Bistrica and Kokra rivers (Figure 5c). The Savinja catchment and the upper part of the Sava catchment are significantly larger compared to other second order hydrographic areas where flash

flooding occurs. Consequently, the two areas by their very nature have experienced rather more flooding, with floods having occurred in different parts of their catchments. Other second order hydrographic areas of note include (by frequency of flash floods): catchment areas of the Idrijca River (17), Dravinja River (15), Meža and Mislinja rivers along with the upper part of the Soča River catchment area (14), the drainage area of coastal watercourses (12), the catchment areas covering torrents into the Drava River between Dravograd and Maribor (11), and the Kamniška Bistrica River catchment (10). Catchment areas where flash floods most often occur thus encompass a relatively contiguous mountainous and hilly area of northern Slovenia, consisting of alpine and large swathes of subalpine landscapes. Part of Slovenian Istria also ranks among the areas with frequent flash floods; partly because of natural geographical conditions, partly because of the perceived threat to the Sečovlje salt pans, and, above all, on account of very detailed records, stretching far back, of flooding in the Dragonja River catchment (Zorn, 2008; Orožen Adamič, 1980).

Figure 4: Percentage of flash floods by second order hydrographic areas in Slovenia between 1550 and 2015.



Source: Own survey.

An even more detailed perspective of flash flooding frequency is revealed looking at third order hydrographic areas (Figure 5d), with the highest number of documented floods having occurred in catchments of the Poljanska Sora River (21), the Savinja River above the confluence with Paka River (16), and the Sava Dolinka River (14). Furthermore, 10 or more flash floods affected the catchments of Selška Sora (13), Dragonja (12),

Mislinja, Voglajna with Hudinja and Dravinja (11), Kamniška Bistrica with Rača, Pšata and Koritnica (10) rivers. A relatively high number of floods also occurred in catchments of the following rivers: Bolska (9), headwaters of Idrijca (8) and Soča (8), Ložnica with its tributaries (8) and Reka (8). Seven flash floods were recorded in catchments of Bača, Paka, Reka in the Goriška Brda area and Meža River above the confluence with Mislinja. There are no surprises amongst the listed river catchments, since basically all of them are considered well-known flash flooding areas (Jesenovec, 1995; Komac, Natek, Zorn, 2008). Other catchments in third order hydrographic areas recorded smaller numbers of flash floods.

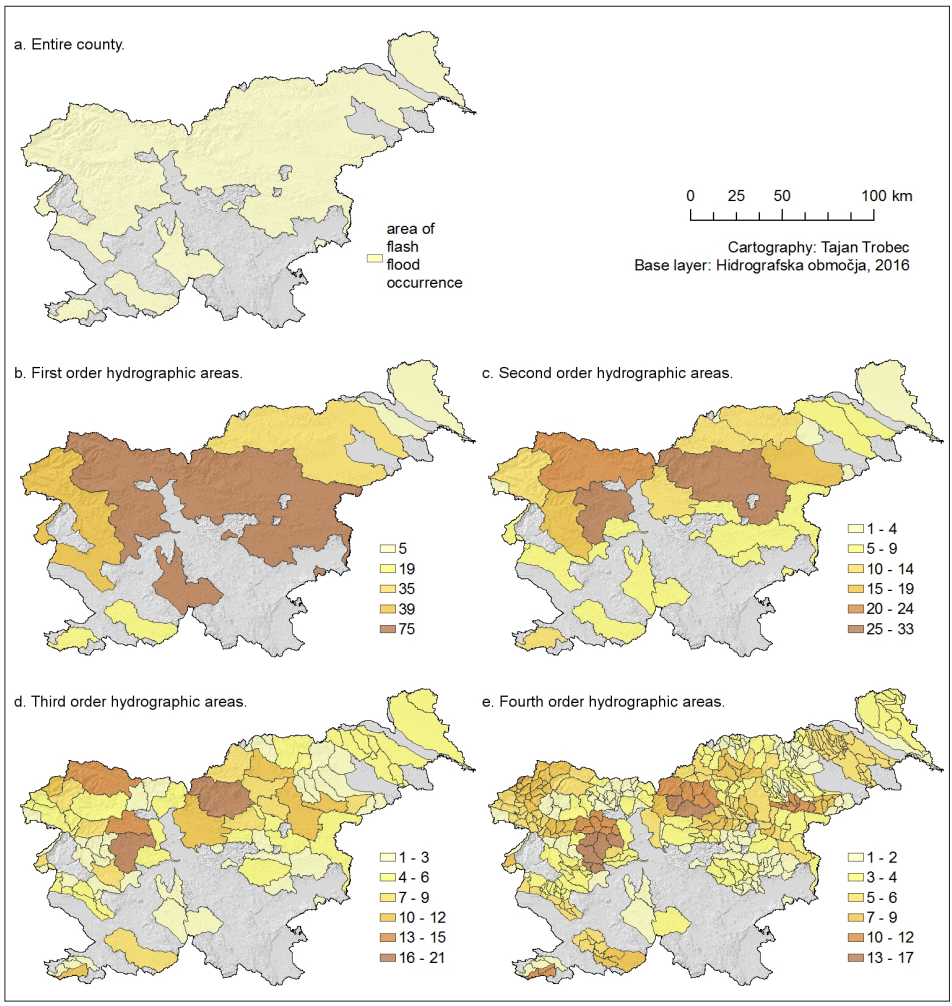
In terms of fourth order hydrographic areas that had experienced large numbers of flash floods the Poljanska Valley and Upper Savinja Valley together with the Zadrečka Valley stand out (Figure 5e). Along the Poljanska Sora River and its tributaries there were between 14 and 17 flash floods, and along the Savinja River in the Upper Savinja Valley with its tributaries between 11 and 15. These catchments are well known flood areas, that have already been examined in detail (Orožen Adamič, Kolbezen, 1984; Meze, 1978; Kladnik, 1991). In addition to natural geographical characteristics that increase their susceptibility to violent runoff and flash flooding, it is people who are largely responsible for the damage to the built environment during high waters. Along the Sora River there is a relatively narrow valley floor that is densely populated and criss-crossed with roads and industry buildings in certain areas (Komac, Natek, Zorn, 2008). As a result, the damage during high water times is substantially greater than what it would be if appropriate adjustments were made. Along the Dreta River flood risk is further increased because of the abandonment of many mills and sawmills, destruction of obsolete dams and subsequent filling of the river bed with gravel, as well as due to construction and infrastructure expanding into flood areas (Meze, 1978; Kladnik, 1991).

For reasons already mentioned hydrographic areas in Dragonja River catchment stand out with twelve flash floods. With eleven or ten floods follow the Selška Sora catchment, the central part of the Dravinja catchment area, the Predelica catchment (the right tributary of Koritnica) as well as Celje and surroundings. The Selška Sora River and its tributaries are known for their torrential flows, which in recent times, but also in the more distant past, quite often resulted in flash flooding of varying dimensions (Klabus, 2007; Komac, Natek, Zorn, 2008). The area along the middle reaches of the Dravinja River is Slovenia's second largest flood area due to the particular geographic formation of the valley floor (Natek, 2005). It typically experiences very frequent and substantial overflows of flood waters, which are attributed to the sharp decline in the gradient of the Dravinja and its tributaries seen as the Pohorje merges with the Dravinjske Gorice area (Šifrer, 1978). Predelica ranks so high in the number of flash floods also on account of debris flows, which occurred in the valley in 1891 (Zorn, Komac, 2002) and 2000 (Komac, 2001). Celje with its surroundings is a high risk area for flooding, due to its location on a floodplain at the confluence of three torrent watercourses, namely the Savinja, Voglajna and Hudinja rivers (Radinja, 1993). Thus, it is not surprising that it was so often flooded in the past.

There were nine flash floods alongside the Sava Dolinka and its torrents between Kranjska Gora and Mojstrana (Hladnik, Belca, etc.) as well as in the Suhodolnica

catchment (left tributary of Mislinja). Eight flash floods affected areas along the main rivers or torrent tributaries of the Koritnica and Soča, as well as Reka rivers. Seven or eight flash floods affected areas along main watercourses or headwater torrents of the Sava Dolinka, Kamniška Bistrica above the confluence with Nevljica, Bolska and Mislinja rivers. There were also seven flash floods in the catchments of Bača and alongside (Briška) Reka as well as the Nikova torrent which flows into the Idrija River. In other catchments at the level of fourth order hydrographic areas fewer floods occurred.

Figure 5: Distribution and number of flash floods by hydrographic areas of different orders in Slovenia between 1550 and 2015.



Source: Own survey.

Cartographic presentations showing the frequency of flash floods at the level of third and fourth order hydrographic areas also facilitate the detection of differences and disparities between individual regions and smaller catchments. Though direct comparisons between them are somewhat problematic, since in some areas records go a long way back, whereas elsewhere there are only descriptions of much more recent floods. Additionally, flooding in some places was better documented. The fact that documentation of flooding is (especially during more distant times) dependent primarily on the damage flooding causes to the built environment, presents further limitations. Areas can be very susceptible to exceptional runoffs on account of their natural geographic features, but if there is no human activity present, or people had appropriately adjusted to the threat, extreme runoffs and flooding will not be recorded in the literature. Despite described limitations, certain conclusions can be drawn at the level of third and fourth order hydrographic areas, while different questions also arise.

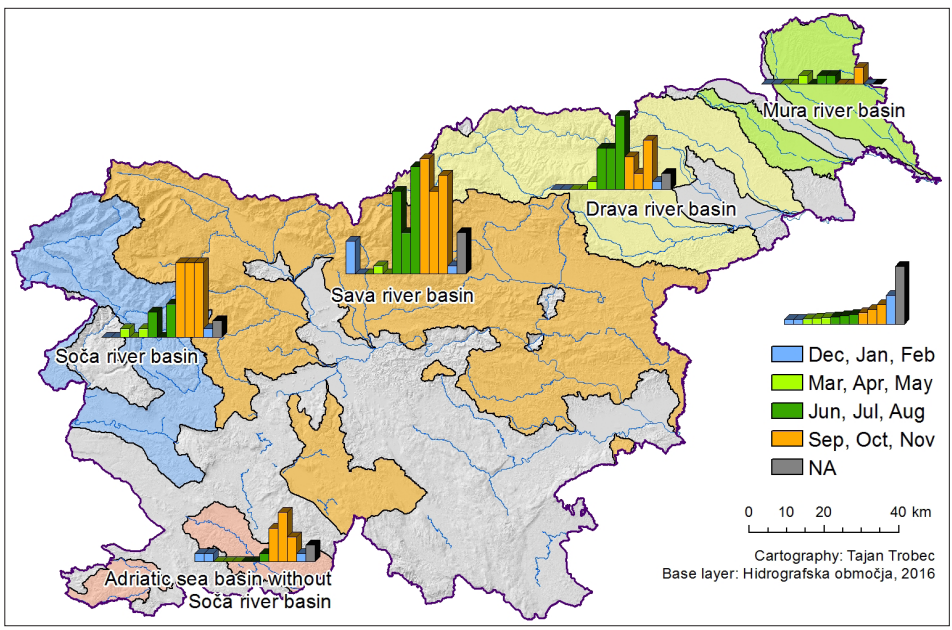
The cartographic presentations of flooding at the level of third and fourth order hydrographic areas (Figures 5d and 5e) show that the highest altitude river catchments in the Alps, in spite of their great susceptibility to extreme runoffs (due to large volumes of intense precipitation, extreme slopes, steep gradients and presence of active erosion areas), in general, do not experience significantly more frequent flash flooding. Most flash floods have actually occurred in certain previously mentioned river catchments in subalpine hills. The main reason for this is the predominance of Alpine karst water catchment areas in the Alps where, even during heavy and intense precipitation, underground water flows continue to dominate, at least partly diminishing large flow peaks. On the other hand, a larger part of the subalpine hills lies on impervious bedrock, which promotes surface runoff and thus increases susceptibility to flash flooding. In addition, the subalpine hills are, compared to mostly remote Alpine valleys, more densely populated, interspersed with infrastructure and thus more vulnerable. That is why flash floods in the subalpine hills rarely remain unnoticed and unaccounted for, whereas, in the Alps, especially in lower order watercourses, this would certainly be more common. Based on documented flash floods, compared to the neighbouring and nearby areas, disproportionately few floods affected the remote and sparsely populated karst headwaters in the Sava Bohinjka as well as Tržiška Bistrica River catchments. The questions are, to what extent is this a consequence of specific natural geographical features, or alternatively, to what degree could it be attributed to the methodological limitations we outlined for this type of study into the frequency of flash flooding.

Catchments or groups of catchments with relatively few flash floods or even no history of them are also found in the subalpine hills. For instance, disproportionately few flash floods have occurred in the area of Kozjak, especially when compared to nearby Slovenske Gorice. So too, the southwestern part of the Posavje Hills has experienced a disproportionately low number of flash floods. Looking at the natural geographical features it is almost unbelievable that there would be noticeably less flooding in Kozjak compared to Slovenske Gorice or Goričko. Similarly, it is also unlikely that flash floods have not affected the southwestern part of the Posavje Hills. Certainly, in both cases this can be, at least partly, attributed to the mentioned methodological limitations arising from insufficient records of flooding in these areas.

4 SPATIAL DISTRIBUTION OF FLASH FLOODS WITH REFERENCE TO THEIR SEASONAL DISTRIBUTION

The map depicting monthly distribution of flash floods at the level of first order hydrographic areas (Figure 6) shows that in the Soča river basin and the rest of the Adriatic drainage basin flash flooding most frequently occurs between September and November. In the Sava and Drava river basins most flash floods occur between June and November. Despite the small overall number of floods in the Mura basin, they also exhibit a seasonal dimension, with flash floods mainly occurring between May and November. Thus, in the watershed of the Adriatic Sea basin most flooding occurs in a relatively narrower period of the year compared to the Black Sea basin. The latter points to different flash flooding regimes in specific areas of the country as a result of different climatic conditions (Ogrin, 1996; 2002).

Figure 6: Distribution of flash floods according to the month of occurrence by first order hydrographic areas in Slovenia between 1550 and 2015.

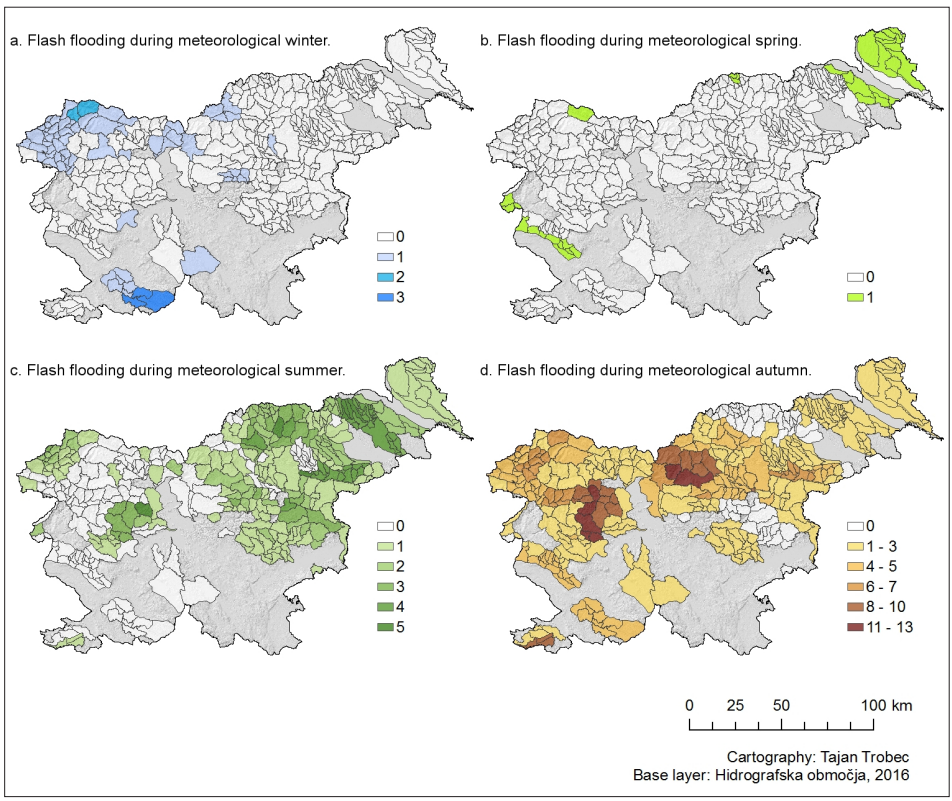


Source: Author's survey.

The map at the level of fourth order hydrographic areas (Figures 7a and 7b) shows that flash floods during meteorological winter and spring are rare in Slovenia and occur in a very small area. The majority of flood events occur during meteorological summer and autumn. Autumnal flash flooding occurs across much of the country, with the exception of areas along torrent tributaries of the Drava River between Dravograd and Maribor and torrent tributaries of the Sava and Savinja rivers in the central part of the Posavje Hills

(Figure 7d). In general, autumnal flash floods are more common in mountainous and hilly landscapes and in the West of the country, whilst to the East there are fewer. Meteorological summer shows a completely different picture. In this period, flash floods occur mainly in the East of the country, whilst in the West, in absolute and even more so in relative terms, they occur less frequently (Figure 7c). This does not mean that summer downpours are less frequent or less intense in the West of the country compared to the East. Rather, in the West, summer precipitation does not reach the intensity and volume of autumnal downpours. On the other hand, in the East of Slovenia autumnal downpours are significantly less torrential and intense than in the West, which makes summer downpours more pronounced there and responsible for a larger number of flash floods.

Figure 7: Distribution and number of flash floods during individual meteorological seasons by fourth order hydrographic areas in Slovenia between 1550 and 2015.

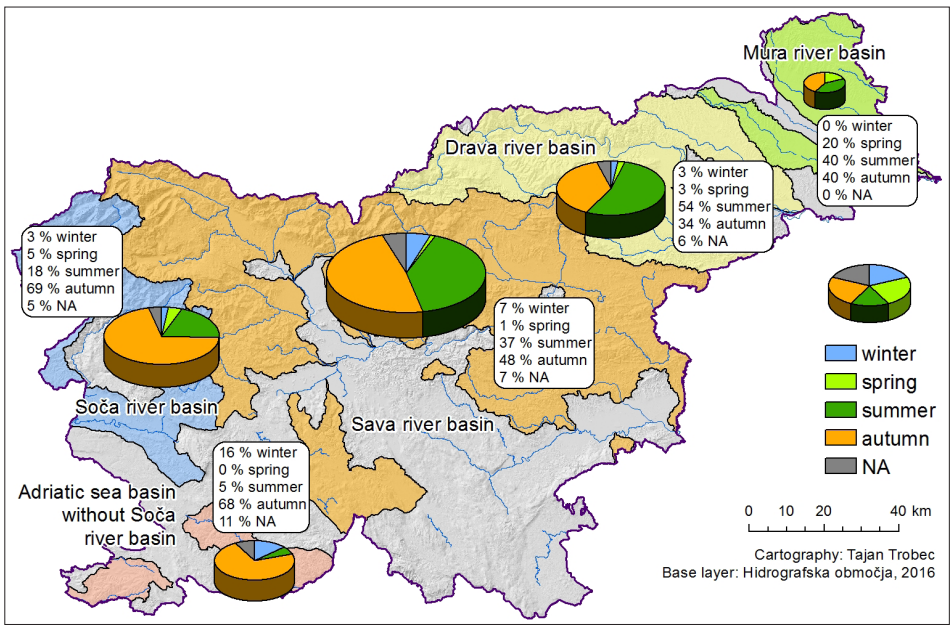


Source: Own survey.

At the level of first order hydrographic areas, Slovenia can be divided into two areas based on the meteorological seasons in which the majority of flash floods occur. In central

and western parts, which encompass the Adriatic drainage basin and the Sava river basin, most flash floods occurred during the meteorological autumn, whereas, in the eastern part, which includes the Drava and Mura river basins, most occurred during the meteorological summer (Figure 8). Although documented flash floods in the Mura river basin were roughly equally frequent during meteorological summer and autumn, a proper statistical analysis was not justified due to the small number of floods (5 floods). Given the intensification of continental climate impacts toward eastern Slovenia (Ogrin, 1996; 2002) we assume that, in the long run, meteorological summer would be the season with the most flash floods in the Mura River basin.

Figure 8: Distribution of flash floods according to the meteorological season of occurrence by first order hydrographic areas in Slovenia between 1550 and 2015.



Source: Own survey.

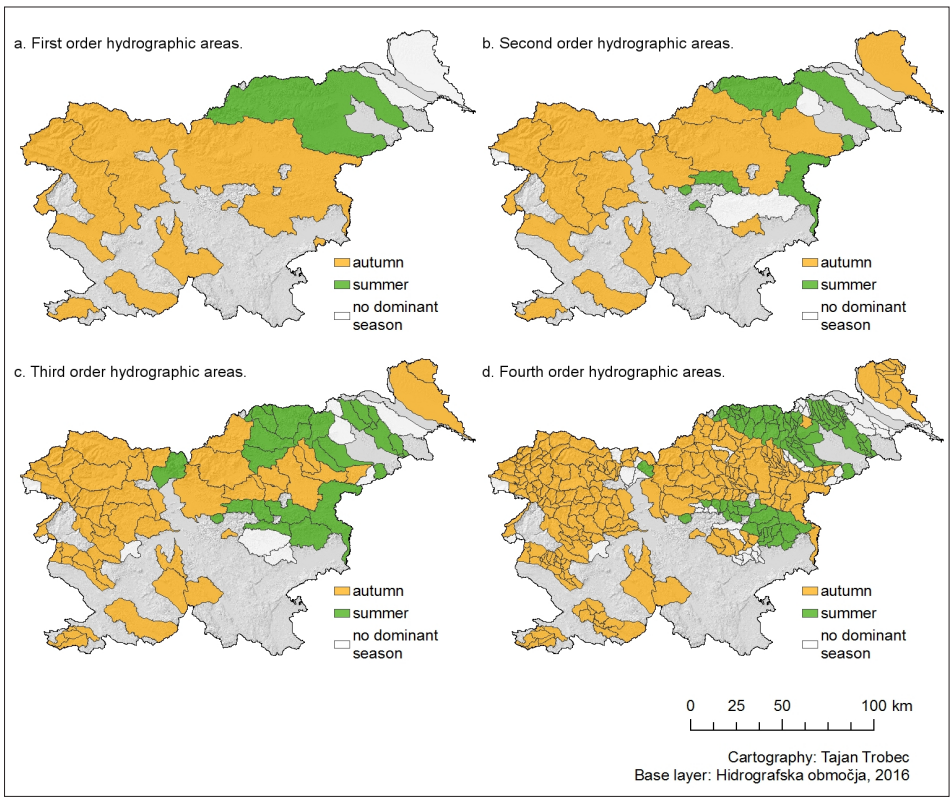
The predominance of autumnal flash floods over flooding in the rest of the year is most obvious in the area of the Adriatic drainage basin. In the catchment of the Soča and its tributaries during this time of the year 69% of flash floods occurred, while in the remaining watercourses of the Adriatic drainage basin the figure was 68% (Figure 9a). On the other hand, the predominance of summer flash floods over autumnal events was clearly evident in the Drava river basin, albeit somewhat less pronounced with 54% of flash floods. In climate terms, the Sava river basin presents a transition area. Due to its location and size, it is affected by both continental climatic influences from the East and Mediterranean climatic influences from the West. Consequently, despite a slight predominance

of autumnal flash flooding events (48%) over summer events (37%), both meteorological seasons are much the same.

On the map of second order hydrographic areas (Figure 9b), it is possible to observe that in most parts of the country (especially in Alpine, Mediterranean and Dinaric Slovenia and in the western Subalpine hills) autumnal flash flooding more or less predominates. In the remaining areas, which partly cover the Pannonian Hills, Posavje Hills and Pohorje, summer flash floods dominate, or else meteorological summer and autumn share a dominant position. At the level of second order hydrographic areas, summer flash floods predominate only in the Pesnica, Rogatnica and Sotla catchments, as well as in some torrents in the wider Zasavje area and in the catchments of torrent tributaries of the Drava River between Dravograd and Maribor.

An even more refined view of hydrographic areas (third order - Figure 9c) reveals some more catchments where summer flash floods predominate. In the area of Pohorje such catchments include the Polskava and Ložnica (tributaries of the Dravinja) as

Figure 9: Distribution and proportion of flash floods during individual meteorological seasons by hydrographic areas of different orders in Slovenia between 1550 and 2015.



Source: Own survey.

well as the Paka and Mislinja. In the Posavje Hills there are also many smaller torrent watercourses (Gračnica, Rečica, Lahomnica, Sevnična, Blanščica, Brestanica, etc.), which mostly drain from central parts of the hills. Surprisingly, the Kokra is also amongst catchments, where most flash flooding occurs during the meteorological summer, mainly due to a few small, local summer floods (Jesenovec, 1995; Pavšek, 1995). The seasonal distribution of flash floods at the level of fourth order hydrographic areas (Figure 9d) is similar to the distribution at the level of third order hydrographic areas. Nevertheless, certain differences exist between the two on account of summer and autumnal flash floods of different scales. For instance, at the level of fourth order hydrographic areas, catchments of Mislinja and Paka rivers as well as the upper part of the Sotla catchment are no longer among the areas where summer flash flooding predominates.

The depicted spatial distributions of flash floods by meteorological seasons can be explained by a combination of different climatic influences. Areas primarily affected by autumn flash flooding largely coincide with areas characterised by orographic precipitation. Such precipitation is usually strongest during the passage of fronts and cyclones in meteorological autumn, and can lead to flash flooding. Orographic precipitation mainly develops when there are south-westerly winds in mountainous and hilly parts of western and south-western Slovenia. Towards the northeast their influence gradually weakens, though it can stretch all the way to the eastern Karavanke Mountains and Pohorje (Pristov, 1982; Vrhovec, 2002; Ogrin, 2008). Areas with dominant autumnal flooding also extend to these places, as evidenced by the cartographic presentations at the level of third and fourth order hydrographic areas (Figure 9c, 9d). Due to continental climatic influences in the eastern part of the country, autumn frontal and cyclonic precipitation is less pronounced compared to summer convective precipitation, whose onset is usually provoked by the passage of cold fronts or upper level lows in an overheated atmosphere (Petkovšek, Trontelj, 1996). Consequently, in many areas of this part of the country summer flash floods occur more commonly than autumnal events, or at least as frequently.

Since there are generally the same number of autumnal and summer flash floods in Slovenia (Trobec, 2015) one might expect that areas dominated by flooding events in one or the other meteorological season would occupy approximately the same spatial footprint. Instead, hydrographic areas at all levels cover significantly larger surface areas where autumnal flash flooding predominates. The reason for the disproportionately greater number of areas where autumnal flash flooding predominates is the fact that on average the floods are larger in extent than those occurring in summer. Most summer flash flooding is associated with local downpours, which also cause localised flooding. On the other hand, flash floods in autumn are usually the result of distinct frontal disturbances, with precipitation spread over a wider area, which in turn causes more extensive flooding. Less extensive summer flash floods therefore cover, on average, a smaller number of hydrographic areas, which is reflected in them being less evident in a spatial sense in hydrographic areas of different orders.

5 CONCLUSIONS

In Slovenia, flash floods occur in steep terrain areas, which encompass virtually all Alpine areas, a large part of subalpine areas, hills in the Mediterranean and Pannonian Slovenia, as well as catchments of certain torrent watercourses in Dinaric landscapes. In the remaining areas, flash floods either do not occur or else they experience alternate types of floods. At the level of first order hydrographic areas most flash floods (60%) occurred in the Sava River basin. Approximately one third of floods occurred in Posočje and Podravje. The Adriatic drainage basin excluding the Soča River accounted for 15% of flash floods, while this figure was only 4% in the Pomurje basin. At the level of lower order hydrographic areas most flash flood events occurred in the Savinja catchment (33), particularly in the Upper Savinja Valley together with the Zadrečka Valley (16). Following Savinja in terms of number of flash floods is the Sora catchment (26), where floods most frequently occurred along the Poljanska Sora River and its tributaries (21). Flash flooding was very common in the Sava river catchment up to and including the confluence of the Kokra River (23), where they most often occurred along the Sava Dolinka River and its tributaries (14). Catchments where flash floods occur most frequently cover a relatively contiguous mountainous and hilly area of northern Slovenia, which includes alpine, as well as a large swathe of subalpine areas.

Flash flooding during meteorological winter and spring is rare in Slovenia and occurs in a small area. In contrast, autumnal flash floods occur across most of the country. They are common in mountainous and hilly areas and in the West of the country, whereas there are fewer in the East. During meteorological summer, flash floods occur mainly in the East, while they are less common in the West. Thus, in a large part of the country flash floods occurred predominantly in autumn, to a greater or lesser extent. These areas largely coincide with areas characterised by orographic precipitation. On the other hand, summer flash floods predominate in the eastern part of the country (Pannonian Hills, part of the Posavje Hills and Pohorje), or else meteorological summer and autumn are equivalent in terms of flash flood numbers. A large share of summer flash floods in these areas are caused, in particular, by summer convective precipitation.

Results of the spatio-temporal analysis of flash flooding events may offer a scientific basis for preventive action in certain areas or individual catchments in Slovenia. In line with findings from prognostic geography (Radinja, 1983) we can likely expect that flash flooding will continue to occur in the areas where it has until now, and furthermore, with similar spatio-temporal dynamics. This paper also represents a starting point for studying possible future changes in dynamics of flash flooding, which will, according to climate model predictions, depend on climate change.

(*Translated into English by James Cosier*)

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PREDLOG KVANTITATIVNEGA MODELA VREDNOTENJA GEODIVERZITETE NA PRIMERU KRASA ZGORNJE PIVKE, SLOVENIJA

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Izvleček
V članku je predstavljena nova metoda vrednotenja geodiverzitete, ki je bila preizkušena na kraškem območju Zgornje Pivke. Metoda temelji na vrednotenju celotnega območja na osnovi prostorske razporejenosti elementov geodiverzitete in razčlenjenosti površja. Razvili smo jo z namenom čimbolj objektivnega in sistematičnega vrednotenja geodiverzitete na nekem območju. V članku smo metodo uporabili na območju Zgornje Pivke, kjer se je izkazala za zelo uporabno.

Ključne besede: geodiverziteta, GIS, varstvo narave, geomorfologija, kras, Zgornja Pivka

1 UVOD

Celotno pestrost narave sestavljata biotski in abiotski del. Prvi primeri vrednotenja pestrosti narave so temeljili na geomorfoloških in geoloških elementih, kar se je odražalo tudi v oblikovanju prvega geološkega rezervata (Siebengebirge v takratni Prusiji; leta 1836) in prvega narodnega parka na svetu (Yellowstone leta 1872) (Gray, 2013). V današnjem času je veliko večja pozornost preučevanja pestrosti narave namenjena preučevanju biotskega dela narave, kar je posledica pretiranega izkoriščanja naravnih virov, posledičnega izumrtja rastlinskih in živalskih vrst ter izgube habitatov (Pettersson, Keskitalo, 2013). Po podpisu Konvencije o biološki raznovrstnosti v Rio de Janeiru leta 1992 se je število raziskav na tem področju skokovito povečalo; vrstile so se študije o vrednotenju, zaščiti in ohranjanju raznovrstnosti žive narave. Slednja se nanaša na gensko (ohranjanje genske raznovrstnosti), vrstno (zmanjšanje upadanja števila vrst) in ekosistemsko raznovrstnost (vzdrževanje in zaščita habitatov) ter ohranjanje povezav med njimi.

Pretiran biocentrični pristop k varovanju narave je vidik nežive narave skoraj v celoti prezrl. Šele v zadnjih dveh desetletjih se je ponovno začel kazati interes za varovanje in vrednotenje neživega dela narave (Gray, 2013; Melelli, 2014). Sodobni termin *geodiverziteta* tako obsega pestrost geoloških (kamnine, minerali, fosili) in geomorfoloških elementov (oblike in procesi) ter prsti. Na ponovno oživitev interesa za vrednotenje nežive narave ne kažejo le strokovni članki in iskanje najustreznejših metod vrednotenja elementov nežive narave. Pojavlja se namreč tudi vse večje zanimanje za t. i. geoturizem, ki temelji na povezavi interpretacije geoloških in geomorfoloških prvin pokrajine in rekreacije (Necheş, 2016), in hkrati se ustanavljajo geoparki, ki so neposredna posledica povečanega zanimanja za nežive elemente narave.

Za potrebe vrednotenja geodiverzitete se je razvila cela množica različnih metod, ki na različne načine vrednotijo geodiverziteto. Vsem metodam je skupno vrednotenje na dveh nivojih: znanstveno vrednotenje in vrednotenje dodanih vrednosti. Znanstveni kriteriji vrednotenja navadno izhajajo iz znanstvenega razumevanja oblike ali procesa, medtem ko dodane vrednosti opredeljujejo uporabnostni in upravljavski potencial (Pereira, Pereira, Caetano Alves, 2007; Reynard, Coratza, 2007; Zouros, 2007; Reynard, 2009; Gray, 2013). Metode vrednotenja se bistveno razlikujejo tudi v načinu zajemanja podatkov o elementih geodiverzitete. Preprostejše metode vrednotijo posamezne točke ali območja, medtem ko modernejše metode obravnavajo celotno obravnavano območje in znotraj njega identificirajo območja višjega indeksa geodiverzitete (Melelli, 2014; Stepišnik, Repe, 2015).

V zadnjem času je opazen velik metodološki napredek pri vrednotenju geodiverzitete, saj je bilo izdelanih mnogo avtomatiziranih, kvantitativnih metod vrednotenja, ki poskušajo čim manj subjektivno oziroma kvalitativno opredeliti vrednosti geodiverzitete za celotna obravnavana območja (Kozłowski, 2004; Benito-Calvo in sod., 2009; Pellitero in sod., 2011; Pereira, Pereira, Caetano Alves, 2007; de Paula Silva, Rodrigues, Pereira, 2014; Melelli, 2014).

Namen tega članka je predstaviti novo delno avtomatizirano kvantitativno metodo vrednotenja geodiverzitete. Postopek vrednotenja v večji meri temelji na analizi digitalnih prostorskih podatkov v geografskih informacijskih sistemih. Večina dosedanjih poskusov vrednotenja pestrosti abiotskega dela narave je temeljila na vrednotenju posameznih točk in/ali sklenjenih območij elementov geodiverzitete, naš predstavljeni model pa obravnava celotno območje raziskave.

Najosnovnejša težava pri vrednotenju geodiverzitete je subjektivni element ocenjevanja, kar je navadno rezultat ohlapno opredeljenih kriterijev vrednotenja ter kompleksnosti izbire posameznih elementov geodiverzitete. Tako so končne vrednosti navadno rezultat lastne presoje ocenjevalca, torej zaznavno subjektivne (Melelli, 2014; Stepišnik, Repe, 2015). Cilj naše metode je, da subjektivni element ocenjevanja v čim večji meri izločimo iz vrednotenja. Edini del postopka, ki vključuje subjektivne elemente, je izbor elementov geodiverzitete. Prav zato je njihova identifikacija čimbolj poenostavljena in omejena le na osnovne elemente, ki jih lahko identificira vsak ocenjevalec z osnovno izobrazbo iz geografije ali geologije.

Poleg elementov geodiverzitete metoda upošteva tudi razčlenjenost površja, ki je prav tako pomemben dejavnik pestrosti nežive narave (Hjort, Luoto, 2010; Ruban, 2010; Gray,

2013; Pereira, Pereira, Caetano Alves, 2007; de Paula Silva, Rodrigues, Pereira, 2014; Melelli, 2014; Stepišnik, Repe, 2015; Necheş, 2016). Pri končnem izračunu indeksa geodiverzitete smo združili tako podatke o lokacijah različnih elementov geodiverzitete kot o razgibanosti reliefa. Metoda določevanja indeksa geodiverzitete temelji na orodju *Block statistics (Statistika blokov)* v programskem paketu *ArcGis*.

Metoda je že bila uspešno uporabljena na paleovulkanskem območju Kratova v Makedoniji (Trenchovska, 2016). V raziskavi smo jo uporabili na območju južnega dela Pivške kotline oziroma Zgornje Pivke, ki je v geomorfološkem in hidrološkem smislu eno najbolj pestrih območij v Sloveniji. Želimo pokazati objektivnost in uporabnost modela tudi v kraškem tipu reliefa.

2 MATERIALI IN METODE

V raziskavi smo za inventarizacijo in vrednotenje geodiverzitete uporabili lidarski digitalni model nadmorskih višin s prostorsko ločljivostjo 1 x 1 m (ARSO, 2015) in digitalno morfografsko karto elementov geodiverzitete. Za prostorske analize in izračun indeksa geodiverzitete smo uporabili Esrijev program *ArcMap*, različico 10.3.1. Vse analize in izračune indeksov smo naredili za osnovno prostorsko enoto v obliki kvadrata z velikostjo 200 x 200 m. Velikost prostorske enote smo prilagodili velikosti celotnega preučevanega območja Zgornje Pivke. Izbran način razdelitve območja omogoča objektivnost pri inventarizaciji, analizi ustvarjenih podatkov in primerjanju končnih vrednosti.

Model inventarizacije in vrednotenja geodiverzitete je sestavljen iz treh glavnih faz. V prvi fazi na podlagi terenskega kartiranja, strokovne literature (Serrano, Ruiz-Flaño, 2007; Gray, 2013), kartografskega gradiva različnih meril (1 : 5.000; 1 : 25.000) in digitalnih ortofoto posnetkov (GURS, 2014) identificiramo ter prostorsko dokumentiramo elemente geodiverzitete. Naš model upošteva geomorfološke in hidrološke elemente geodiverzitete. Na celotnem območju preučevanja smo na terenu na podlagi državne topografske karte v merilu 1 : 25.000 skartirali tri različne vrste geomorfoloških oblik (večje kraške kotanje, zatrepne doline in kopaste vrhove) in tri različne vrste hidroloških oblik (izvire, reke, presihajoča jezera). Oblike smo kasneje digitalizirali in izdelali vektorske sloje posameznih vrst oblik. Od topografskih elementov smo izbrali razgibanost površja, ki smo jo izračunali kot indeks reliefne razgibanosti na osnovi analize lidarskega digitalnega modela nadmorskih višin (Riley, DeGloria, Elliot, 1999). Tako smo v prvi fazi dobili vektorske sloje elementov geodiverzitete in sloj indeksa reliefne razgibanosti, na katerih temelji nadaljnja analiza.

Druga faza modela vključuje inventarizacijo elementov geodiverzitete na prostorsko enoto. Najprej smo vektorske sloje elementov geodiverzitete pretvorili v rastrske z velikostjo celice 1 x 1 m; ta velikost ustreza velikosti celic digitalnega modela nadmorskih višin. Inventarizacijo smo izvedli na podlagi statistične analize maksimuma z orodjem *Block statistics (Neighborhood toolset – maximum value)*. Določili smo prisotnost ali odsotnost vsakega elementa posebej znotraj prostorske enote. V nadaljevanju smo rastrske sloje reklasificirali in sešteli z orodjem *Raster calculator*. Tako smo dobili točno število

različnih elementov, ki se pojavljajo znotraj 1828 enako velikih prostorskih enot na celotnem preučevanem območju.

Tretja faza predstavlja izračun indeksa geodiverzitete s pomočjo enačbe (Serrano, Ruiz-Flaño, 2007), ki smo jo modificirali in prilagodili potrebam našega modela (Trenchovska, 2016):

$$Gd = Eg * R$$

Gd je indeks geodiverzitete, *Eg* število različnih elementov geodiverzitete na prostorsko enoto in *R* indeks reliefne razgibanosti v isti prostorski enoti.

Sloja indeksa reliefne razgibanosti in števila elementov geodiverzitete na prostorsko enoto smo zmnožili z orodjem *Raster calculator* in dobili vrednost indeksa geodiverzitete, ki dosega vrednosti med 0 in 1220,07. Dobljene vrednosti indeksa smo razvrstili v tri naravne Jenksove razrede (Jenks, 1967). Tako smo dobili nizek, srednji in visok indeks geodiverzitete. Za lažjo uporabnost in interpretacijo rezultatov smo razrede pretvorili v homogene zaokrožene enote. Območja z visokim indeksom so vroče točke geodiverzitete (Ruban, 2010).

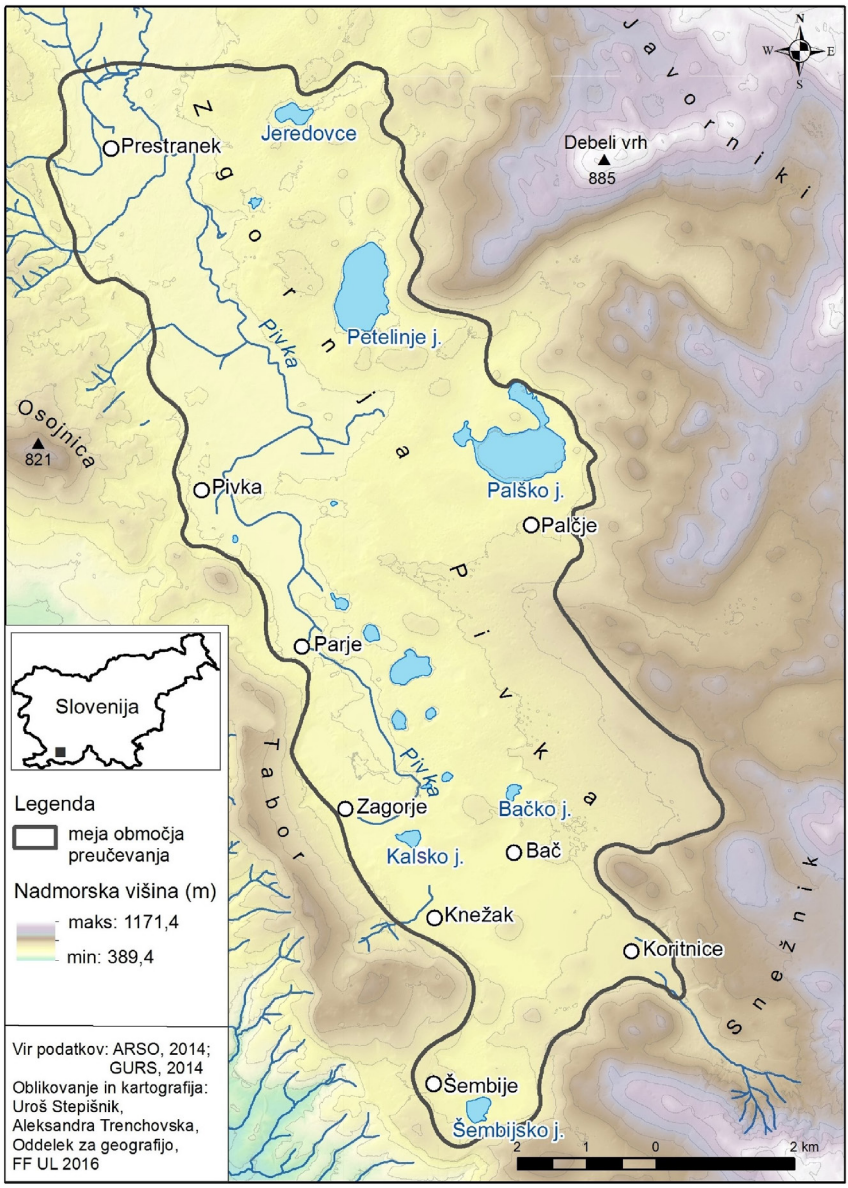
3 RELIEFNE ZNAČILNOSTI ZGORNJE PIVKE

Celotno območje Pivške kotline je znižan relief, zgrajen pretežno iz flišnih kamnin, delno tudi karbonatnih, po katerem tečeta glavna vodotoka Pivka in Nanoščica s pritoki. Kotlina je z vseh strani obdana z višjim kraškim reliefom visokih dinarskih planot Nanosa, Hrušice, Javornikov in Snežnika na severu in vzhodu, na zahodu pa meji na Slavenski ravnik, ki se na jugu nadaljuje v Taborski greben. Vode iz Pivške kotline se stekajo proti različnim delom oboda, kjer ponikajo in odtekajo v več smereh. Kotlina predstavlja razvodnico med jadranskim in črnomorskim povodjem, zaradi kompleksne geološke zgradbe pa prihaja do bifurkacije voda, ki iz kotline odtekajo. Z geomorfološkega, geološkega in hidrološkega vidika je to ena najbolj kompleksnih enot slovenskega dinarskega krasa.

Zaradi razlik v izoblikovanosti površja in geoloških značilnosti delimo Pivško kotlino na Zgornjo ali Podsnežniško Pivko in Spodnjo ali Podnanoško Pivko. Spodnja Pivka leži v spodnjem delu porečja Pivke, severno od Prestranka, in v grobem obsega tudi celotno porečje Nanoščice. Gradijo jo predvsem flišne kamnine, zato je na tem območju razvit fluvialni relief. Zgornja Pivka obsega južni del Pivške kotline med Prestrankom in Šembijami. Gradijo jo predvsem karbonatne kamnine, dno kotline in okoliških kotanj pa prekrivajo tudi rečne naplavine (Slovenija: pokrajine in ljudje, 2001).

Območje Zgornje Pivke je v grobem uravnana pokrajina, ki jo sestavljata dolinsko dno ob Pivki in njenih pritokih ter kraški ravnik, razčlenjen na raznovrstne kraške kotanje in kopaste vrhove. Sega od Šembij na jugu do zahodne meje na Taborskem grebenu, na vzhodu pa do Javornikov. Samo na severni strani ni omejena z višjim reliefom, ampak se pri Prestranku odpira v severni del Pivške kotline oziroma v Spodnjo Pivko. Celotno območje je okoli 15 km dolgo in do 5 km široko ter se blago spušča od skrajnega jugovzhodnega dela pri Koritnicah, kjer ima nadmorsko višino okoli 640 m, do Prestranka v nadmorski višini okoli 520 m.

Slika 1: Lega preučevanega območja.



Površje Zgornje Pivke lahko razdelimo na dve večji morfološki enoti: uravnano dolinsko dno, prekrito z raznovrstnimi rečnimi nanosi (slika 2A), ter višjo skalno teraso (slika 2B), ki obsega južni del Zgornje Pivke med okoliškimi pobočji Javornikov, Taborskega

hrbta in obronkov Snežniškega pogorja. Manjše sklenjeno območje uravnanega naplavljenega dna se nahaja še med naselji Koritnice, Bač in Knežak, zgrajeno je iz prodnih in peščenih nanosov občasnih potokov, ki pritekajo izpod Velike Milanje, kjer se je zaradi prevlade dolomitov oblikoval fluviokraški geomorfni sistem. Nad tem območjem se dviguje cela vrsta izrazitih kopastih vrhov.

Največje sklenjeno naplavno dno na območju Zgornje Pivke je ob reki Pivki, od izvira pri Zagorju do severnega roba območja pri Prestranku. Široko naplavno dno, ki ga prekrivajo drobnozrnati, poplavni nanosi Pivke, se na nekaj mestih zoži v ozke in plitve kanjone. Na preučevanem območju so tudi številni kraški izviri pritokov Pivke; nekateri od njih ležijo v značilnih zatrepnih dolinah.

Višja, živoskalna uravnava, ki gradi največji del Zgornje Pivke, je popolnoma zakrasela. Prekrita je s številnimi vrtačami, kopastimi vrhovi in drugimi manjšimi kraškimi oblikami. Zanjo so značilne tudi številne večje in globlje kotanje. Dna nekaterih kotanj segajo do nivoja epifreatične cone, zato so občasno ojezerjena.

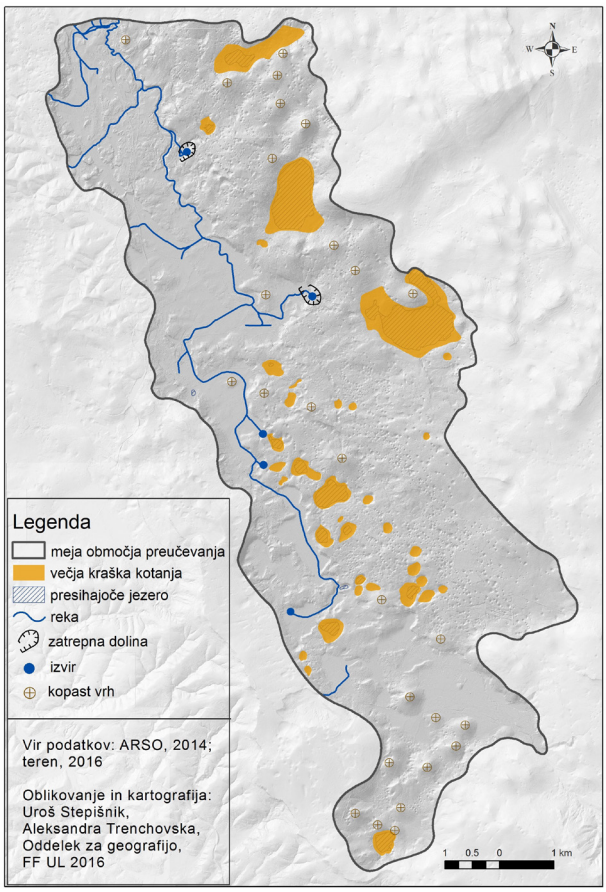
Slika 2: A. Kraški ravnik s presihajočimi jezeri v zaledju izvira Mišnik pri Parju; pogled proti jugu (foto: U. Stepišnik). B. Naplavna ravnica ob izviru Pivke pri Zagorju; pogled proti zahodu (foto: U. Stepišnik).

4 VREDNOTENJE GEODIVERZITETE ZGORNJE PIVKE

Elemente geodiverzitete smo podrobno kartirali na terenu, pri tem smo si pomagali z uporabo daljinskega zaznavanja. Na osnovi kartiranja smo razločili šest elementov geodiverzitete, od tega tri vrste hidroloških in tri vrste geomorfoloških elementov. Ti elementi so najpomembnejši za opredeljevanje indeksa geodiverzitete, hkrati pa predstavljajo dovolj osnovne elemente, da jih lahko na enak način dokumentira več različnih ocenjevalcev. Na ta način smo v čim večji meri izločili subjektivni moment ocenjevanja.

Skupaj smo identificirali 89 elementov geodiverzitete, ki so neenakomerno razporejeni (slika 3). Najbolj značilne geomorfološke reliefne oblike so večje kraške kotanje (36) in kopasti vrhovi (28), prisotni sta tudi dve manjši zatrepni dolini. V zahodnem delu območja je nekaj pomembnejših izvirov (5) in površinski tok reke Pivke s pritoki. Posebnost plitvega krasa Zgornje Pivke so nedvomno presihajoča jezera (17).

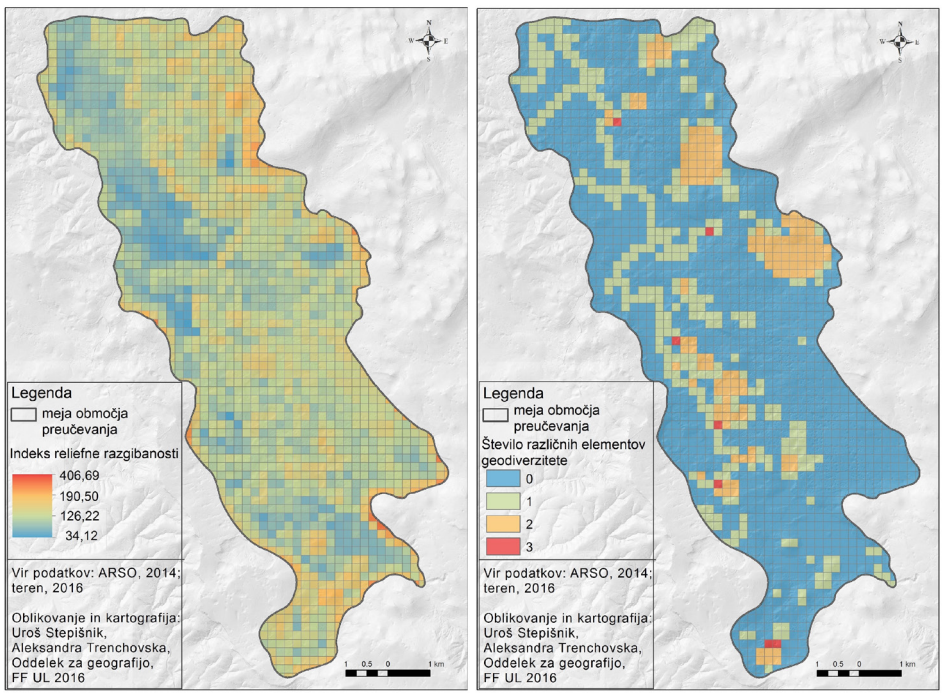
Slika 3: Morfografska karta elementov geodiverzitete.



Indeks reliefne razgibanosti smo izračunali na osnovi statističnih analiz *(Block statistics)* lidarskega digitalnega modela nadmorskih višin in z uporabo enačbe po Rileyju, ki se lahko uporablja za kvantitativni prikaz topografske razgibanosti različno velikih območij (Riley, DeGloria, Elliot, 1999). Izračunali smo ga za prostorske enote velikosti 200 x 200 m, da bi sovpadal z rezultati ostalih statističnih analiz elementov geodiverzitete in da smo s tem posplošili lidarske podatke. Vrednosti indeksa so se gibale med 34,12 in 406,69. Prostorske enote z visoko vrednostjo indeksa so na vzhodnem delu območja, kjer se kraška uravnava postopoma dviguje v pobočje Javornikov, na skrajnem južnem delu na obronkih Snežniškega pogorja ter na pobočjih večjih kraških kotanj. Nizka vrednost indeksa se v največjem obsegu pojavlja na zahodnem delu preučevanega območja v dolinskem dnu ob Pivki in njenih pritokih ter na obširni fluviokraški uravnavi na jugovzhodu (slika 4).

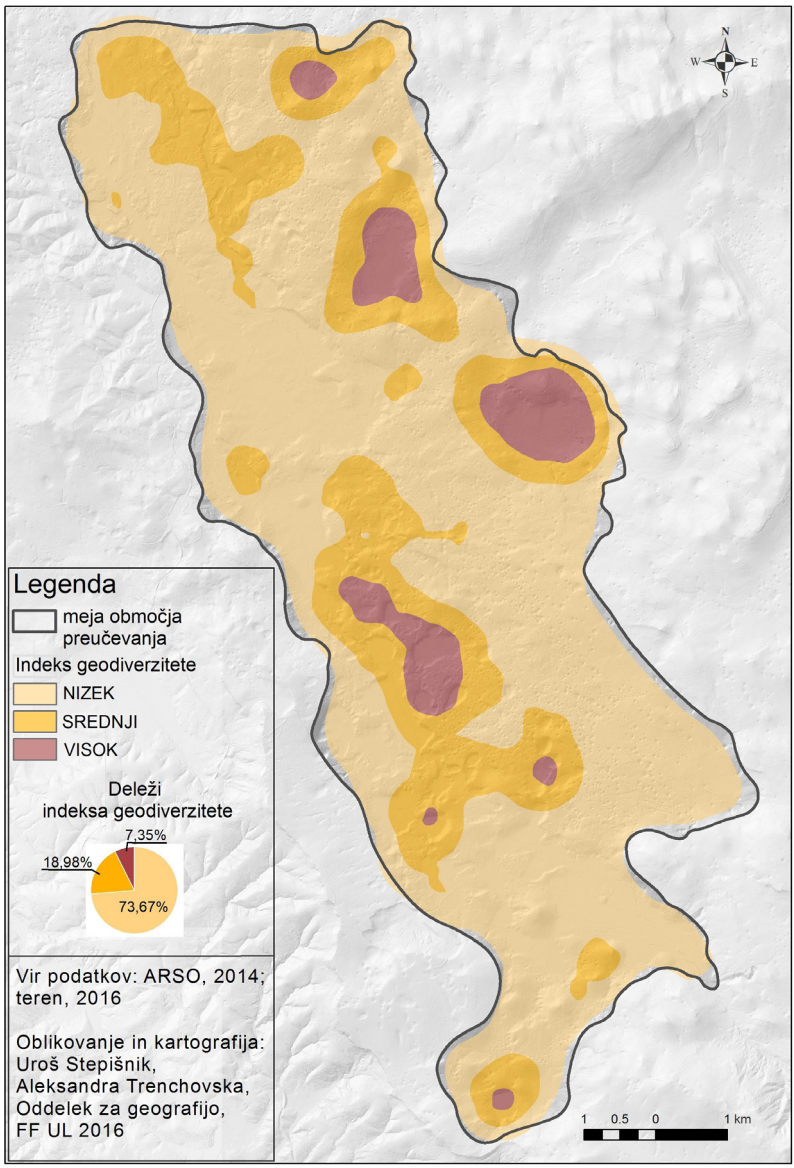
Celotno območje preučevanja z velikostjo 75 km^2 smo razdelili na 1828 enako velikih prostorskih enot (blokov). S statistično analizo *(Block statistics – maximum value)* in seštevanjem *(Raster calculator)* smo vsakemu bloku določili točno število različnih geomorfoloških in hidroloških elementov geodiverzitete, ki se je gibalo med vrednostima 0 in 3 (slika 4). Večina prostorskih enot (1321) ni vsebovala nobenega elementa geodiverzitete. V 354 enotah je bil prisoten le en element, v 146 enotah dva elementa in v sedmih enotah trije elementi.

Slika 4: Indeks reliefne razgibanosti in število elementov geodiverzitete na osnovno prostorsko enoto.



Indeks geodiverzitete na preučevanem območju smo dobili z množenjem digitalnih slojev indeksa reliefne razgibanosti in števila različnih elementov geodiverzitete na prostorsko enoto. Po metodi Jenksovih naravnih razredov (Jenks, 1967) smo jih razvrstili v tri razrede: nizek, srednji in visok (slika 5).

Slika 5: Območja razredov indeksa geodiverzitete in njihovi deleži na Zgornji Pivki.



Preglednica 1: Površine in deleži območij indeksa geodiverzitete na Zgornji Pivki.

Indeks geodiverzitete (meje razredov)	Površina (km^2)	Deleži (%)
Nizek (0–126,22)	55,2	73,6
Srednji (126,22–381,00)	14,2	18,9
Visok (381,00–1220,07)	5,5	7,3

Rezultati, dobljeni z uporabo novega kvantitativnega modela kažejo, da je več kot polovica (73,67 %) preučevanega območja v razredu nizkega indeksa geodiverzitete. Ta razred prevladuje na območjih, kjer je število elementov geodiverzitete enako nič in imajo hkrati nizek indeks reliefne razgibanosti. To so dolinska dna z nizko nadmorsko višino in majhnimi nakloni površja.

Srednji indeks geodiverzitete zavzema 18,98 % preučevanega območja. Pojavlja se na območjih, kjer sta prisotna eden ali dva elementa geodiverzitete in kjer ima indeks reliefne razgibanosti reliefa srednje vrednosti. Ta indeks je večinoma razporejen na stiku kraških uravnav in dolinskega dna ter na območjih večjih kraških kotanj.

Območja z visokim indeksom geodiverzitete zavzemajo 7,35 % Zgornje Pivke. Ta območja lahko opredelimo tudi kot vroče točke geodiverzitete (Ruban, 2010). Na teh območjih se pojavljajo trije različni elementi geodiverzitete znotraj osnovnih celic prostorskih enot in so hkrati tudi območja visokega indeksa reliefne razgibanosti.

Na preučevanem območju Zgornje Pivke se nahaja sedem sklenjenih območij z visokim indeksom geodiverzitete (slika 5). Najsevernejše je na območju Jeredovce, podolgovate kraške kotanje, ki je občasno ojezerjena. V njeni okolici je tudi nekaj kopastih vrhov, kar skupaj

Slika 6: Območje Palškega presihajočega jezera je eno od območij visokega indeksa geodiverzitete Zgornje Pivke; pogled proti severu (foto: U. Stepišnik).

z visokim indeksom reliefne razgibanosti daje relativno visoke vrednosti indeksa geodiverzitete. Južneje so območja visokega indeksa geodiverzitete zaradi podobnih geomorfoloških, hidroloških in reliefnih značilnosti tudi na območjih Petelinjskega, Palškega, Bačkega in Šembijskega jezera; pri vseh območjih gre za večjo kraško kotanjo s presihajočim jezerom, ki je obdana s kopastimi vrhovi. Manjše sklenjeno območje z visokim indeksom geodiverzitete se nahaja še okoli 700 m jugovzhodno od izvira Pivke na območju Kalskega jezera. Visok indeks geodiverzitete tega območja opredeljujejo visok indeks reliefne razgibanosti, kraška kotanja s presihajočim jezerom ter bližina površinskega toka reke Pivke.

Največje sklenjeno območje visokega indeksa geodiverzitete obsega del kraškega ravnika vzhodno od Parij. To območje poleg kraške uravnave obsega sedem večjih kraških kotanj, od katerih jih je šest občasno ojezerjenih. V bližini se nahajajo tudi kraški izviri, kopast vrh in površinski tokovi Pivke s pritoki. Velika pestrost geomorfoloških in hidroloških elementov daje skupaj z relativno visokim indeksom reliefne razgibanosti visok indeks geodiverzitete tega območja.

5 RAZPRAVA IN ZAKLJUČKI

Koncept geodiverzitete je bil uveden v zadnjih dveh desetletjih zaradi ponovnega porasta zanimanja za abiotske elemente narave (Gray, 2013; de Paula Silva, Rodrigues, Pereira, 2014). Vrednotenje geodiverzitete je pomembno za upravljanje posameznih območij z vidika varstva narave, geoturizma in izobraževanja. Geodiverziteta se izraža kot vrednost nekega območja, ki ga je mogoče opredeliti s kvalitativnimi in/ali kvantitativnimi kazalci. Največji problem kvalitativnih metod je subjektivnost ocenjevalcev, saj ti pri vrednotenju geodiverzitete uveljavljajo svoje osebne nazore do nežive narave. Zato se rezultati raziskav precej razlikujejo med seboj in so v veliki meri subjektivni. Kvalitativni kazalci tako niso primerni niti za primerjalne študije niti za študije, pri katerih sodeluje več ocenjevalcev (Ruban, 2010).

Veliko večji delež objektivnosti rezultatov je mogoče doseči s kvantitativnim pristopom (Hjort, Luoto, 2010; Ruban, 2010; Melelli, 2014). Ta način dovoljuje tudi primerjavo in združevanje podatkov različnih študij vrednotenja. Hkrati lahko s kvantitativnim pristopom, pri katerem navadno uporabljamo GIS orodja, učinkovito obdelamo veliko količino podatkov. Tovrstni pristop je izredno praktičen za vrednotenje obsežnejših območij ali območij z večjo gostoto elementov geodiverzitete. Mogoča je tudi primerjava podatkov za isto območje v različnih časovnih obdobjih; na ta način lahko vrednotimo izgubo geodiverzitete v določenem času na nekem območju. Z uporabo kvantitativnih metod je mogoče identificirati tudi območja visokega indeksa geodiverzitete oziroma žarišč geodiverzitete.

Metoda, ki smo jo uporabili pri naši raziskavi, združuje prostorski odnos med razgibanostjo površja in elementi geodiverzitete. Metoda je delno avtomatizirana, hkrati pa z zelo preprosto identifikacijo in dokumentacijo elementov geodiverzitete v veliki meri izločimo subjektivne komponente vrednotenja. Metodo smo preizkusili na območju Zgornje Pivke, kjer smo ugotovili, da tam obstaja sedem območij, ki jih lahko opredelimo kot žarišča geodiverzitete. Identificirana območja sovpadajo s presihajočimi jezeri, ki so tudi trenutno opredeljena kot naravne vrednote (Skoberne, Peterlin, 1991). Aplikacija delno

avtomatizirane metode, ki smo jo razvili za potrebe čimbolj objektivnega vrednotenja geodiverzitete, se je tako izkazala za primerno. V prihodnje bo potrebno preizkusiti in ovrednotiti metodo na več različnih območjih, geomorfoloških okoljih in različno velikih območjih ter primerjati rezultate med seboj.

Literatura in viri

Glej angleško različico prispevka.

A PROPOSAL OF QUANTITATIVE GEODIVERSITY EVALUATION MODEL ON THE EXAMPLE OF UPPER PIVKA KARST, SLOVENIA

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Abstract
The article presents a new method for geodiversity evaluation, which was evaluated in the Upper Pivka karst area. The method is based on entire area evaluation on the basis of spatial distribution of geodiversity elements and terrain ruggedness. The method was developed for the purpose of objective and systematic geodiversity evaluation on various sites. In this article, we applied the method in the Upper Pivka area, where it demonstrated to be very useful.

Key words: geodiversity, GIS, nature protection, geomorphology, karst, Upper Pivka, Slovenia

1 INTRODUCTION

The diversity of nature is composed of the biotic and abiotic components. The first occurrences of natural diversity evaluation were based on geomorphological and geological elements, which also reflected in the establishing of the first geological reserve (Siebengebirge in the former Prussia in 1836) and the first national park in the world (Yellowstone in 1872) (Gray, 2013). Current nature diversity studies are paying more attention to biotic component of nature, as a result of excessive exploitation of natural resources and consequent extinction of plant and animal species, as well as habitats (Pettersson, Keskitalo, 2013). After the signing of the Convention on Biological Diversity in Rio de Janeiro in 1992, the number of studies in this topic rapidly increased; there have been numerous studies for evaluation, protection, and conservation of biodiversity. The latter refers to genetic (conserving genetic diversity), species (reducing species loss), and ecosystem diversity (maintaining and protecting habitats), as well as protecting their interconnections.

An excessive biocentric approach to nature protection almost entirely overlooked the abiotic aspect of nature. Interest in protection and evaluation of abiotic nature has

increased in the last two decades (Gray, 2013; Melelli, 2014). The modern term geodiversity encompasses the diversity of geologic (rocks, minerals, fossils) and geomorphologic elements (forms and processes) and soils. The revival of interest for evaluation of abiotic nature is not only indicated by expert articles and the search for the most suitable methods of abiotic nature evaluation. There is also increasing interest for so-called geotourism, which is based on the combination of geologic and geomorphologic interpretation of landscape features and recreation (Necheş, 2016), with an increasing number of geoparks, which are a direct result of increased interest in abiotic nature elements.

With purpose for geodiversity evaluation, various methods had been developed, which evaluate geodiversity in different manner. All methods use a two-stage evaluation of scientific and additional values. Scientific criteria are generally based on the scientific understanding of a relief form or process, while additional values define the utilization and managerial potential (Pereira, Pereira, Caetano Alves, 2007; Reynard, Coratza, 2007; Zouros, 2007; Reynard, 2009; Gray, 2013). The evaluation methods differ significantly also in the way of acquiring information on geodiversity elements. Simpler methods evaluate individual points or areas, while modern methods consider the entire area under evaluation, and define the areas with a higher geodiversity index (Melelli, 2014; Stepišnik, Repe, 2015).

During recent times, significant methodological progress in geodiversity evaluation became noticeable, as many automated, quantitative evaluation methods were developed, which define the values for entire study areas with minimum subjective or qualitative assessment (Kozłowski, 2004; Benito-Calvo et al., 2009; Pellitero et al., 2011; Pereira, Pereira, Caetano Alves, 2007; de Paula Silva, Rodrigues, Pereira, 2014; Melelli, 2014).

The purpose of this article is to present a new, semi-automated quantitative method of geodiversity evaluation. The evaluation procedure is predominantly based on the analysis of digital spatial data in geographic information systems. Most attempts at evaluation of abiotic nature diversity so far have been based on an evaluation of individual points and/or connected areas of geodiversity elements. Our proposed model assesses the entire study area.

The fundamental problem of geodiversity evaluation is the subjective element of assessment, which is generally the result of loosely defined evaluation criteria and the complexity in choosing individual geodiversity elements. Final values are generally the result of the assessor's own judgment, i.e. clearly subjective (Melelli, 2014; Stepišnik, Repe, 2015). The goal of our method is to eliminate, as much as possible, the subjective element of assessment from the evaluation. The only part of the procedure that includes subjective elements is the selection of geodiversity elements. For this reason, the identification of geodiversity elements is as simplified as possible and limited to basic elements, which can be identified by any assessor with a basic education in geography and geology.

In addition to the geodiversity elements, the method considers surface fragmentation, which is also an important factor of abiotic nature diversity (Hjort, Luoto, 2010; Ruban, 2010; Gray, 2013; Pereira, Pereira, Caetano Alves, 2013; de Paula Silva, Rodrigues, Pereira, 2014; Melelli, 2014; Stepišnik, Repe, 2015; Necheş, 2016). The final calculation of geodiversity index combines information on locations of different geodiversity elements

and the terrain ruggedness. The method of determining the geodiversity index is based on the *Block statistics* tool in the *ArcGis* software package.

The method has already been successfully used on the paleovolcanic area of Kratovo in Macedonia (Trenchovska, 2016). In the study, we applied the method in the southern part of the Pivka Basin, or Upper Pivka, which is one of the most diverse areas in Slovenia in terms of geomorphology and hydrology. We hope to present the objectivity and usefulness of this model for karst-type terrain regions.

2 MATERIALS AND METHODS

To inventory and evaluate the geodiversity, we used a digital LiDAR elevation model with a 1x1 m resolution (ARSO, 2015) and a digital morphographic map of geodiversity elements. For spatial analyses and the geodiversity index calculations, we used Esri's *ArcMap* software, version 10.3.1. All analyses and index calculations were performed for a spatial unit in the shape of a 200 x 200 m square. The size of the spatial unit was adapted to the size of the entire studied area of Upper Pivka. The chosen method of allocation allows objectivity in taking inventory, in the analysis of created data, and in the comparison of final values.

The inventory and geodiversity evaluation model is composed of three main phases. In the first phase, geodiversity elements are identified and spatially documented on the basis of terrain mapping, scientific literature (Serrano, Ruiz-Flaño, 2007; Gray, 2013), cartographic material of various scales (1:5.000; 1:25.000), and digital orthophotos (GURS, 2014). Our model takes into account the most important geomorphologic and hydrologic geodiversity elements. For the entire study area, we used the National topographic map, 1:25.000 scale to map three different types of geomorphologic landforms (larger karst hollows, pocket valleys, conical hills) and three different types of hydrologic landforms (springs, rivers, intermittent lakes). The types were later digitized and vector layers of specific types were prepared. Of the topographic elements, we selected terrain ruggedness, which was calculated as a terrain ruggedness index on the basis of an analysis of a digital LiDAR elevation model (Riley, DeGloria, Elliot, 1999). The results of the first phase were vector layers of geodiversity elements and a terrain ruggedness index, which represent the basis for further analysis.

The second phase of the model includes the inventory of geodiversity elements for each spatial unit. First, we transformed vector layers of geodiversity elements into raster layers with a cell size of 1 x 1 m; this cell size matches with the cell size of the digital elevation model. The inventory was performed on the basis of a statistical analysis of the maximum, using the *Block statistics* tool (*Neighborhood toolset – maximum value*). We determined the presence or absence of an element within a spatial unit for each element separately. Next, we reclassified and performed a sum of the raster layers using the *Raster calculator* tool. We thus obtained the precise number of different elements occurring within the 1828 spatial units of equal size in the entire studied area.

The third phase represents the geodiversity index calculation using the equation (Serrano, Ruiz-Flaño, 2007), which we modified and adapted for the purpose of our model.

The modified equation is as follows (Trenchovska, 2016):

$$Gd = Eg * R$$

Where Gd is the geodiversity index, Eg is the number of different geodiversity elements within spatial unit, and R is the terrain ruggedness index of a spatial unit.

The layers of terrain ruggedness index and the number of different geodiversity elements within spatial unit were multiplied using the Raster calculator tool to obtain the geodiversity index which ranges from 0 to 1220.07. The geodiversity index was classified into three natural Jenks' classes (Jenks, 1967). We thus obtained a low, medium, and high geodiversity index. For easier use and interpretation of results, we transformed classes into homogenous rounded units. Areas with a high index are geodiversity hotspots (Ruban, 2010).

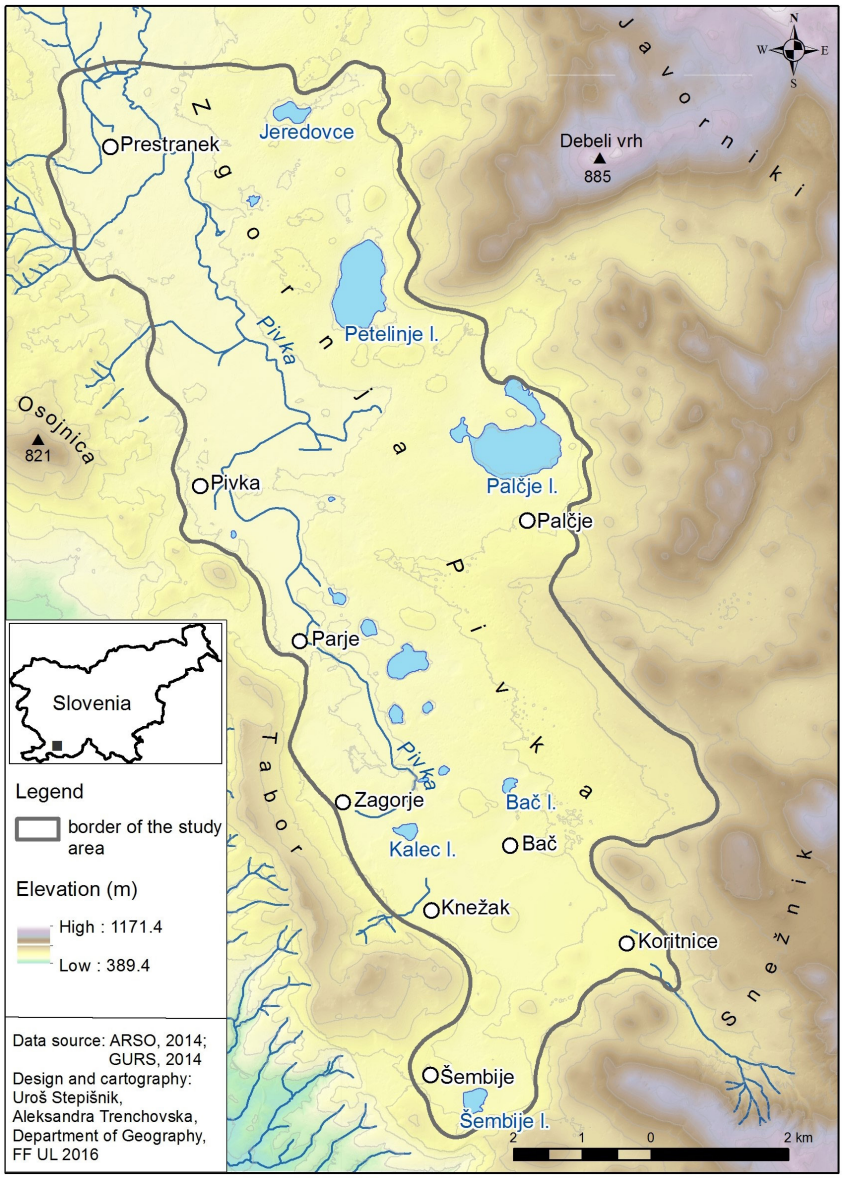
3 TERRAIN CHARACTERISTICS OF UPPER PIVKA

The entire area of Pivka Basin is a lower terrain, predominantly composed of flysch rocks and partially carbonate rocks, over which flow the two main rivers, Pivka and Nanoščica, with their tributaries. The basin is enclosed on all sides by a higher karst terrain of high Dinaric plateaus Nanos, Hrušica, Javornik, and Snežnik in the north and east, and borders in the west on Slavenski ravnik, which transitions in the south into Taborski greben. The waters from the Pivka Basin flow into different parts of the surrounding areas, where they flow underground in different directions. The area represents the watershed between the Adriatic and Black Sea catchments, and due to the complex geological compositions the water is draining to both catchments. From geomorphological, geological, and hydrological perspective, it is one of the most complex units of Slovenian Dinaric karst.

Due to differences of surface formations and geological features, the Pivka Basin is divided into Upper Pivka (Zgornja Pivka), or Podsnežniška Pivka, and Lower Pivka (Spodnja Pivka), or Podnanoška Pivka. The Lower Pivka lies in the lower section of the Pivka drainage basin, north of Prestranek, and roughly includes the entire drainage basin of Nanoščica. It is composed primarily of flysch rocks; therefore, the fluvial relief developed in this area. The Upper Pivka includes the southern part of the Pivka Basin between Prestranek and Šembije. It is composed primarily of carbonate rocks, while the bottom of the basin and surrounding hollows are also covered by fluvial deposits (Slovenija: pokrajine in ljudje, 2001).

The area of Upper Pivka is a roughly flattened landscape, divided into the valley floor along the Pivka River and its tributaries, and the higher karst plain, which is dissected by various karst hollows and conical hills. It spans from Šembije in the south, borders on Taborski greben in the west and Javorniki in the east. Only in the north it is not bounded by a higher terrain, but opens up by Prestranek into the remaining part of the Pivka Basin, or Lower Pivka. The entire area is about 15 km long and up to 5 km wide, gently sloping down from the far southeastern part near the village of Koritnice, with an altitude of about 640 m, to Prestranek, with an altitude of about 520 m.

Figure 1: Location of the study area.



The terrain of the Upper Pivka Valley can be divided into two larger morphological units: the valley bottom covered by various fluvial sediments (Figure 2A) and the higher positioned karst plain (Figure 2B), which includes the southern part of Upper Pivka between the surrounding slopes of Javorniki, Taborski greben, and the edges of

Snežnik Mountain. A smaller continuous area of the flattened floodplain is located between the settlements of Koritnice, Bač, and Knežak. This is an area of sand-gravel deposits of temporary streams, flowing from the area beneath Velika Milanja, where a fluviokarst geomorphic system developed due to predominantly dolomite rock composition. A whole line of prominent conical hills rises above this area.

The largest continuous floodplain in the Upper Pivka area lies along the Pivka River itself, from its spring in the village of Zagorje to the northern edge of the area near Prestranek. The wide floodplain, covered by fine-grained sediments of Pivka River, transitions into narrow and shallow canyons in some locations. The area also includes numerous karst springs of Pivka tributaries; some of them are located in characteristic pocket valleys.

The higher, bedrock terrain, which comprises the largest portion of Upper Pivka, is completely karstified. It is covered by numerous sinkholes, conical hills, and other smaller karst landforms. It is also characterized by numerous larger and deeper hollows. Bottoms of some hollows reach the level of the epiphreatic zone and therefore occasionally are inundated.

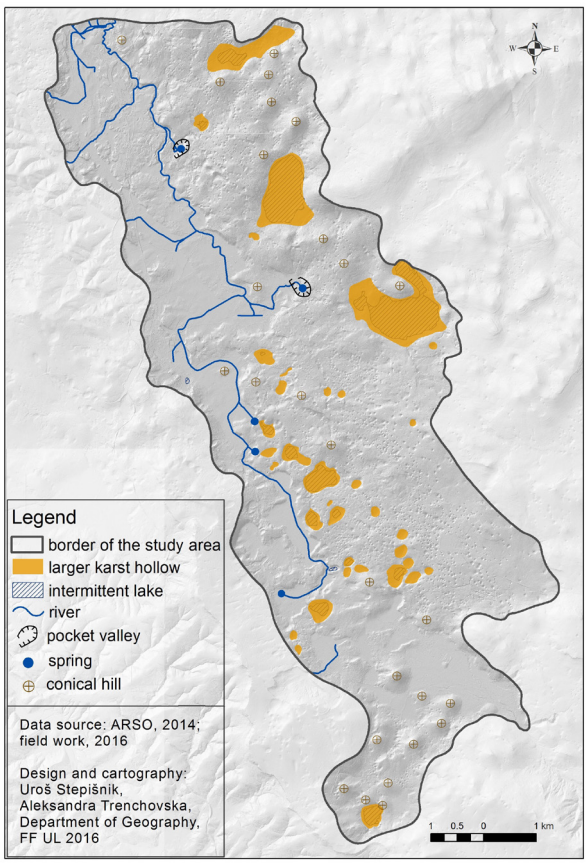
Figure 2: A. Karst plain with intermittent lakes in the hinterland of the Mišnik spring near Parje; the view towards the south (photo: U. Stepišnik). B. Floodplain by the spring of Pivka in Zagorje; the view towards the west (photo: U. Stepišnik).

4 EVALUATING GEODIVERSITY OF UPPER PIVKA

Geodiversity elements were mapped in detail in the field, also by using remote sensing. Based on mapping, we determined six different geodiversity elements, of which three types were hydrological and three types were geomorphological. These elements are the most important for defining the geodiversity index, and they also are so basic that can be documented in the same manner by multiple assessors. Thus, we have eliminated the subjective aspect of assessing to the greatest degree possible.

In the study area, we identified a total of 89 geodiversity elements, which are discontinuously distributed (Figure 3). The most characteristic geomorphological landforms in the study area are larger karst hollows (36) and conical hills (28). Two smaller pocket valleys are also present in the area. Some important springs (5) and the surface flow of Pivka River with its tributaries are located in the western part of the area. A special feature of the shallow karst of Upper Pivka are undoubtedly the intermittent lakes (17).

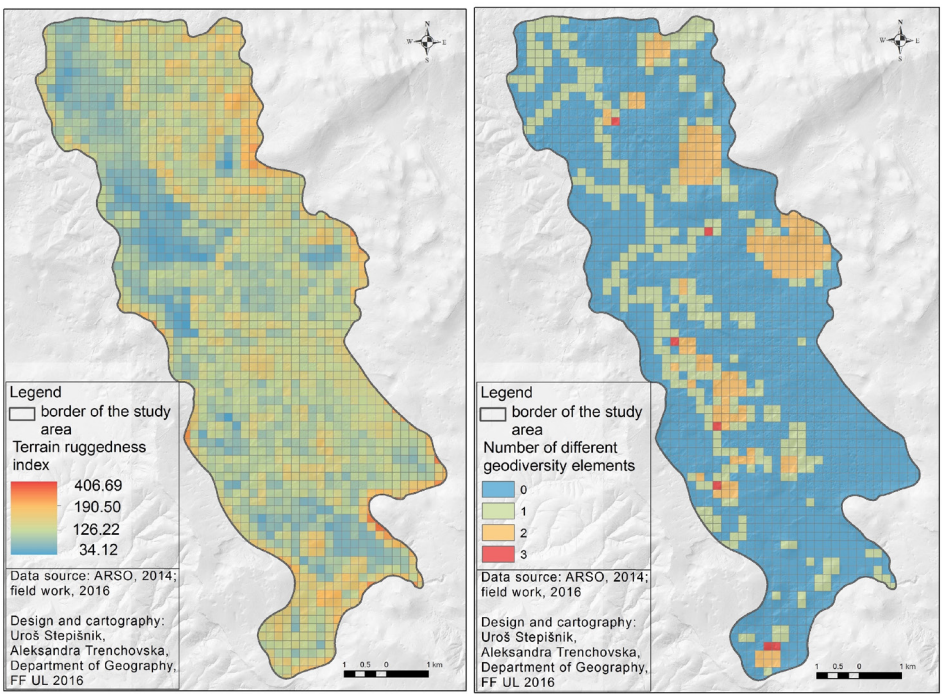
Figure 3: Morphographic map of geodiversity elements.



The terrain ruggedness index was calculated on the basis of statistical analyses (*Block statistics*) of the digital LiDAR elevation model and using Riley's equation, which can be used for a quantitative display of topographic ruggedness of areas of different sizes (Riley, DeGloria, Elliot, 1999). The calculation was done for a spatial unit of a 200 x 200 m block, in order to match with the results of other statistical analyses of geodiversity elements and to generalize the precision of LiDAR data. Index values ranged from 34.12 to 406.69. Spatial units with high index values are located in the eastern part of the area, where karst plain gradually rises towards the slopes of Javorniki, in the far southern part of the area on the outskirts of Snežnik Mountain and on the slopes of larger karst hollows. Low ruggedness index values were predominantly in the western part of the studied area, on the levelled terrain along the Pivka River and its tributaries, and on the extensive fluvial karst plain in the southeast (Figure 4).

The entire 75 km^2 of the study area was divided into 1828 spatial units (blocks) of equal size. Using a statistical analysis of maximum (*Block statistics – maximum value*) and summing (*Raster calculator*), we determined the exact number of different geomorphologic and hydrologic geodiversity elements for each block, which ranged between 0 and 3 (Figure 4). Most spatial units (1321) did not contain a single geodiversity element. Only one element was present in 354 units, two elements in 146 units, and three elements in 7 units.

Figure 4: Terrain ruggedness index and number of different geodiversity elements within a spatial unit.



We calculated the geodiversity index in the study area by multiplying the digital layers of terrain ruggedness index and the number of different geodiversity elements within spatial unit. It was categorized into three classes: low, medium, and high, using Jenks' natural breaks method (Jenks, 1967) (Figure 5).

Figure 5: Areas of geodiversity index classes and their percentage in the Upper Pivka.

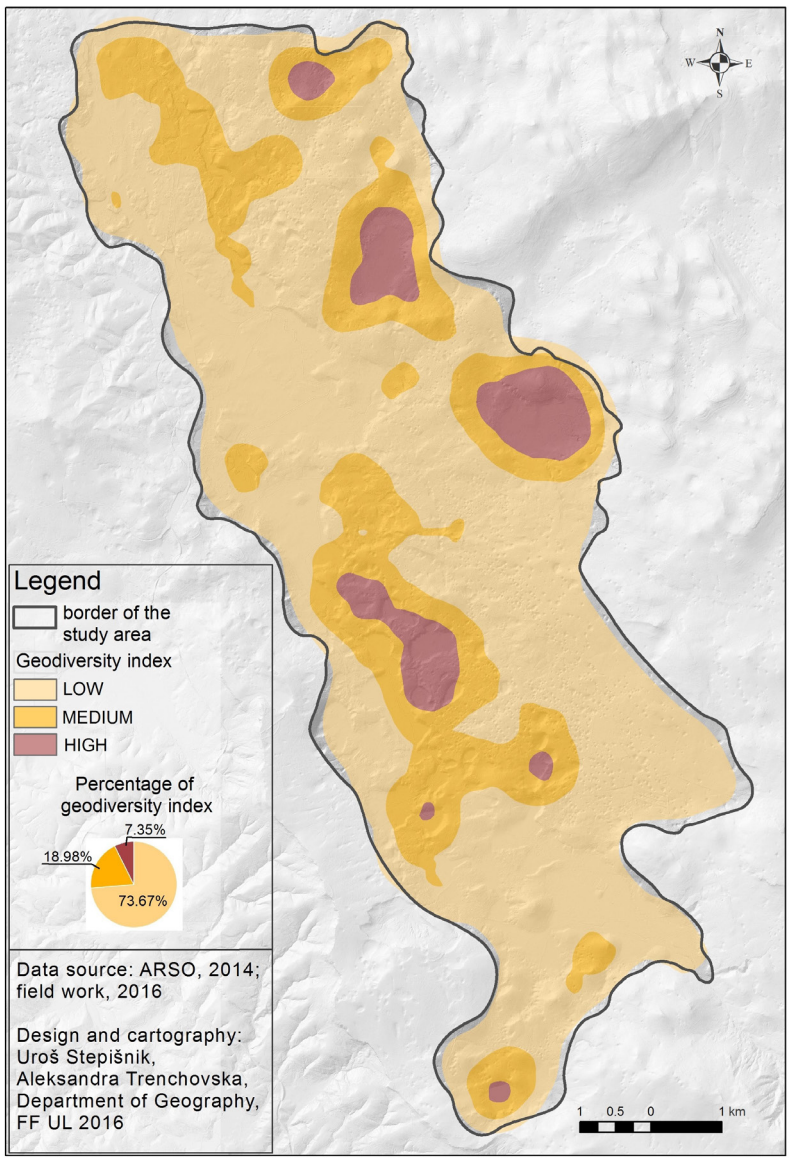


Table 1: Surface area and percentage of geodiversity index within Upper Pivka.

Geodiversity index	Surface area (km^2)	Percentage (%)
Low (0–126.22)	55.2	73.6
Medium (126.22–381.00)	14.2	18.9
High (381,00–1220.07)	5.5	7.3

The results obtained with the new quantitative model indicate that over half (73.67%) of the study area falls within the low geodiversity index class. This class is predominant in areas where there the number of different geodiversity elements is zero and the area has a low terrain ruggedness index. These are valley bottoms with low elevation and low slope gradient.

The medium geodiversity index covers 18.98% of the study area. It occurs in area with one or two different geodiversity elements and where the terrain ruggedness index has a medium value. This index is mostly distributed along the contact of karst plain and the valley floor, and in areas of larger karst hollows.

Areas with high geodiversity index represent 7.35% of the Upper Pivka area. Such areas with a high geodiversity index can be defined as geodiversity hotspots (Ruban, 2010). These areas have three different geodiversity elements occurring within the basic spatial unit cells, and also have a high terrain ruggedness index.

In the study area of Upper Pivka, there are seven continuous areas with a high geodiversity index (Figure 5). The northernmost area is located in the area of Jeredovce. This is an elongated karst hollow with an intermittent lake. There are also some conical hills

Figure 6: Area of intermittent Palčje Lake is one of the high geodiversity index areas in Upper Pivka; view towards the north (photo: U. Stepišnik).

around the hollow, which together with the high terrain ruggedness index produces relatively high geodiversity index values. Towards the south, areas with a high geodiversity index because of similar geomorphological, hydrological, and terrain characteristics are also located around Petelinje, Palčje, Bač and Šembije Lakes; all these areas have large karst hollows with intermittent lakes surrounded by conical hills. A smaller continuous area with a high geodiversity index is located about 700 m southeast from the spring of Pivka, around Kalec Lake. The high geodiversity index of this area is defined by a high terrain ruggedness index and the karst hollow with the intermittent lake, as well as the vicinity of the surface flow of the Pivka River.

The largest continuous area with a high geodiversity index is the part of the karst plain to the east of the village Parje. This area includes seven larger karst hollows, six of which have intermittent lakes. There are also karst springs, a conical hill, and surface flow of the Pivka River with its tributaries close to this area. The high diversity of geomorphologic and hydrologic elements, together with a relatively high terrain ruggedness index, gives to this area a high geodiversity index.

5 DISCUSSION AND CONCLUSION

The concept of geodiversity was introduced in the last two decades due to increasing interest in abiotic nature elements (Gray, 2013; de Paula Silva, Rodrigues, Pereira, 2014). Geodiversity evaluation is important for the managing of specific areas from the perspective of nature protection, geotourism, and education. Geodiversity is expressed as a value of an area that can be defined by qualitative and/or quantitative indicators. The greatest problem of qualitative methods is the subjectivity of assessors. When evaluating geodiversity, assessors apply their personal views towards abiotic nature. Study results therefore differ significantly and are highly subjective. Qualitative indicators are also neither suitable for comparative studies, nor for studies done by more than one assessor (Ruban, 2010).

A much greater objectivity of the results can be achieved using a quantitative approach (Hjort and Luoto, 2010; Ruban, 2010; Melelli, 2014). This approach allows comparison and combining data of various evaluation studies. Furthermore, a quantitative approach, which generally uses GIS tools, can effectively process a much larger quantity of data. Such an approach is extremely practical for evaluating larger areas or areas with a higher density of geodiversity elements. It also allows comparison of data for the same area during different time periods; we can thus evaluate a loss of geodiversity through time for a specific area. Using quantitative methods, we can also identify areas of high geodiversity index or geodiversity hotspots.

The method used in our study combines the spatial relationship of terrain ruggedness with geodiversity elements. The method is partially automated, but at the same time eliminates the subjective component of assessment using a very simple identification and documentation of geodiversity elements. The method was tested in the Upper Pivka area, where we determined seven different areas, which can be defined as geodiversity hotspots. The identified areas match the intermittent lakes, which are also currently

defined as natural values (Skoberne, Peterlin, 1991). Application of this semi-automated method, developed for the purpose of objective evaluation of geodiversity, has thus proved to be appropriate. In the future, the method needs to be applied and evaluated at different areas, geomorphological environments, and areas of different sizes, with a consequent comparison of results.

(Translated by GRENS-TIM d. o. o.)

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ZAZNAVANJE KAKOVOSTI ZRAKA V LJUBLJANI

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Izvleček
V članku so predstavljeni rezultati raziskave, ki je z obsežnim anketiranjem v mestu Ljubljana ugotavljala zaznavanje kakovosti zraka, in sicer tako v primerjavi z zaznavanjem drugih okoljevarstvenih področij kot tudi v primerjavi z rezultati monitoringa kakovosti zraka na preučevanem območju. Ugotovitve kažejo, da prebivalci zaznavajo onesnaženost zraka kot glavni okoljski problem v mestu in da prepričanje o slabi kakovosti zraka v Ljubljani ostaja globoko zakoreninjeno kljub njenemu splošnemu izboljšanju.

Ključne besede: onesnaževanje zraka, kakovost zraka, zaznavanje okoljskih problemov, monitoring, Ljubljana, Slovenija

1 UVOD

Mestna območja se zaradi zgostitve prebivalstva in raznovrstnih človekovih dejavnosti spopadajo s problemom onesnaževanja zraka, ki še posebej pesti mesta z omejenimi samočistilnimi sposobnostmi. Onesnažen zrak pomembno vpliva na kakovost drugih sestavin okolja oziroma na kakovost bivalnega okolja, pomemben pa je tudi njegov neposredni vpliv na zdravje in počutje prebivalstva.

Četudi so v preteklosti prebivalci zaznavali onesnaženost zraka, je tedanji Hidrometeorološki zavod z rednimi meritvami v Sloveniji in Ljubljani začel šele v drugi polovici šestdesetih let dvajsetega stoletja. Že prve meritve so pokazale zelo visoko onesnaženost zraka v kotlinah in dolinah, kar so pripisali tudi njihovim skromnim samočistilnim sposobnostim zaradi pogostega prizemnega temperaturnega obrata in slabše prevetrenosti (Hrček, 2014), v Ljubljani pa tudi že takrat ugotovljenemu toplotnemu otoku, ki povzroča stekanje zraka proti središču mesta (Planinšek, Hrček, 2014). Sprva se je onesnaženost zraka enačilo s koncentracijami žveplovega dioksida in dima, šele desetletja pozneje se je okoljska politika osredotočila tudi na druga onesnaževala in reakcije med njimi (dušikovi oksidi, ogljikovodiki, fotokemijski smog, ozon). V Ljubljani so sicer prve meritve dušikovih oksidov in ozona izvedli že leta 1975 (Rajh Alatič, 2014), vendar je bila v tistem času pozornost namenjena koncentracijam žveplovega dioksida in dima. Njihove meritve so prispevale

k zakonodajnemu urejanju področja, ozaveščanju prebivalstva, prostorskemu načrtovanju in širjenju daljinskega ogrevanja v mestih. V Ljubljani so tako spodbujali priklapljanje gospodinjstev na toplovodno omrežje iz toplarne v Mostah in ukinjali manjše kotlovnice (Hrček, 2014; Planinšek, Hrček, 2014). Okoljevarstveni ukrepi v energetiki in industriji, prestrukturiranje gospodarstva in zamenjava energentov so v slovenskih mestih v osemdesetih in devetdesetih letih 20. stoletja postopoma odpravili težave z žveplovim dioksidom. Večja okoljska ozaveščenost in zavedanje (zdravstvenih) vplivov onesnaženega zraka sta pozornost preusmerila v druga onesnaževala in meritve. V zadnjih letih je po ocenah strokovnjakov (Cegnar in sod., 2014) v Sloveniji najbolj pereča onesnaženost zraka z ozonom in delci PM_{10}, po količinah katerih je v vrhu držav Evropske unije, tako glede izpustov na prebivalca kot tudi na enoto površine. Čezmerna onesnaženost z delci je posledica pretežno lokalnih izpustov cestnega prometa in ogrevanja stavb, pri čemer je zaradi učinkov gospodarske krize v zadnjih letih zaznati povečano rabo biomase in celo premoga v zastarelih kurilnih napravah (Ogrin, Vintar Mally, 2013; Odlok o načrtu …, 2014).

Za udejanjanje okoljevarstvenih ukrepov tako na področju zraka kot drugih sestavin okolja je zaželeno, da se (lokalno) prebivalstvo zaveda okoljskih problemov. Vendar pa zaznavanje kakovosti sestavin okolja le deloma temelji na znanju oziroma razumevanju problematike. Špes (1998) denimo izpostavlja, da se zaznavanje kakovosti okolja in dejanska onesnaženost oziroma stanje okolja razhajata, saj je zaznavanje odvisno od stopnje pripravljenosti in sposobnosti zaznavanja posameznika, na kar pa vplivajo številni dejavniki. Zaznave prebivalcev so prav tako pomembne kot ugotovitve stroke, saj oboje vodi reakcije in odločitve prebivalstva, tudi prizadevanja za varstvo okolja in večjo kakovost bivanja. Polajnar Horvat (2014) v tem kontekstu opredeli človekovo zaznavanje problemov okolja skupaj z njihovim razumevanjem in zavedanjem za sestavni del okoljske ozaveščenosti, ki človeka navdaja z zaskrbljenostjo in ga potencialno vodi v reševanje problema.

Namen pričujočega prispevka je raziskati zaznavanje kakovosti oziroma onesnaženosti zraka pri prebivalcih mesta Ljubljana, in sicer tako v primerjavi z zaznavanjem drugih okoljevarstvenih področij (onesnaženost vode, onesnaženost prsti, hrup, svetlobno onesnaževanje, ravnanje z odpadki) kot tudi v primerjavi z rezultati monitoringa kakovosti zraka na preučevanem območju. Obsežno anketiranje v četrtnih skupnostih na območju znotraj avtocestnega obroča je omogočilo vpogled v zaznavanje posameznih vidikov kakovosti zraka, primerjavo z rezultati monitoringa in nomotetično opredeljevanje prepoznanih vzorcev. Za primerjavo zaznav z izmerjenimi koncentracijami onesnaževal in trendi njihovega spreminjanja smo uporabili podatke ARSO – Agencije Republike Slovenije za okolje (Cegnar in sod., 2014) in rezultate meritev z difuzivnimi vzorčevalniki (Ogrin in sod., 2014), ki so potekale na preučevanem območju v letih 2013 in 2014. Raziskava je izhajala iz delovne hipoteze, da prebivalci Ljubljane zaznavajo onesnaženost zraka v mestu kot glavni okoljski problem, vendar sočasno prepoznavajo tudi izboljšanje kakovosti zraka.

2 METODE DELA

Zaznavanje kakovosti zraka smo v raziskavi ugotavljali z anketiranjem, ki smo ga spomladi 2013 izvedli v Mestni občini Ljubljana (MOL), in sicer na urbanem območju

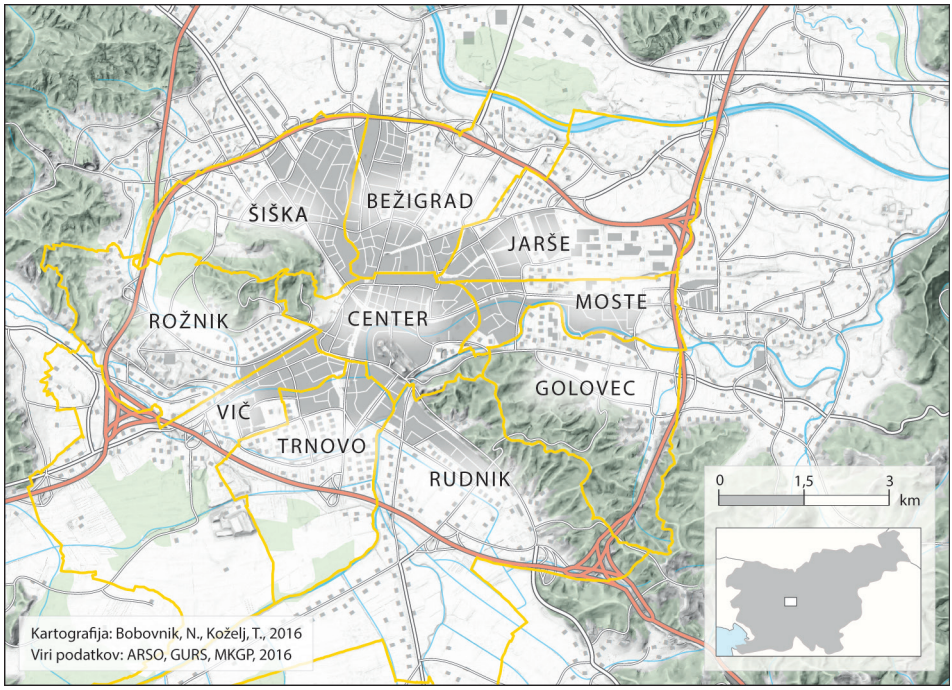
znotraj avtocestnega obroča. Anketarji[1] so bili razporejeni po celem območju sorazmerno s številom prebivalcev v posameznih četrtnih skupnostih Ljubljane, izbor sodelujočih pa je bil naključen. Skupno je bilo v mestu izvedenih 1672 anket. Sodeloval je lahko le en član gospodinjstva, starejši od 15 let. Anketarji so anketirance obiskali osebno na domu in jih povprašali o različnih vidikih stanja okolja v soseski, kjer imajo stalno ali začasno prebivališče.

Glede na opisana izhodišča anketiranja smo v raziskavo vključili 0,6 % vseh prebivalcev občine, ki je v prvi polovici leta 2013 imela skupno 282.994 prebivalcev (Prebivalstvo po velikih …, 2015). Dejansko pa je bil delež vključenih na preučevanem območju večji, saj je bilo anketirano le prebivalstvo osrednjega dela občine, ki leži znotraj avtocestnega obroča. Skupno je sodelovalo vsaj 1,4 % gospodinjstev v občini (leta 2011 je bilo v MOL skupno 119.281 gospodinjstev – Prebivalstvo, gospodinjstva …, 2015). Med anketiranci je bilo 45,6 % moških in 54,4 % žensk, s čimer je delež sodelujočih žensk le za 2,4 % presegal delež žensk v prebivalstvu MOL leta 2013. Vzorec se je tako po spolni sestavi dobro približal reprezentativnosti, ustrezen pa je bil tudi po starostni sestavi. Največje odstopanje od deleža posamezne starostne skupine v prebivalstvu MOL v letu anketiranja je doseglo 2,8 % pri mladih v starosti 15–24 let, saj jih je bilo med anketiranci 16,9 %, v občini pa le 14,1 % (Prebivalstvo po velikih …, 2015). Presoja reprezentativnosti vzorca glede na izobrazbeno sestavo je težavna, saj so zadnji celoviti podatki o izobrazbeni sestavi iz popisa 2002 (Prebivalstvo, staro 15 let …, 2015), v vmesnem času pa se je tako v državi kot tudi občini izobrazbena sestava pomembno izboljšala. Vseeno lahko ugotovimo, da je v anketi sodeloval primerjalno bistveno nižji delež prebivalcev z osnovnošolsko izobrazbo in bistveno višji delež prebivalcev z najvišjimi stopnjami izobrazbe. Tudi sorodne raziskave (Polajnar Horvat, 2014) so ugotavljale večjo pripravljenost sodelovanja pri visoko- in višješolsko izobraženih. Poudariti velja tudi, da so anketiranci na lokaciji anketiranja v povprečju prebivali 23,6 leta, zato je upravičeno pričakovanje, da lahko verodostojno ocenjujejo dolgoročne spremembe v svojem bivalnem okolju.

V članku analiziramo odgovore anketirancev, ki so se nanašali na oceno problematičnosti stanja posameznih okoljevarstvenih področij (onesnaženost vode, onesnaženost prsti, hrup, svetlobno onesnaževanje, ravnanje z odpadki) v primerjavi z oceno problematičnosti onesnaženosti zraka. Anketiranci so podali tudi mnenje o glavnih povzročiteljih onesnaženosti zraka in drugih sestavin okolja, ocenili pa so tudi trende spreminjanja onesnaženosti. Odgovore smo analizirali glede na lokacijo prebivanja anketirancev kot tudi na ravni posameznih četrtnih skupnosti (znotraj preučevanega območja je v celoti ali deloma deset od skupno sedemnajstih četrtnih skupnosti MOL) in celega preučevanega območja. Z namenom preučitve prostorskega vzorca razporejanja odgovorov so bili vsi rezultati analizirani s pomočjo geografskih informacijskih sistemov. Za prostorsko interpolacijo smo uporabili metodo kriginga, ki na podlagi vrednosti znanih točk določi interpolirano vrednost vmesnih območij (How Kriging …, 2016).

1 Anketiranje so aprila 2013 izvedli študenti 3. letnika geografije v okviru vaj predmeta Ekološka geografija. Vsem sodelujočim študentkam in študentom se najlepše zahvaljujemo za skrbno opravljeno delo. Posebna zahvala za natančno preverjanje vnosov, pomoč pri obsežni obdelavi zbranih podatkov in pripravi kartografskih prikazov velja kolegu Nejcu Bobovniku.

Slika 1: Preučevano območje s četrtnimi skupnostmi Mestne občine Ljubljana.



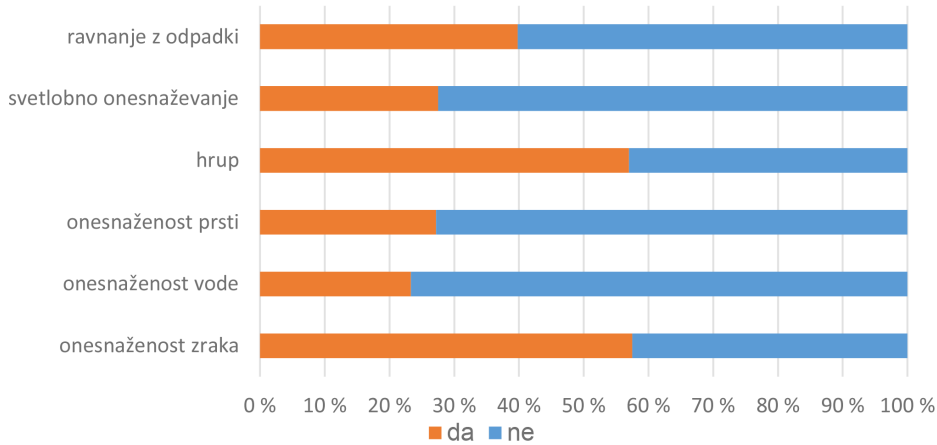
Subjektivne zaznave anketirancev smo primerjali z razpoložljivimi rezultati meritev kakovosti zraka. Na preučevanem območju ARSO redno meri posamezna onesnaževala na merilnih postajah Ljubljana Bežigrad (merilno mesto mestnega ozadja) in Ljubljana Biotehniška fakulteta (merilno mesto mestnega ozadja), medtem ko je del Okoljskega merilnega sistema MOL merilno mesto Ljubljana Center (lokacija ob križišču Vošnjakove ulice in Tivolske ceste spada v tip prometnega merilnega mesta). Za primerjavo onesnaženosti zraka z ozonom in dušikovim dioksidom smo lahko uporabili tudi rezultate meritev z difuzivnimi vzorčevalniki (Ogrin in sod., 2014), ki so znotraj avtocestnega obroča Ljubljane potekale v letih 2013 in 2014.

3 REZULTATI IN RAZPRAVA

Z namenom postavitve zaznavanja kakovosti zraka v širši kontekst zaznavanja okoljskih problemov v soseskah, kjer prebivajo, so morali anketiranci uvodoma za vsako izmed ključnih okoljskih področij (tj. ravnanje z odpadki, svetlobno onesnaževanje in hrup, onesnaženost zraka, vode in prsti) oceniti, če je stanje na posameznem področju problematično (odgovor »da«) ali ne (odgovor »ne«) (slika 2). Na ravni celega preučevanega območja Ljubljane velja izpostaviti ugotovitev, da je več kot polovica vprašanih za problematična opredelila onesnaženost zraka (57,5 %) in hrup (57,0 %). Več kot tretjina

anketirancev je izpostavila še ravnanje z odpadki (39,8 %), vendar so bila mnenja o tem med četrtnimi skupnostmi zelo deljena, saj je denimo z ravnanjem z odpadki v četrtni skupnosti Golovec nezadovoljnih kar 53 % vprašanih, v četrtni skupnosti Rudnik pa le 15 %. V splošnem je največji delež anketiranih (76,7 %) kot neproblematično označil onesnaženost vode, prav tako skoraj tri četrtine vprašanih v svoji soseski ni zaznalo problema onesnaženosti prsti (72,8 %) in svetlobnega onesnaževanja (72,5 %). V posameznih soseskah so prebivalci kljub temu izpostavili moteče svetlobno onesnaževanje, zlasti na območju četrtnih skupnosti Center (moteče za 39,2 % vprašanih) in Bežigrad (moteče za 36,1 % vprašanih).

Slika 2: Delež anketirancev, ki opredeljujejo stanje posameznega okoljskega področja v soseski za problematično.



Vir: Anketiranje ..., 2013.

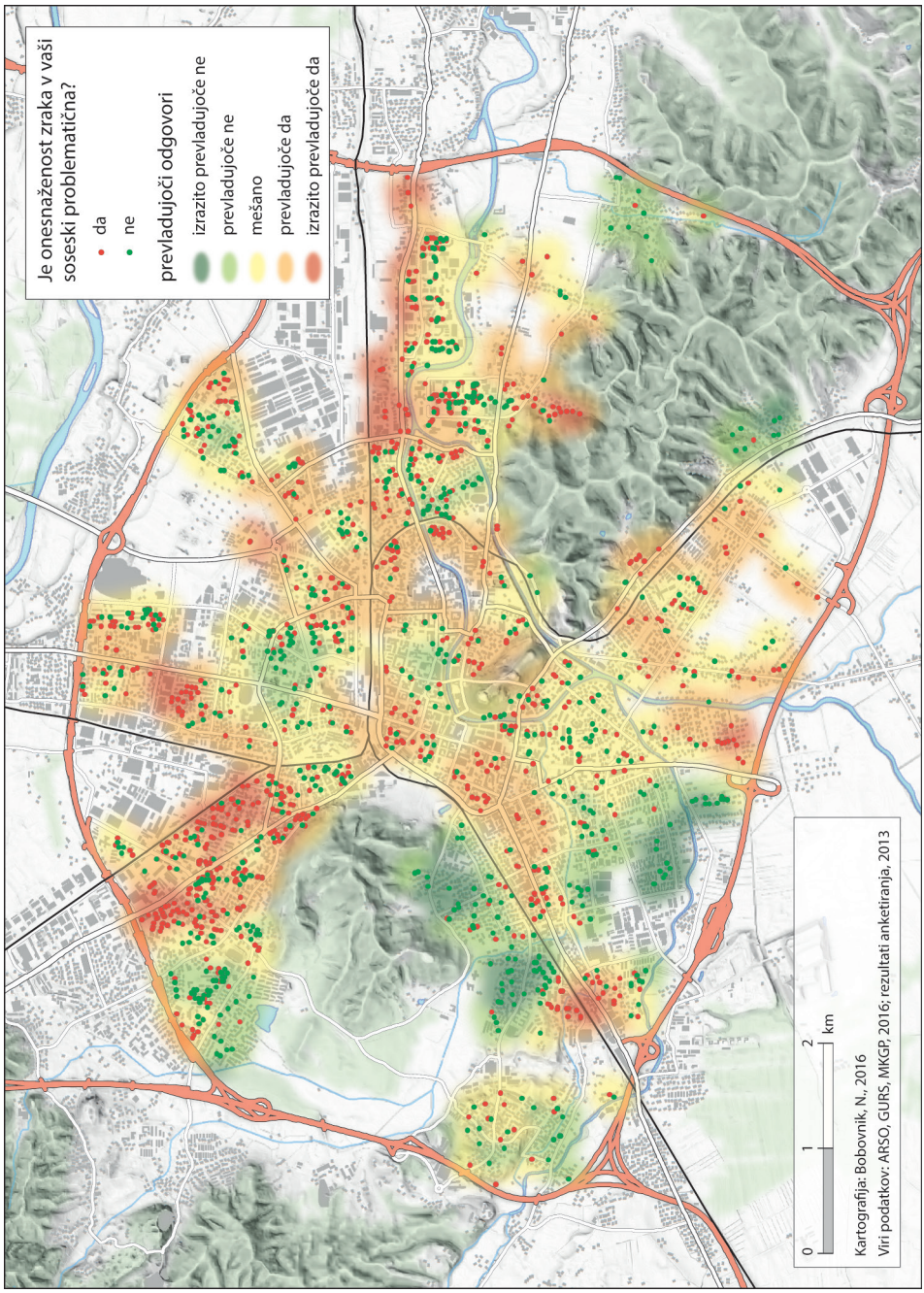
Na onesnaženost zraka, ki jo je kot okoljski problem izpostavil največji delež anketirancev v mestu, so na ravni četrtnih skupnosti najbolj pogosto opozarjali v Centru (68,1 %), najmanj pa na območju Rožnika (32,0 %). V večini četrtnih skupnosti je bila onesnaženost zraka izpostavljena najpogosteje, le na območju četrtnih skupnosti Bežigrad, Center, Trnovo in Rožnik je bil pogosteje kot problematičen opredeljen hrup. Oba prevladujoča okoljska problema anketiranci večinsko povezujejo s prometom, ki naj bi bil po mnenju 73 % vprašanih glavni povzročitelj onesnaženosti zraka in po mnenju kar 82 % vprašanih tudi glavni vir hrupa. Hrup in onesnažen zrak sta kot glavna okoljska problema v bivalnem okolju globoko zakoreninjena v zavesti ljudi, saj so do podobnih ugotovitev prišle tudi raziskave v geografsko drugačnih, pretežno podeželskih območjih Koprskega Primorja in Prekmurja (Vintar Mally, 2009). Tudi leta 2015 izvedena evropska raziskava kakovosti življenja v 79 evropskih mestih (Quality of life …, 2016), za katero so anketirali okrog 500 prebivalcev posameznega mesta, je opozorila na velik pomen, ki ga prebivalci Ljubljane

pripisujejo kakovostnemu zraku. Med tremi najpomembnejšimi problemi, s katerimi se sooča Ljubljana, so namreč izpostavili brezposelnost (43 %), zdravstveno oskrbo (41 %) in onesnaževanje zraka (25 %). V isti raziskavi je kar 76 % sodelujočih prebivalcev slovenske prestolnice zagotovilo, da so zadovoljni s kakovostjo zraka (od tega jih je bila tretjina celo zelo zadovoljna z njo), kar je bistveno večji delež v primerjavi s sodelujočimi v naši raziskavi (42,5 %), ki so onesnaženost zraka izpostavili kot neproblematično. Leta 2015 se je Ljubljana med evropskimi prestolnicami uvrstila na šesto mesto po zadovoljstvu s kakovostjo zraka (za Dunajem, Helsinki, Dublinom, Luksemburgom in Stockholmom) in na deveto mesto po zadovoljstvu s stopnjo hrupa, s katero je bilo zadovoljnih 74 % vprašanih prebivalcev Ljubljane (Quality of life …, 2016). Sklepamo lahko, da izražajo prebivalci v svojem lokalnem okolju večje nezadovoljstvo s kakovostjo okolja kakor v raziskavah, ki sugerirajo primerjavo njihovega mesta z drugimi evropskimi mesti.

Pri podrobnejši analizi prostorskega vzorca (slika 3), tudi s pomočjo prostorske interpolacije na podlagi metode kriginga, je mogoče opredeliti nekaj večjih območij v mestu Ljubljana, kjer so prebivalci še posebej pogosto izpostavili problem onesnaženosti zraka. Po velikosti izstopa območje v Šiški, ki se vzhodno od Celovške ceste širi vse do železniške proge, na južni strani pa sega do Drenikove ulice. Zaznavanje problema onesnaženega zraka izrazito prevladuje tudi zahodno od Celovške ceste, zlasti Na jami ter v pasu med Šišensko cesto in mestno obvoznico. Nedaleč vstran, na območju Kosez, pa so prebivalci kljub bližini obvoznice izražali pretežno nasprotno mnenje in onesnaženosti zraka niso zaznavali kot problematične. Izstopajoče visok delež prebivalcev je izpostavljal onesnažen zrak še vzdolž Založke ceste (vzhodno od križišča s Kajuhovo ulico), v Štepanjskem naselju, v delih Bežigrada (zlasti med Posavskega ulico in Tolstojevo ulico, zahodno od Dunajske ceste) in v središču mesta, kjer je več manjših območij zgostitve tovrstnih odgovorov. V četrtni skupnosti Center je tudi sicer kar 68 % vprašanih kakovost zraka označilo za problematično. Med obsežnejšimi območji, kjer je zadovoljstvo s kakovostjo zraka največje, velja poleg Kosez izpostaviti še dele Rožne doline in Viča severno od železniške proge, zahodni del Murgel ter predel Bežigrada med Linhartovo cesto in Topniško ulico.

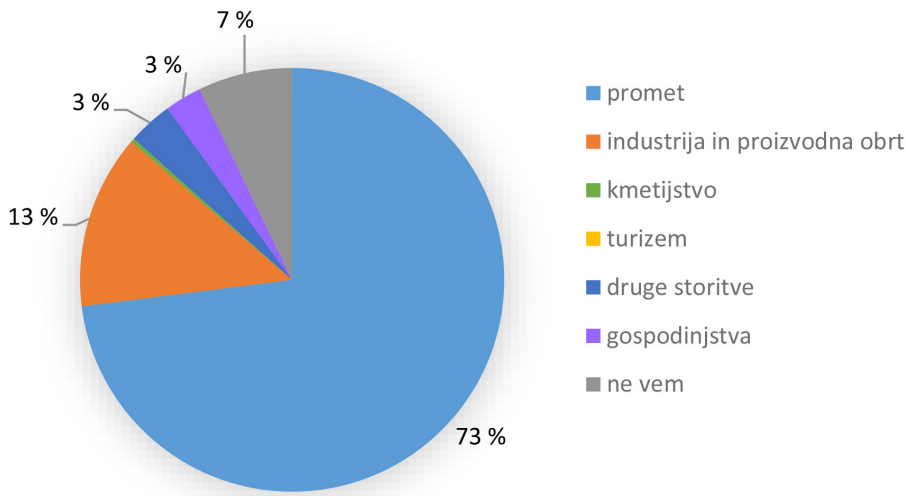
Primerjava mnenj prebivalcev z objektivnimi meritvami kakovosti zraka v mestu je zelo omejena, saj sta v redne meritve onesnaževal in meteoroloških parametrov vključeni le merilni mesti Ljubljana Bežigrad in Ljubljana Center, koncentracije PM delcev pa merijo tudi pri Biotehniški fakulteti. Rezultati meritev so v letu 2013 pokazali nekoliko manjšo onesnaženost zraka od običajne, kar je bila predvsem posledica ugodnejših vremenskih razmer in s tem povečane samočistilne sposobnosti. Tudi v tem letu je bila problematična onesnaženost zraka s PM delci in ozonom, na prometno izpostavljenih mestih pa tudi z dušikovim dioksidom. Znotraj celotne merilne mreže v Sloveniji je bila namreč leta 2013 presežena letna mejna vrednost za PM_{10} le na merilnem mestu Ljubljana Center, kjer je bila kar 74 dni v letu presežena tudi dnevna mejna vrednost (dovoljeno število prekoračitev na leto je 35). Slednja je bila po več kot 20 dni prekoračena tudi na obeh merilnih mestih mestnega ozadja. Prav tako je bila v poletnih mesecih skupno 29-krat prekoračena ciljna 8-urna vrednost (120 $\mu g/m^3$) za ozon na merilnem mestu Ljubljana Bežigrad (Cegnar in sod., 2014). Poleti 2013 so bile z difuzivnimi vzorčevalniki izvedene meritve ozona na 16 različnih lokacijah v mestu. V tritedenskem merilnem obdobju so

Slika 3: Problematičnost onesnaženosti zraka v Ljubljani po mnenju anketirancev.



zabeležile povprečne koncentracije višje od 40 µg/m^3 na območju peš con (npr. Tromostovje, Stari trg) oziroma mestnega ozadja v mirnih soseskah Bežigrada, Murgel in Kodeljevega. Nižje poletne koncentracije ozona pa so imela merilna mesta pod neposrednim vplivom prometnih izpustov, ki prispevajo k razkrajanju ozona. Na osnovi poletnih in zimskih meritev koncentracij dušikovega dioksida so bile v okviru iste raziskave izračunane povprečne letne koncentracije dušikovega dioksida (za obdobje od februarja 2013 do februarja 2014) na 81 merilnih mestih v Ljubljani (Ogrin in sod., 2014). Na splošno so bile koncentracije dušikovega dioksida najnižje v mestnem ozadju, najvišje pa v zaprtih cestnih koridorjih, čeprav za njimi niso dosti zaostajala niti merilna mesta ob drugih prometno bolj obremenjenih cestah. Najvišje koncentracije so bile izmerjene ob mestnih vpadnicah, neposredno ob mestni obvoznici in v središču mesta (Vintar Mally, Ogrin, 2015). Tudi redni monitoring v Sloveniji je v zadnjih letih nameril prekoračeno letno mejno koncentracijo dušikovega dioksida na prometnem merilnem mestu Ljubljana Center (Cegnar in sod., 2014). Opisanih razmer se vsaj deloma zagotovo zavedajo tudi prebivalci, saj so v neposredni bližini prometno najbolj obremenjenih cest pogosteje izpostavljali problematiko onesnaženosti zraka v primerjavi s prebivalci prometno mirnejših sosesk.

Slika 4: Glavni povzročitelj onesnaženosti zraka v Ljubljani po mnenju anketirancev.



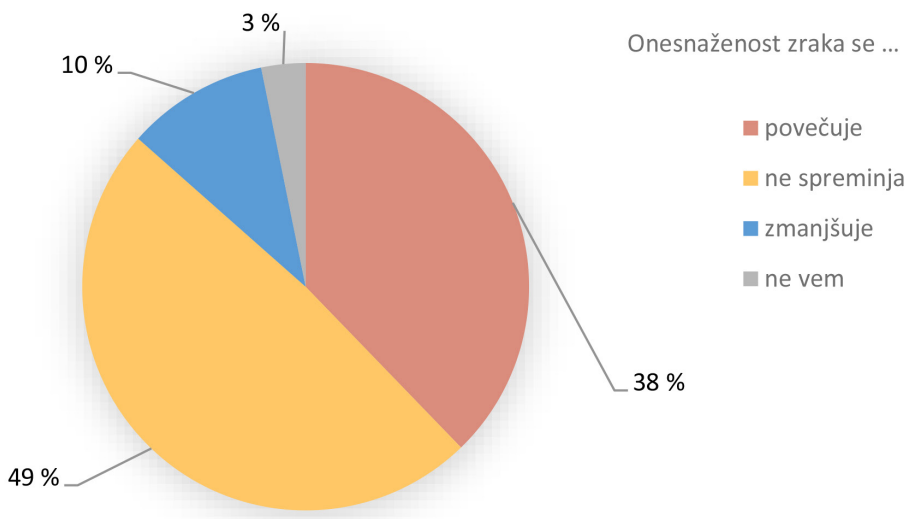
Vir: Anketiranje ...,2013.

Anketiranci se dobro zavedajo vplivov prometa na kakovost zraka, saj je kar 73 % vprašanih v njem prepoznalo glavnega povzročitelja onesnaženosti zraka v Ljubljani (slika 4). Po posameznih četrtnih skupnostih je delež tega odgovora znašal od 52,6 % (Jarše) do 82,4 % (Center). Prepričanja prebivalcev potrjujejo izračuni energetske bilance za MOL, ki denimo za leto 2009 ugotavljajo, da je promet prispeval 52 % emisij trdnih delcev in 60 % emisij dušikovih oksidov (Cerkvenik, Persovšek, Podboj, 2010). Dušikovi

oksidi so problematični tudi v vlogi predhodnikov ozona, promet pa v Sloveniji na splošno prispeva največji delež (41 %) vseh izpustov predhodnikov ozona (Logar, 2016). Promet je tudi sicer pogosto opredeljen kot glavni vir pritiskov na okolje v Ljubljani (Plut, 2007; Špes, 2007). Več kot desetina anketiranih (13,3 %) je za glavnega onesnaževalca zraka navedla industrijo in proizvodno obrt, zlasti v četrtnih skupnostih Jarše (23,7 %) in Moste (25,2 %). Njihovo prepričanje lahko deloma pripišemo bližini proizvodnih obratov v teh delih mesta. Le 2,8 % vprašanih je izpostavilo gospodinjstva, ki k emisijam ne prispevajo le posredno s prometom, ampak tudi neposredno z ogrevanjem stavb, saj individualna kurišča med kurilno sezono prispevajo največ izpustov PM delcev. Glede na razporeditev odgovorov lahko sklepamo, da se prebivalci bolj zavedajo svojega prispevka k onesnaževanju zraka s prometom kot pa zaradi ogrevanja stavb.

Skoraj polovica vprašanih prebivalcev Ljubljane je prepričana, da se kakovost zraka ne spreminja, kar 38 % pa jih ocenjuje, da se onesnaženost zraka v mestu celo povečuje (slika 5). V mnenju prebivalcev se očitno ne odraža uspešno znižanje emisij in koncentracij žveplovega dioksida v mestu, ki je bilo posledica zamenjave energentov in izgradnje čistilnih naprav na glavnih onesnaževalcih. Po drugi strani pa velja prepričanje anketirancev pripisati zavedanju onesnaženosti zraka z ozonom v poletnem času ter s PM delci in dušikovimi oksidi v zimskem času. Prevladujoče negativno mnenje o kakovosti zraka v Ljubljani je zagotovo tudi posledica medijske izpostavljenosti nedovoljeno visokega števila prekoračitev dnevne mejne vrednosti PM_{10}, zaradi česar je Slovenija ravno v letu anketiranja prejela tudi opomin Evropske komisije. Sklepamo lahko tudi, da mnogi anketiranci z onesnaženostjo zraka povezujejo naraščajoče izpuste toplogrednih plinov in so se tudi na podlagi tega

Slika 5: Trend spreminjanja onesnaženosti zraka v Ljubljani po mnenju anketirancev.



Vir: Anketiranje ..., 2013.

odločali za negativno oceno, čeprav ti izpusti večinoma ne vplivajo na lokalno kakovost zraka. Tudi meritve onesnaževal v Ljubljani ne potrjujejo domnev anketirancev. V obdobju 2002–2013 niso na merilnem mestu Ljubljana Bežigrad trendov povečevanja onesnaževal pokazale niti povprečne letne koncentracije ozona niti dušikovega dioksida (na medletna nihanja so še najbolj vplivale vremenske razmere, opaznega trenda sprememb pa ni bilo), koncentracije PM_{10} delcev pa so se celo zmanjšale (Cegnar in sod., 2014).

Da je kljub objektivno izmerjenemu znižanju onesnažil pri lokalnem prebivalstvu globoko zakoreninjeno prepričanje, da se kakovost zraka ne izboljšuje oziroma se celo slabša, poročajo tudi druge raziskave po svetu (Schwartz, 2006), ki izpostavljajo tudi odsotnost statistično pomembnih korelacij med izmerjenimi koncentracijami onesnaževal in zaznavanjem (percepcijo) kakovosti zraka anketirancev (Brody, Peck, Highfield, 2004; Paas in sod., 2016). Zaradi pomanjkanja merilnih mest v Ljubljani ni možno ugotavljanje statističnih povezav meritev z mnenji anketirancev, lahko pa na osnovi drugih rezultatov domnevamo, da bi prišli do podobnih ugotovitev.

4 SKLEP

Preučitev zaznavanja kakovosti zraka v Ljubljani je potrdila hipotezo v delu, ki je predpostavljal, da je onesnaženost zraka za prebivalce mesta glavni okoljski problem. Na ravni celega mesta je namreč več kot polovica anketirancev opredelila onesnaženost zraka za problematično in tudi v večini mestnih četrti je bil onesnažen zrak najpogosteje označen kot problematičen. Le v štirih četrtnih skupnostih je prebivalce pogosteje motil hrup, ki je bil tudi na splošno drugi najpogosteje izpostavljeni okoljski problem v mestu. Vzrok za onesnažen zrak in hrup v soseski so anketiranci najpogosteje pripisali prometu, kar se večinoma ujema tudi z ugotovitvami stroke. Nasprotno pa se ni potrdilo pričakovanje, da bodo prebivalci prepoznali tudi izboljšanje kakovosti zraka v mestu. V zmanjševanje onesnaženosti zraka je prepričana le desetina anketirancev, polovica ni zaznala sprememb, kar 38 % vprašanih pa je menilo, da se onesnaženost zraka celo povečuje.

Glede na ugotovitve raziskave ostaja prepričanje o slabi kakovosti zraka v Ljubljani globoko zakoreninjeno kljub namerjenim manjšim koncentracijam onesnaževal v zraku. Predvsem se prebivalci zavedajo pritiskov prometa na stanje okolja, kar deloma izvira tudi iz aktivne politike ozaveščanja, zlasti prizadevanja občine za spodbujanje trajnostne mobilnosti v mestu, in medijske odmevnosti izstopajočih problemov, kot je pogostost preseganja mejnih vrednosti PM delcev in onesnaževanje z dušikovim dioksidom ob prometno najbolj obremenjenih cestah. Manjše pa je zavedanje onesnaževanja iz individualnih kurilnih naprav, na katere ima tudi občina manj možnosti vplivanja. Prav zavedanje o okoljskih problemih je ključno na poti njihovega reševanja, zato predstavljeni vidiki zaznavanja kakovosti zraka nudijo tudi izhodišče za razmislek načrtovalcev razvoja mesta v prihodnosti.

Literatura in viri

Glej angleško različico prispevka.

PERCEPTIONS OF AIR QUALITY IN LJUBLJANA

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Abstract
This article presents the results of research examining perceptions of air quality in the city of Ljubljana based on extensive interviews. Perceptions of air quality are also compared with perceptions of other environmental problems, as well as to data from air quality monitoring in the study area. The findings suggest that residents perceive air pollution as a major environmental problem in the city and that people remain firmly convinced of Ljubljana's poor air quality despite its overall improvement.

Keywords: air pollution, air quality, perception of environmental problems, monitoring, Ljubljana, Slovenia

1 INTRODUCTION

Due to population densities and a diverse range of human activities, urban areas are faced with the problem of air pollution which particularly affects cities with limited self-cleaning capacities. Air pollution has a significant impact on the quality of other components of the environment and on the quality of the living environment, whilst it also has a significant direct impact on the health and well-being of the population.

Though residents were aware of air pollution in the past, the then Hydrometeorological Institute of Slovenia only started recording regular measurements in Slovenia and Ljubljana in the second half of the 1960s. From the first measurements, they showed very high levels of air pollution in basins and valleys, which were attributed to their limited self-cleaning capacities due to frequent ground-level temperature inversions and poor ventilation (Hrček, 2014). An additional factor identified, even back in those times, was a heat island effect in Ljubljana, causing air flows towards the city centre (Planinšek, Hrček, 2014). At first, air pollution was equated to concentrations of sulphur dioxide and smoke, and it was only decades later that environmental policies began to focus also on other pollutants and reactions between them (nitrogen oxides, hydrocarbons, photochemical smog, ozone). In fact, the first measurements of nitrogen oxides and ozone in Ljubljana were undertaken back in 1975 (Rajh Alatič, 2014), though at the time,

concentrations of sulphur dioxide and smoke were still the centre of attention. These measurements contributed to raising awareness of the population and the expansion of district heating in urban areas as well as influencing the legislative regulation of this field and spatial planning. Thus, in Ljubljana, households were encouraged to connect into the district heating network serviced by the Moste heating plant and smaller boiler stations were also closed down (Hrček, 2014; Planinšek, Hrček, 2014). In the 1980s and 1990s, environmental protection measures in the energy and industry sectors, restructuring of the economy and changing energy sources gradually resolved the problems of sulphur dioxide in Slovenian cities. Increased environmental awareness and understanding of the (health) impacts of air pollution shifted attention to other pollutants and measurements. In recent years, experts (Cegnar et al., 2014) have assessed that concentrations of ozone and sub-10µm particulate matter (PM_{10}) represent the most pressing air pollution problems in Slovenia, with their levels amongst the highest within European Union countries, both in terms of emissions per capita and per unit area. Excessive particle pollution is a result of primarily local emissions from road traffic and heating of buildings, which has in recent years, as a result of the economic crisis, increasingly relied on burning of biomass or even coal in outdated heating facilities (Ogrin, Vintar Mally, 2013; Odlok o načrtu ..., 2014).

In order to implement environmental protection measures relating to air quality or other components of the environment, it is desirable that the (local) population are aware of the environmental problems. However, perceived quality of components of the environment is only partly based on knowledge and understanding of the issues. Špes (1998), for instance, points out that perceptions of environmental quality and the actual pollution levels or else the state of the environment may differ, since perceptions depend on an individual's readiness and ability to perceive, which in turn are influenced by numerous factors. Just as findings of experts are important, so too are perceptions of the population, since both underpin reactions and decisions of the population, including efforts to protect the environment and increase the quality of life. In this context, Polajnar Horvat (2014) defines people's perceptions along with their understanding and awareness of environmental problems as integral aspects of environmental awareness that instills in humans a concern and potentially leads them to address the problems.

The aim of this paper was to explore residents' perceptions of air quality and pollution in the city of Ljubljana and, furthermore, to compare these findings with perceptions of other environmental protection issues (water pollution, soil contamination, noise pollution, light pollution, waste management), as well as with data of monitored air quality in the study area. Large-scale surveying in city districts within the ring road provided insights into individuals' perceptions of air quality, allowed for comparisons with data from monitoring and enabled nomothetic analysis for identification of patterns. To compare perceptions with measured concentrations of pollutants and their changing trends, we used data from ARSO - Slovenian Environment Agency (Cegnar et al., 2014) and measurements from diffusive samplers (Ogrin et al., 2014), that were gathered in the study area in 2013 and 2014. The study was based on the working hypothesis that residents of Ljubljana perceive air pollution in the city as a major environmental problem, whilst at the same time also recognising that air quality has improved.

2 RESEARCH METHODS

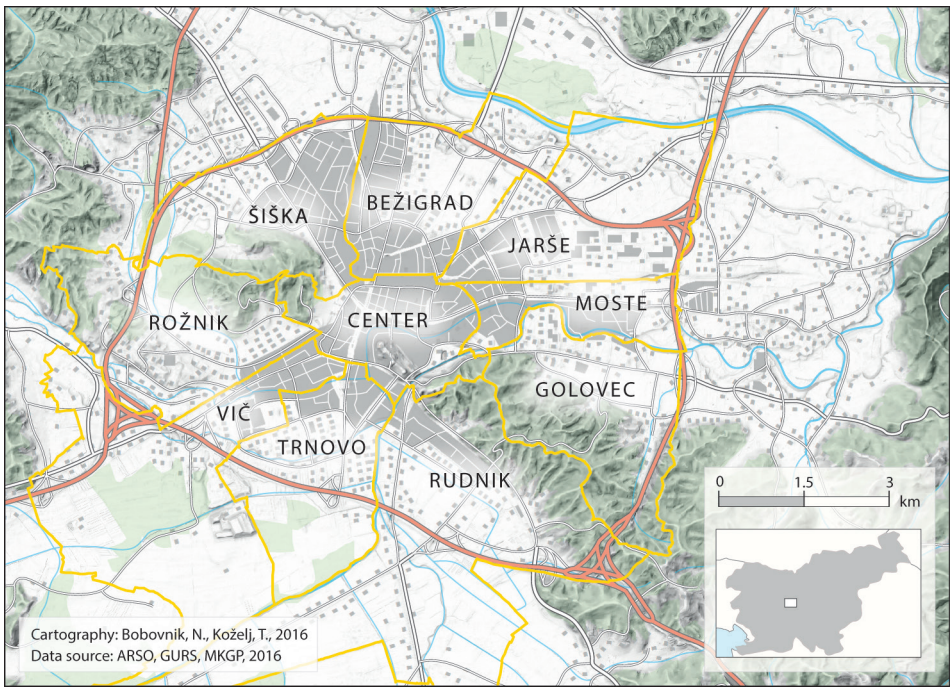
In this study, we assessed perceptions of air quality via surveys conducted in spring 2013 in the City Municipality of Ljubljana (MOL), specifically in the urban area within the ring road. Interviewers were distributed throughout the area in proportion to the number of residents in each district in Ljubljana. Selection of participants was random. In total, 1,672 surveys were conducted. Only one member of a household, older than 15 years, was allowed to participate. Interviewers[1] visited the respondents at their homes in person and questioned them on the state of the environment in the neighbourhood, where they permanently or temporarily resided.

With reference to the outlined survey design, 0.6% of the municipality's population were included in the study; the total population in the first half of 2013 was 282,994 (Prebivalstvo po velikih ..., 2015). However, the study area was restricted to the central part of the municipality within the ring road, hence the actual participation rate for the population in the study area was even greater. A total of at least 1.4% of households in the municipality participated in the study (in 2011 there were a total of 119,281 households in MOL - Prebivalstvo, gospodinjstva …, 2015). 45.6% of respondents were men and 54.4% women; the proportion of women participating was thus only 2.4% above the ratio of women in the MOL population in 2013. Therefore, the sex structure within the sample was very close to representative. The age structure of the sample was also appropriate. The largest deviation between our sample and the population of MOL at the time of the survey regarding individual age groups was 2.8% for young people aged 15–24 years, representing 16.9% of respondents compared to 14.1% of the municipal residents (Prebivalstvo po velikih …, 2015). Assessing how representative the sample was in terms of educational structure is problematic, as the last comprehensive data on educational structure was gathered in the 2002 census (Prebivalstvo, staro 15 let …, 2015), while since then, the educational structure of the country as well as of the municipality has improved significantly. Despite this, we were able to determine that, comparatively, our sample group included a much smaller proportion of the population with only primary school education and a substantially larger proportion of the population with the highest levels of education. Similar research (Polajnar Horvat, 2014) likewise revealed that people with post-secondary or higher education are more willing to participate in surveys. It should be noted that, on average, respondents had lived at the place where the survey occurred for 23.6 years, hence it is reasonable to expect they were able to credibly evaluate long-term changes in their living environments.

In this paper, we analyse respondents' answers relating to their assessments of the status of individual environmental protection issues (water pollution, soil contamination, noise pollution, light pollution, waste management), in comparison with their assessment of air pollution. Furthermore, respondents conveyed their opinions on the main causes of air pollution and pollution of other components of the environment. They also evaluated

1 The survey was conducted in April 2013 by 3rd year undergraduate geography students as part of the practical work in the Ecological Geography course. We wish to thank all students who participated for their diligent work. A special thanks goes to our colleague Nejc Bobovnik for carefully checking entered data, helping with large-scale processing of collected data and producing cartographic representations.

Figure 1: The study area featuring the inner-districts of the City Municipality of Ljubljana.



trends and changes in pollution. Answers were analysed with respect to the respondent's place of residence, as well as at the level of individual districts (ten out of a total of seventeen MOL districts lie either in part or in their entirety within the studied area) and for the entire study area. In order to examine the spatial pattern of answer distribution, all results were analysed using geographic information systems (GIS). Spatial interpolation was performed using kriging, where the interpolated values of the intermediate areas are determined based on values of known points (How Kriging ..., 2016).

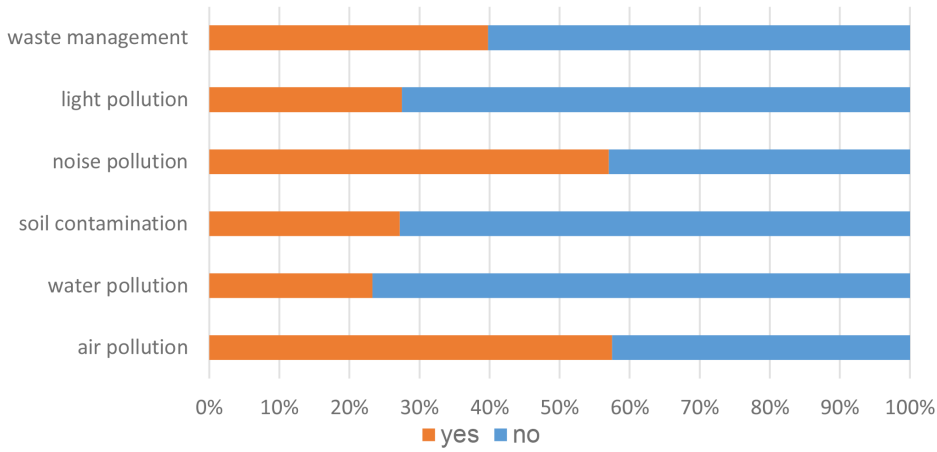
Respondents' subjective perceptions were compared to available air quality measurements in the study area, where ARSO regularly measures individual pollutants at measuring stations Ljubljana Bežigrad (an urban background measuring station) and Ljubljana Biotechnical Faculty (an urban background measuring station), while the Ljubljana Center measuring station (an urban-traffic measuring station located at the intersection of Vošnjakova Street and Tivolska Road) is part of the Environmental Measurement System of MOL. Measurements of ozone and nitrogen dioxide from diffusive samplers within the Ljubljana ring road taken in 2013 and 2014 (Ogrin et al., 2014) were used as well.

3 RESULTS AND DISCUSSION

With the aim to position perception of air quality into the broader context of perception of environmental issues in neighbourhoods where respondents lived, participants

were initially asked whether they consider the situation regarding individual key environmental issues (i.e. waste management, light and noise pollution, air pollution, water and soil contamination) as problematic (answer "yes") or not (answer "no") (Figure 2). It is worth mentioning that, looking at the entire study area in Ljubljana, more than half of respondents considered air (57.5%) and noise pollution (57.0%) as problematic. Furthermore, over a third of respondents thought waste management was also problematic (39.8%), although opinions were sharply divided among residents of different districts. For example, 53% of respondents in the Golovec district were dissatisfied with waste management compared to only 15% in the Rudnik district. In general, water pollution was considered least problematic (76.7% of respondents), moreover, almost three quarters of respondents did not perceive soil contamination (72.8%) and light pollution (72.5%) in their neighbourhood as problematic. Nevertheless, at the level of individual districts, most notably Center and Bežigrad, a significant number of respondents considered light pollution disturbing (39.2% for Center and 36.1% for Bežigrad).

Figure 2: Percentage of respondents who consider the situation regarding individual environmental issues in their neighbourhood as problematic.



Source: Anketiranje …, 2013.

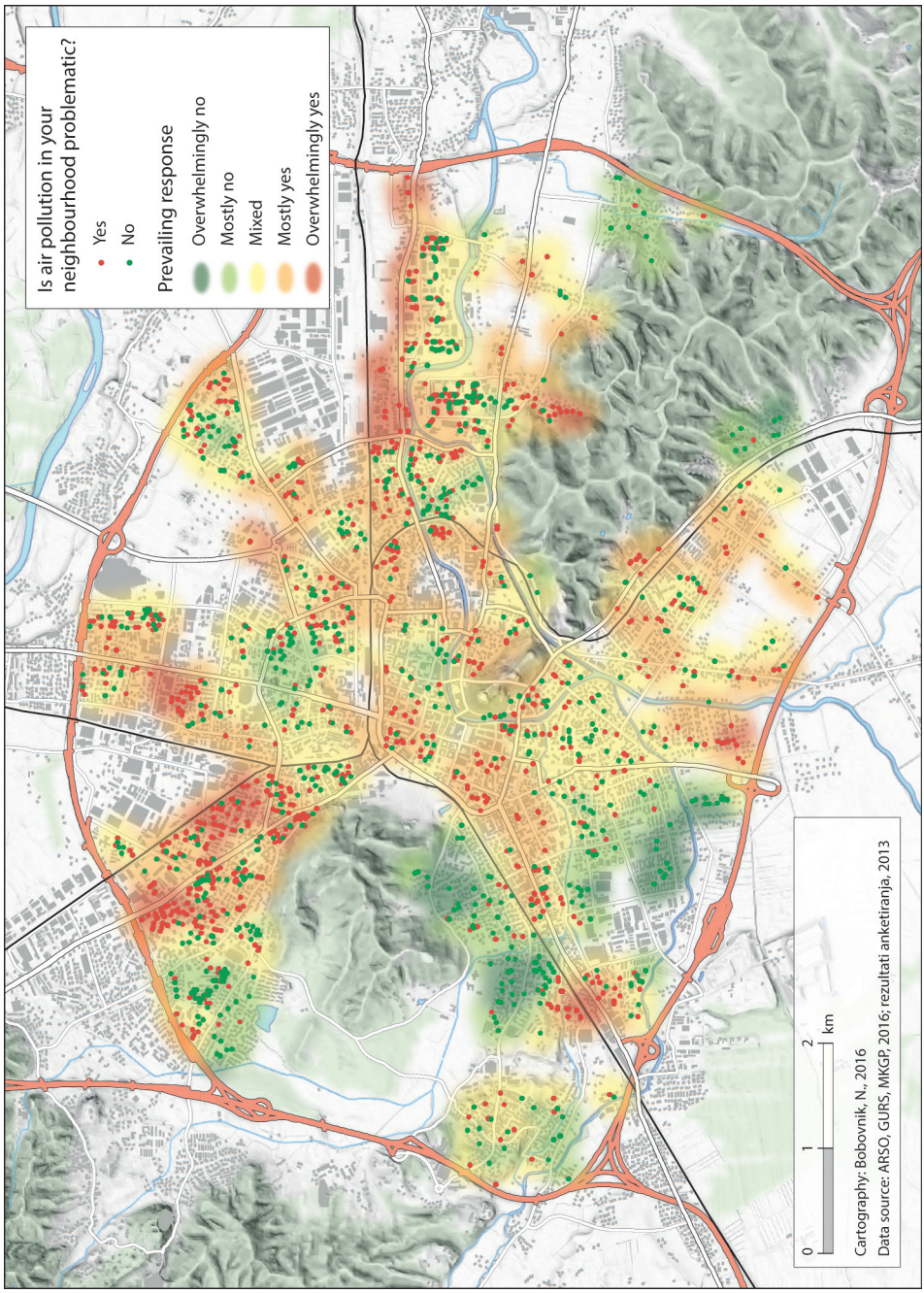
A majority of all respondents considered the issue of air pollution as problematic; at the level of individual districts it was most commonly noted in Center (68.1% of respondents) and least frequently in Rožnik (32.0% of respondents). In most districts air pollution was the most commonly perceived issue, aside from Bežigrad, Center, Trnovo and Rožnik, where noise pollution was more frequently perceived. A majority of respondents associated the two predominant environmental problems with traffic, which 73% and 82% of respondents identified as the main cause of air and noise pollution, respectively. Noise and air pollution are deeply rooted in people's minds as the main environmental

issues in the living environment, with similar findings having been revealed by research in geographically different, predominantly rural areas of the Koper Littoral and Prekmurje (Vintar Mally, 2009). The 2015 European survey on quality of life carried out in 79 European cities (Quality of Life ..., 2016), where about 500 residents of each city were interviewed, also revealed that Ljubljana's residents attach great importance to air quality. According to interviewees in that survey, the three most significant problems Ljubljana's residents are facing are unemployment (43%), health care (41%) and air pollution (25%). In the same survey, 76% of interviewees from the Slovenian capital stated they were satisfied with the quality of the air (of which one third were very satisfied with it). This is a significantly higher proportion compared to our study where 42.5% of respondents did not perceive air pollution in Ljubljana as problematic. In 2015, Ljubljana ranked sixth out of all European capitals in terms of satisfaction with air quality (behind Vienna, Helsinki, Dublin, Luxembourg and Stockholm) and ninth in terms of satisfaction with noise levels. Regarding the latter, 74% of interviewed residents in Ljubljana were satisfied (Quality of Life ..., 2016). We assume that people express greater dissatisfaction with the quality of the environment in their local area when studies are more restricted as opposed to in broader surveys where comparisons with other European cities are implicitly suggested.

Through a more detailed analysis of the spatial pattern of responses (Figure 3), using, inter alia, the method of spatial interpolation based on kriging, it is possible to identify a few relatively large areas of Ljubljana, where air pollution was particularly frequently considered problematic. Out of these, an area in the Šiška district stands out in terms of size, spreading eastward from Celovška Street all the way to the railway line and extending to Drenikova Street on the south side. Air pollution is also the most frequently perceived problem west of Celovška Street, especially in the Na jami area and in the narrow area between Šišenska Road and the ring road. Not far away, in Koseze district, residents expressed a contrary view despite the proximity of the ring road, such that air pollution was not perceived as a problem. A noticeably high proportion of the population highlighted the problem of air pollution also along Zaloška Road (east of the intersection with Kajuhova Street), in Štepanjsko naselje area, in parts of Bežigrad (especially between Posavskega and Tolstojeva Street, west of Dunajska Road) and in the city centre. In the latter, there were several smaller clusters of such responses. Moreover, 68% of the Center district respondents considered air quality in their neighbourhood problematic. Larger areas where satisfaction with air quality was greatest that are worth mentioning, besides Koseze district, include parts of Rožna dolina and Vič north of the railway line, the western part of Murgle and the area of Bežigrad between Linhartova Road and Topniška Street.

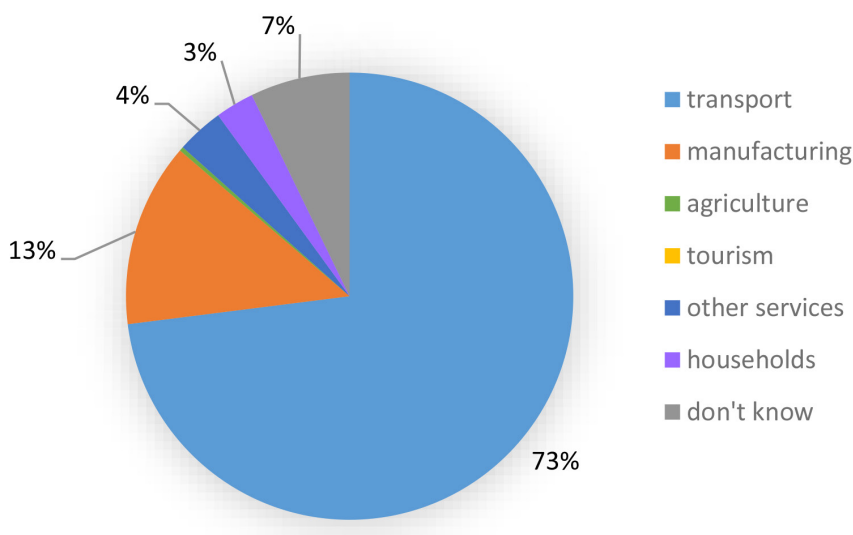
Comparisons of residents' opinions with objective air quality measurements in the city are possible only to a very limited extent, as only the Ljubljana Bežigrad and Ljubljana Center measuring stations are part of the network for continuous measuring of pollutants and meteorological parameters, whilst particulate matter (PM) concentrations are measured also next to the Biotechnical Faculty. Measurements in 2013 indicated slightly lower air pollution than usually, which was mainly due to favourable weather conditions leading to increased self-cleaning capacity. The recurrent issue of air pollution in terms

Figure 3: The problem of air pollution in Ljubljana based on survey responses.



of PM particles and ozone was again a problem in 2013 in Ljubljana, moreover, in heavy traffic areas nitrogen dioxide was also problematic. In fact, in 2013 the annual limit value for PM_{10} measured across the entire pollution monitoring network of Slovenia was exceeded only at the Ljubljana Center measuring station, where the daily limit value was exceeded in total on 74 days of the year (35 permitted exceedences per year). Furthermore, the daily limit value was exceeded on more than 20 days of the year at both of the urban background measuring stations. During summer months, the target 8-hour value for ozone (120 µg/m^3) was in total exceeded 29 times at the Ljubljana Bežigrad measuring station (Cegnar et al., 2014). In summer 2013, measurements of ozone concentrations were recorded by means of diffusive samplers at 16 different locations in the city. During the three-week measurement period, average concentrations higher than 40 µg/m^3 were recorded in pedestrian areas (e.g. Tromostovje [The Triple Bridge], Stari trg [Old Square]) and at urban background locations in the quiet neighbourhoods of Bežigrad, Murgle and Kodeljevo. Lower summer ozone concentrations were recorded at measuring points under the direct influence of traffic emissions, which contribute to ozone decomposition (Ogrin et al., 2014). In the same study, based on summer and winter measurements of nitrogen dioxide concentrations, average annual nitrogen dioxide concentrations were calculated (for the period from February 2013 to February 2014) at 81 measuring points in Ljubljana (Ogrin et al., 2014). In general, nitrogen dioxide concentrations were lowest at urban background locations and highest in closed street canyons, although measuring points along other heavy traffic roads were not far behind in this regard. The highest

Figure 4: Survey results on the main causes of air pollution in Ljubljana.



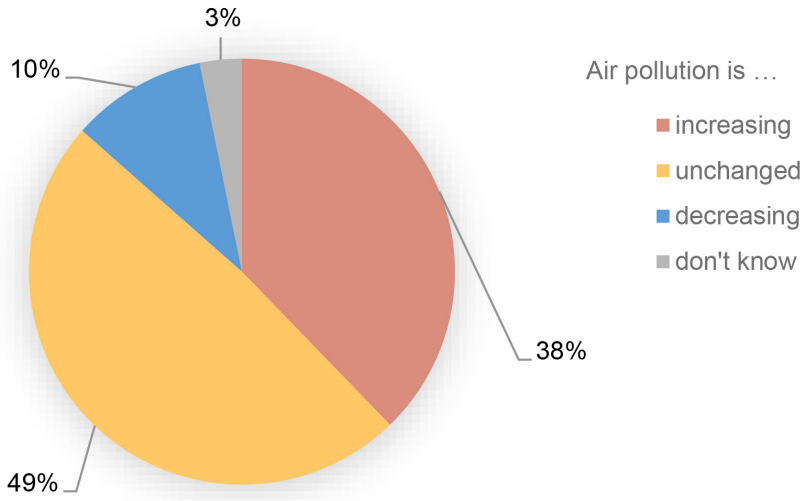
Source: Anketiranje ..., 2013.

concentrations were measured along city entrances, directly beside the city ring road and in the city centre (Vintar Mally, Ogrin, 2015). Continuous pollution monitoring in Slovenia revealed that in recent years the annual limit value for nitrogen dioxide concentrations has been exceeded at the Ljubljana Center urban-traffic measuring station (Cegnar et al., 2014). Residents were undoubtedly, at least in part, aware of the described situation, since respondents in the immediate vicinity of the busiest roads more frequently highlighted air pollution as a problem compared to respondents in low traffic neighbourhoods.

Respondents were well aware of the impact of traffic on air quality; as many as 73% of respondents saw it as the main cause of air pollution in Ljubljana (Figure 4), while in individual districts the proportion ranged from 52.6% (in Jarše) to 82.4% (in Center). Respondents' views were consistent with energy balance calculations for MOL, which, for instance, show that traffic accounted for 52% of PM emissions and 60% of nitrogen oxide emissions in 2009 (Cerkvenik, Persovšek, Podboj, 2010). Nitrogen oxides also present a problem functioning as precursors of ozone. In general, traffic is responsible for the largest proportion (41%) of all ozone precursor emissions in Slovenia (Logar, 2016). Furthermore, traffic is frequently identified as the major source of environmental pressures in Ljubljana (Plut, 2007; Špes, 2007). Over a tenth of respondents (13.3%) considered industrial production and craft manufacturing as the main sources of air pollutants, especially in Jarše (23.7%) and Moste (25.2%) districts, which can in part be attributed to the vicinity of production facilities in these parts of the city. Only 2.8% of respondents mentioned households in this regard, even though they not only indirectly contribute to emissions by increasing traffic, but also directly via heating of buildings. During the heating season, individual furnaces account for the majority of PM emissions. Based on the distribution of responses we can conclude that people are more aware of their own contribution to air pollution from transportation rather than household heating.

Almost half of the surveyed residents of Ljubljana believe that air quality has not changed, 38% of them thought air pollution in the city is actually increasing (Figure 5). The views of the population clearly do not reflect the success that has been achieved in reducing emissions and sulphur dioxide concentrations in the city, which came about due to changes in energy sources and the adoption of pollution control devices by large polluters. Respondents' beliefs could be attributed to their awareness that in summer air pollution is largely associated with ozone and in winter with PM and nitrogen oxides. Prevailing negative opinions on Ljubljana's air quality are certainly influenced also by media coverage of the breaching of yearly permitted exceedences of the daily limit value for PM_{10}, for which Slovenia received a formal notice from the European Commission right at the time of our survey. We can also infer that many respondents link air pollution with increasing greenhouse gas emissions and this contributed to their negative assessments, although these emissions largely do not affect local air quality. What is more, measurements of pollutants in Ljubljana do not support respondents' views. In the period 2002–2013 no trend of increase in pollutants was evident at the Ljubljana Bežigrad measuring station, neither in terms of ozone nor nitrogen dioxide average annual concentrations (weather conditions had the largest influence on yearly fluctuations and there was no observed change in trend), whilst PM_{10} concentrations actually declined (Cegnar et al., 2014).

Figure 5: Changes in air pollution in Ljubljana based on survey responses.



Source: Anketiranje ..., 2013.

Other studies (Schwartz, 2006) around the world also find that in spite of objective quantifiable reductions of pollutants, local residents hold onto a deep-rooted belief that air quality is not improving, or is even worsening. Additionally, some highlight the lack of statistically significant correlations between measured pollutant concentrations and perception of air quality by respondents (Brody, Peck, Highfield, 2004; Paas et al., 2016). Due to the lack of monitoring locations in Ljubljana it is not possible to identify statistical correlations between measured data and respondents' views, though looking at other studies we assume we would reach similar conclusions.

4 CONCLUSION

Examination of perceptions of air quality in Ljubljana confirmed the assumption within the hypothesis, which presumed that air pollution is a key environmental problem for the city's residents. Looking at the city as a whole, more than half of the respondents identified air pollution as problematic and, what is more, air pollution was the most frequently perceived environmental problem in a majority of the city's districts. Only in four districts residents more often perceived noise pollution, which was in general the second most prevalent environmental problem across the city. Respondents most commonly pointed to traffic as the cause of neighbourhood air and noise pollution, which largely matches the findings of experts. In contrast, the expectation that people would recognise improvements in the city's air quality was not confirmed. Only a tenth of the respondents believed that air pollution is reducing, half did not perceive any changes and 38% of respondents thought that air pollution is in fact getting worse.

According to the findings of the survey, deep-rooted beliefs about poor air quality in Ljubljana persist, this is in spite of measured reductions in concentrations of air pollutants. Above all, residents are conscious of the impact of traffic on the environment, which partly stems from active awareness-raising policies, in particular the efforts of MOL to promote sustainable mobility in the city, and media coverage of acute problems, such as frequent breaching of limit values for PM and nitrogen dioxide pollution along the most heavily congested roads. There is less awareness of pollution from individual furnaces and heating facilities, which the municipality also has less influence over. Informed awareness of environmental problems is a crucial part of solving them, this is why the presented perceptions of air quality can provide a starting point for planners when considering future urban development.

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DELO Z UČENCI S POSEBNIMI POTREBAMI: MNENJA IN IZKUŠNJE UČITELJEV GEOGRAFIJE

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Izvleček
V času značilnih hitrih sprememb na področju znanja, tehnologije ter tudi sistema vrednot dobivajo otroci in mladostniki s posebnimi potrebami drugačno mesto in vlogo v svetu, kot so jo imeli v preteklosti. Na področju oseb s posebnimi potrebami so s spremembami vzniknile in obrodile ideje integracije, normalizacije in v novejšem času inkluzije. S pilotsko kvalitativno raziskavo smo želeli ugotoviti, kako učitelji geografije, ki poučujejo na osnovnih in srednjih šolah v Sloveniji, ocenjujejo svojo usposobljenost za delo z učenci s posebnimi potrebami in kakšne so njihove dosedanje izkušnje. Učitelji geografije se zavedajo pomembnosti in zahtevnosti tovrstnih nalog ter jih tudi z vso odgovornostjo sprejemajo, pri čemer so v oceni lastne kompetentnosti kritični. Med največje pomanjkljivosti dosedanjega dela v inkluzivni šoli uvrščajo preveliko število učencev s posebnimi potrebami, vključenih v posamezen razred, saj vključenost več kot dveh učencev z različnimi posebnimi potrebami lahko pomembno vpliva na kakovost pouka v razredu.

Ključne besede: učenec, učitelj, pouk geografije, posebne potrebe, vzgoja, izobraževanje

1 UVOD

S pojmom otroci/mladostniki oz. osebe s posebnimi potrebami zajemamo vse tiste, ki pri vzgoji in izobraževanju daljši ali krajši čas potrebujejo prilagoditve in pomoč. Otroci s posebnimi potrebami so vsi otroci, ki imajo ovire, primanjkljaje, slabosti, težave in motnje na področju gibanja, zaznavanja, govora, spoznavanja, čustvovanja, vedenja in učenja (Bela knjiga o …, 1995). Leta 2006 je Zakon o osnovni šoli (2006) med otroke s posebnimi potrebami uvrstil tako nadarjene otroke kot tiste, ki imajo težave na učnem področju iz najrazličnejših vzrokov. Z vključevanjem otrok in mladostnikov s posebnimi potrebami v redni šolski sistem je bil narejen velik korak v smeri njihovega celostnega

vključevanja v družbo. Leta 2012 so stopile v veljavo spremembe 11. (izobraževanje nadarjenih učencev) ter 12. (izobraževanje učencev s posebnimi potrebami) in 12.a člena (izobraževanje učencev z učnimi težavami) Zakona o osnovni šoli (Zakon o spremembah …, 2011). V skladu z zakonom so nadarjeni učenci tisti »učenci, ki izkazujejo visoko nadpovprečne sposobnosti mišljenja ali izjemne dosežke na posameznih učnih področjih, v umetnosti ali športu. Šola tem učencem zagotavlja ustrezne pogoje za vzgojo in izobraževanje tako, da jim prilagodi vsebine, metode in oblike dela ter jim omogoči vključitev v dodatni pouk, druge oblike individualne in skupinske pomoči ter druge oblike dela« (Zakon o spremembah …, 2011, str. 11317–11318). Učenci s posebnimi potrebami so »učenci, ki potrebujejo prilagojeno izvajanje programov osnovne šole z dodatno strokovno pomočjo ali prilagojene programe osnovne šole oziroma posebni program vzgoje in izobraževanja. Ti učenci so glede na vrsto in stopnjo primanjkljaja, ovire oziroma motnje, opredeljeni v zakonu, ki ureja usmerjanje otrok s posebnimi potrebami« (Zakon o spremembah …, 2011, str. 11318). Taisti zakon pa učence z učnimi težavami opredeljuje kot »učence, ki brez prilagoditev metod in oblik dela pri pouku težko dosegajo standarde znanja. Šole tem učencem prilagodijo metode in oblike dela pri pouku ter jim omogočijo vključitev v dopolnilni pouk in druge oblike individualne in skupinske pomoči« (Zakon o spremembah …, 2011, str. 11318). Usmerjanje otrok, mladoletnikov in polnoletnih oseb s posebnimi vzgojno-izobraževalnimi potrebami ter določanje načinov in oblik izvajanja vzgoje in izobraževanja ureja Zakon o usmerjanju otrok s posebnimi potrebami (2011). Kot otroke s posebnimi potrebami opredeljuje »otroke z motnjami v duševnem razvoju, slepe in slabovidne otroke oziroma otroke z okvaro vidne funkcije, gluhe in naglušne otroke, otroke z govorno-jezikovnimi motnjami, gibalno ovirane otroke, dolgotrajno bolne otroke, otroke s primanjkljaji na posameznih področjih učenja, otroke z avtističnimi motnjami ter otroke s čustvenimi in vedenjskimi motnjami, ki potrebujejo prilagojeno izvajanje programov vzgoje in izobraževanja z dodatno strokovno pomočjo ali prilagojene programe vzgoje in izobraževanja oziroma posebne programe vzgoje in izobraževanja« (Zakon o usmerjanju …, 2011, str. 8425).

Preglednica 1: Vzgojno-izobraževalne značilnosti otrok s posebnimi potrebami.

Posebne potrebe	**Značilnosti**
Otroci z motnjami v duševnem razvoju	• Določene ovire v mentalnem funkcioniranju in spretnostih, kot so komunikacija, skrb zase in socialne spretnosti. • Osnovne sposobnosti učenja so počasnejše, nižje kot bi bilo starosti primerno. • Motnje v duševnem razvoju so lahko lažje, zmerne, težje ali težke. • Kadar gre za lažje motnje v duševnem razvoju, otrokom v osnovi povzroča učne težave področje klasičnega usvajanja pričakovanih znanj šole z enakovrednim izobrazbenim standardom. Sposobni so zaključiti programe šol z nižjim izobrazbenim standardom. Priučijo se osnovnih poklicnih spretnosti in znanj ter so v odrasli dobi relativno dobro socialno prilagojeni in sposobni v osnovi skrbeti zase. • Pri zmernih, težjih in težkih motnjah v duševnem razvoju so motnje tako hude, da posamezniki, razen redkih izjem, skoraj niso sposobni samostojnega življenja.

Slepi in slabovidni otroci	• Slovenska zakonodaja s področja otrok s posebnimi potrebami od leta 2000, ko je bila sprejeta, sicer deloma upošteva razlike med slepimi in slabovidnimi, ko gre za vprašanje tehnoloških pripomočkov in prilagoditve prostora, ne pa tudi na področju zagotavljanja strokovne pomoči in usvajanja specialnih znanj. • Slepi otroci potrebujejo vrsto dodatnih strokovnih spodbud in podpore, da lahko kompenzirajo izostanek vida.
Gluhi in naglušni otroci	• So heterogena populacija invalidov, ki jih je treba obravnavati selektivno ali celo individualno, glede na čas, vrsto in odstotek poškodbe sluha ter zmožnosti govorno-socialne komunikacije. • Posebno pozornost je potrebno posvetiti otrokom z izgubo sluha, ki potrebujejo prilagojene pogoje za svoj optimalni razvoj in šolsko delo. • Gluhi otroci po slušni poti ne morejo prejemati informacij, njihov materni jezik je znakovni jezik. • V kolikor so slušne poti otroka odprte in podprte s polževim vsadkom, le-ta najverjetneje lahko po slušni poti sprejema informacije in razvije govor.
Otroci z govorno-jezikovnimi motnjami	• Imajo težave pri usvajanju in razumevanju ter govornem izražanju, ki niso posledica izgube sluha. • Motnje se kažejo v razumevanju govora in govorno-jezikovnem izražanju, od blagega zaostajanja do nerazvitosti. • Specifične motnje na področju razumevanja, strukturiranja, procesiranja in izražanja se kažejo tudi v neskladju med besednimi in nebesednimi sposobnostmi. • Sekundarno se motnje v govorno-jezikovnem sporazumevanju kažejo tudi na področju branja in pisanja ter pri učenju v celoti. Funkcionalno znanje branja in pisanja je lahko prizadeto v razponu od blagega zaostajanja do funkcionalne nepismenosti.
Gibalno ovirani otroci	• Imajo prirojene ali pridobljene okvare, poškodbe gibalnega aparata, centralnega ali perifernega živčevja. • Gibalna oviranost se odraža v obliki funkcionalnih in gibalnih motenj.
Dolgotrajno bolni otroci	• Kronične motnje ter bolezni, ki jih ovirajo pri šolskem delu. Dolgotrajna bolezen je tista, ki ne izzveni v treh mesecih.
Otroci s primanjkljaji na posameznih področjih učenja	• Zaradi znanih ali neznanih motenj v delovanju centralnega živčnega sistema se pojavljajo zaostanki v razvoju v zvezi s pozornostjo, pomnjenjem, mišljenjem, koordinacijo in komunikacijo. • V razvoju socialnih in emocionalnih sposobnosti se kažejo izrazite težave pri branju, pisanju, pravopisu in računanju. • Primanjkljaji trajajo vse življenje in vplivajo na učenje in vedenje. • Težave pri komunikaciji z vrstniki, neroden je pri uporabi pisala in škarij, počasen je pri sledenju navodil in izvajanju rutinskih spretnosti ter ima težave v časovni in prostorski orientiranosti.
Otroci z motnjami vedenja in osebnosti, ki potrebujejo prilagojeno izvajanje programov vzgoje in izobraževanja z dodatno strokovno pomočjo ali prilagojene programe vzgoje in izobraževanja oziroma posebne programe vzgoje in izobraževanja	• Asocialno vedenje, ki je intenzivno, ponavljajoče in trajnejše ter se kaže z neuspešno socialno integracijo. • Otrokovo asocialno vedenje se pogosto kaže s simptomi, kot so npr. agresivno vedenje, avtoagresivno vedenje, uživanje alkohola in mamil, uničevanje tuje lastnine, pobegi od doma in čustvene motnje.

Vir: Jošt, 2010, str. 13–17.

Ker gre za izjemno heterogeno skupino mladih ljudi, je nemogoče izbrati za vse enake postopke poučevanja, učila in učne pripomočke, kajti pri obravnavi te populacije ni dominantnega postopka. Posledično so učitelji pred izjemno zahtevno nalogo, ki terja od njih veliko znanja, prilagajanja in razumevanja. Po pregledu teoretičnih podlag se zato prispevek osredotoča na rezultate raziskave med učitelji geografije o njihovi usposobljenosti in izkušnjah pri vzgojno-izobraževalnem delu z učenci s posebnimi potrebami pri pouku geografije.

2 VKLJUČEVANJE OTROK S POSEBNIMI POTREBAMI V VZGOJNO-IZOBRAŽEVALNI PROCES

Vključevanje otrok s posebnimi potrebami v večinske oddelke je bilo v Sloveniji uzakonjeno leta 1996 v Zakonu o osnovni šoli in leta 2000 v Zakonu o usmerjanju otrok s posebnimi potrebami. Novi Zakon o usmerjanju otrok s posebnimi potrebami (2011) ureja predvsem usmerjanje v različne programe, določa postopke usmerjanja in postopke dela strokovnih komisij za odločbe o usmeritvi ter opredeljuje možnosti usmerjanja otrok s posebnimi potrebami v programe vzgoje in izobraževanja. Vključevanje otrok s posebnimi potrebami med vrstnike brez posebnih potreb omogoča razvoj njihovih zmožnosti, hkrati pa priznavanje drugačnosti in motenj, ki jih spremljajo vse življenje (Krajnc, 2011).

V strokovni literaturi so uporabljeni različni termini, s katerimi avtorji označujejo vključevanje otrok s posebnimi vzgojno-izobraževalnimi potrebami v večinske šolske ustanove. Med najpogosteje navajanimi sta integracija in inkluzija, ki so ju še v bližnji preteklosti, natančneje pred letom 2000, številni razumeli kot sinonima, saj naj bi šlo v obeh primerih za enake ideje, ravnanje in cilje. Danes večina avtorjev termina ločuje in poudarja pomembne razlike med njima v kakovosti dela in praktičnem izvajanju vključevanja otrok s posebnimi vzgojno-izobraževalnimi potrebami (Kavkler in sod., 2008).

Integracija je doseganje celovitosti v smislu obnove ali »povezovanje posameznih enot, delov v večjo celoto, združevanje ...« (SSKJ, 2016). Pogosto pomeni le namestitev otroka s posebnimi potrebami v večinsko ustanovo, kjer skuša šolsko in širše okolje spremeniti oz. prilagoditi otroka nekemu »povprečju«, da bi se lahko vključil v redni sistem vzgoje in izobraževanja ter dosegal predpisane standarde znanja, branja, pisanja, računanja, se prilagodil načinu sprejemanja informacij, socialnemu okolju, oviram pri gibanju v okolju itd. Če otrok ni sposoben doseči predpisanih minimalnih vzgojno-izobraževalnih dosežkov in se prilagoditi učnemu okolju, ne more doseči popolne integracije v šolsko okolje (Kavkler in sod., 2008). Tudi Resman (2003) in Corbett (1999) pravita, da je integriran le tisti, ki se je adaptiral oz. prilagodil normam, ki so v določenem okolju (šoli) dominantne. Od integriranih učencev se pričakuje, da imajo moč in voljo ter so sposobni delati tisto, kar se pričakuje tudi od drugih učencev oziroma otrok.

V nasprotju z integracijo omogoča inkluzija vsakemu posamezniku, da sodeluje, kolikor zmore, ker doseganje povprečnih dosežkov ni temeljni pogoj za vključitev v šolsko in širše socialno okolje, saj so razlike posameznikov le temelj za socialno povezovanje (Kavkler in sod., 2008). Inkluzivna kultura podpira različne potrebe in sprejema

posebnosti, ki jih oblikujejo spol, narodnost, jezikovna pripadnost, različni družbeni statusi, stopnje izobrazbe in tudi posamezne pomanjkljivosti, težave, motnje in bolezni (Corbett, 1999). Medtem ko ostane pri integraciji šolski sistem nespremenjen kljub uvedbi določenih ukrepov, pa inkluzija spodbuja šolske strokovne delavce k razmišljanju o njihovem delovanju, o pristopih poučevanja, o uporabi različnih oblik pomoči in o načinih odzivanja na potrebe vseh otrok (Farrell, 2005).

Sistem izobraževanja temelji na pomembnih splošnih načelih demokratičnosti, avtonomnosti in enakih možnostih (Košir, 2008). Načela so utemeljena v človekovih pravicah in pojmu pravne države. Za vzgojo in izobraževanje učencev s posebnimi potrebami pa so poleg zgoraj naštetih splošnih načel pomembni še (Kranjc, 2011): načelo integracije, načelo zagotovitve ustreznih razmer, načelo enakih možnosti, načelo vključevanja staršev v proces vzgoje in izobraževanja, načelo organiziranja izobraževanja otrok in mladostnikov s posebnimi potrebami čim bližje domu, načelo individualiziranega pristopa z diferenciranimi in individualiziranimi programi, načelo kontinuiranosti programov, načelo pravočasne usmeritve v ustrezen program vzgoje in izobraževanja ter načelo interdisciplinarnosti, ki zahteva, da v vzgoji in izobraževanju otrok in mladostnikov s posebnimi potrebami sodelujejo različni strokovnjaki (s področja šolstva, zdravstva in socialnega varstva).

Na uspešen razvoj inkluzije vpliva več dejavnikov:

- strokovna pomoč učitelju;
- dodatna strokovna in fizična pomoč za otroke in mladostnike s posebnimi potrebami, ki jo predpisuje Pravilnik o dodatni strokovni in fizični pomoči za otroke s posebnimi potrebami (2013);
- materialni viri (ustrezno okolje, učila ter učni in tehnični pripomočki).

Brez upoštevanja vsega naštetega učitelj ne more otroku s posebnimi potrebami omogočiti optimalnih možnosti za razvoj njegovih sposobnosti. Ker je vključevanje otrok z izrazitimi posebnimi potrebami zelo občutljivo področje, s številnimi zagovorniki in še številnejšimi nasprotniki, mora biti dobro načrtovano in uresničeno z vsemi mogočimi strokovnimi in materialnimi viri (Kavkler in sod., 2008). Težave, s katerimi se srečujemo v procesu vključevanja otrok s posebnimi potrebami, so med drugim pogojene tudi s finančnimi možnostmi države, slabo razvitim inkluzivnim gibanjem v družbi, pretiranim poudarjanjem pomena izobraževalne uspešnosti, obsežnim sistemom specialnih ustanov, specialnih učiteljev in drugih virov, pomanjkljivimi razmerami šolanja v večinskih šolah, velikostjo razredov, organizacijskimi ovirami, različnimi stališči učiteljev in strokovnih delavcev ter njihovim znanjem in obvladovanjem strategij (Kavkler in sod., 2008).

Obenem ne smemo zanemariti tudi odnosa med samimi učenci. Raziskave kažejo (Pijl, Frostad, Flem, 2008), da imajo učenci s posebnimi potrebami lahko težave pri vzpostavljanju odnosov z vrstniki brez posebnih potreb. Pogosto so manj priljubljeni, imajo manj prijateljev in ne pripadajo nobeni skupini vrstnikov. Pripadnost skupini ni sama po sebi umevna, zato se moramo zavedati, da otroci s posebnimi potrebami pri tem morda potrebujejo dodatno pomoč. Zato je nujno zavedanje pomena diferenciranega in

individualiziranega poučevanja, pri katerem gre za proces pristopanja k poučevanju in učenju učencev različnih zmožnosti, da bi tako maksimalizirali in optimalizirali rast in uspešnost vsakega učenca (Dervarič, 2013). Po mnenju Pulec Lahove (2008; cv. Dervarič, 2013) lahko učitelj vzgojno-izobraževalni proces diferencira in individualizira s prilagajanjem štirih elementov kurikula (vsebine, proces, preverjanje in ocenjevanje) ter okolja.

3 METODE RAZISKAVE

3.1 Vsebinska in ciljna opredelitev raziskave

Strokovni svet Republike Slovenije za splošno izobraževanje je oktobra 2007 sprejel Koncept dela z učenci z učnimi težavami v osnovni šoli (Magajna in sod., 2008), v katerem so postavljeni strokovni temelji za razvoj učinkovitejših pristopov obravnave učencev z učnimi težavami. Zasnovan je kot petstopenjski model učne pomoči na kontinuumu učnih težav: od lažjih do izrazitih, od specifičnih do splošnih, od enostavnih do kompleksnih, od kratkotrajnih do vseživljenjskih in od tistih, ki zahtevajo malo učne pomoči in podpore učencu, do tistih, ki zahtevajo veliko specifične učne pomoči in podpore učencu, ter na zgodnji obravnavi učencev z učnimi težavami (Magajna in sod., 2008). V raziskavi smo sledili navedenemu modelu in nismo posebej iskali določene vrste učnih težav, saj se učitelji geografije pri svojem delu srečujejo z učenci, ki imajo raznovrstne učne težave. Učitelji v osnovnih in srednjih šolah so bili tako soočeni z zahtevami po obvladovanju strategij dobre poučevalne prakse in splošne strategije poučevanja otrok s posebnimi potrebami. Učna pomoč in podpora, predvidena s petstopenjskim modelom, vključuje pomoč učitelja pri pouku, vključevanje šolske svetovalne službe ali mobilnih specialnih pedagogov, organizacijo individualne ali skupinske učne pomoči in pomoči zunanje specializirane ustanove, šele potem je mogoče učence z izrazitimi specifičnimi učnimi težavami oziroma s primanjkljaji na posameznih področjih učenja usmeriti v izobraževalni program »prilagojeno izvajanje z dodatno strokovno pomočjo« (Magajna in sod., 2008).

Naš raziskovalni interes je bil usmerjen v različne oblike pomoči učitelja pri pouku, potencialno vključevanje šolske svetovalne službe ali mobilnih specialnih pedagogov, organizacije individualne ali skupinske učne pomoči ter pomoč zunanje specializirane ustanove, v kolikor bi za to zaznali interes učiteljev, sodelujočih v raziskavi.

Z raziskavo o mnenju učiteljev geografije o njihovi usposobljenosti in izkušnjah pri poučevanju učencev s posebnimi potrebami pri pouku geografije, izvedeno poleti 2015, smo želeli dobiti odgovor na naše osnovno raziskovalno vprašanje, ki je bilo usmerjeno v ugotavljanje dosedanjih izkušenj učiteljev geografije v inkluzivni šoli in kako le-ti ocenjujejo lastno usposobljenost (kompetentnost) za poučevanje geografije učencev s posebnimi potrebami.

Želeli smo pridobiti odgovore na štiri raziskovalna vprašanja.

- Kakšne so dosedanje izkušnje učiteljev geografije (tako pozitivne kot negativne izkušnje oz. problemi), ki so jih pridobili na področju dela z učenci s posebnimi potrebami?

- Kje (ne) dobijo učitelji geografije podporo, pomoč, nasvete in od koga (drugi učitelji geografije, strokovne službe na šoli, svetovalci Zavoda za šolstvo, pedagoška dokumentacija - npr. učni načrt, strokovna spopolnjevanja, v strokovni literaturi ipd.)?
- Kaj bi učitelji geografije potrebovali, da bi lažje premagovali ovire za še kakovostnejše delo oz. da bi dosegali želeno kompetentnost?
- V kolikšni meri se učitelji geografije čutijo kos zahtevam (usposobljenost, kompetentnost) za tovrstno delo in kje zaznavajo največji primanjkljaj (metode dela, učila in učni pripomočki, organizacija dela, obseg dela, pedagoški normativi, število učencev s posebnimi potrebami oz. raznolikost njihovih posebnih potreb itd.)?

3.2 Metodologija in raziskovalni vzorec

V avgustu in septembru 2015 smo petnajst učiteljev geografije pisno prosili za sodelovanje v kvalitativni raziskavi. Kriterij za izbor sodelujočih je temeljil na: raznolikem številu let delovne dobe poučevanja geografije (posledično tudi obsegu izkušenj), različnih stopnjah in programih poučevanja (osnovna šola; srednja šola: tri- in štiriletni strokovni programi, ekonomska gimnazija, splošna gimnazija; oddelki bolnišničnih šol), zastopanosti obeh spolov ter njihovi dosedanji izkazani pedagoški aktivnosti/angažiranosti (udeležba na strokovnih posvetovanjih, strokovnih ekskurzijah, pedagoških usposabljanjih, objavljanje strokovnih prispevkov, mentorstvo študentom na pedagoški praksi, nadaljnje formalno izobraževanje ipd.) v zadnjih petih letih ter prostorski raznolikosti šolskih lokacij. Seveda pa je bila pri tem bistvena njihova pripravljenost za sodelovanje. Odzvalo se je 8 učiteljic in 5 učiteljev geografije. Enajst sodelujočih je imelo univerzitetno izobrazbo in naziv profesor/ica geografije, dva sodelujoča pa znanstveni magisterij s področja geografskega izobraževanja. Ena sodelujoča v pretežni meri opravlja delo pedagoginje, v manjšem obsegu pa tudi delo učiteljice geografije. V pisnih intervjujih sodelujoči učitelji geografije so povprečno imeli 15,9 let delovnih izkušenj (najmanj 7 let delovnih izkušenj, največ 34 let delovnih izkušenj). Osem jih je bilo zaposlenih na osnovni šoli (pet žensk in trije moški), pet pa na srednji šoli (dva moška in tri ženske). Intervjuvani učitelji/ce geografije poučujejo na šolah v Kopru, Ljubljani, Tržiču, na Jesenicah, v Slovenj Gradcu, Celju, Krškem, Mariboru in Murski Soboti.

Osnovna izhodišča raziskovanega pojava smo oblikovali na osnovi deskriptivne metode z analizo pisnih dokumentarnih virov. Zbiranje podatkov za raziskavo je temeljilo na kvalitativni empirični pedagoški raziskavi, kot osnovni raziskovalni inštrument pa smo uporabili individualni nestrukturirani pisni intervju, ki nam je omogočil bolj osredotočeno in poglobljeno razlago pojava raziskovanja.

Intervjuvani učitelji/ce so imeli zaradi široko zastavljenih in odprtih vprašanj možnost posredovati osebno mnenje kot pripoved in pri tem niso bili omejeni v obsegu sporočila. Pripoved s pomočjo poizvedovanja (angl. *narrative inquiry*) in refleksije omogoča učitelju ustvarjanje novih pomenov in razlago, organizacijo lastnega znanja o učenju in poučevanju ter s tem spremembe v učni praksi, osebnem in profesionalnem razvoju (Konečnik Kotnik, Javornik Krečič, 2011, str. 10). Avtorji dela Kompetence v kadrovski praksi (2005) ugotavljajo, da so pri metodah ugotavljanja delovnih kompetenc prav intervjuji

lahko zelo primeren način pridobivanja podatkov. Značilnosti poglobljenih intervjujev, kot jih navaja Legard in sod. (2003), so v možnosti generativnosti, saj se spodbuja samostojno oblikovanje odgovorov, v katerih se odražajo znanja in vedenja intervjuvanca.

Pomembno je opozoriti, da v naši kvalitativni pedagoški raziskavi ne gre za to, da bi reprezentativno prikazali opazovano tematiko (zato nismo zasledovali statističnih kategorij ujemanja odgovorov intervjuvanih), temveč smo zasledovali, ali se sodelujoči ne glede na stopnjo poučevanja (osnovna oz. srednja šola), spol ter delovne izkušnje približujejo v ključnih opazovanih predpostavkah, saj smo izbrali specifičen (nadpovprečno aktiven) del učiteljev geografije glede na pogostost in raznolikost njihovega sodelovanja na področju njihovega poklica.

Podatke smo preučevali na deskriptivni ravni in jih predstavili kot generalizirane opise s posameznimi izbranimi primeri individualnih zapisov. V predstavitvi rezultatov zaradi zagotavljanja anonimnosti nismo uporabili imen intervjuvancev, temveč smo zapisali njihov spol, leta delovnih izkušenj ter vrsto šole (razen v dveh primerih, kjer smo izpustili podatek o spolu intervjuvanca zaradi vrste šole, tj. skromno število bolnišničnih šol v Sloveniji). V rezultatih prikazani individualni zapisi so v celoti sledili originalnim zapisom intervjuvanih.

4 REZULTATI IN RAZPRAVA

Mnenja intervjuvanih učiteljev geografije smo oblikovali v predvidenih vsebinskih sklopih, v katerih smo ob generaliziranem opisu najpogostejših odgovorov prikazali tudi konkretne odgovore posameznikov kot ilustracije zapisanih generalizacij. Ob generaliziranih opisih smo v oklepajih podali tudi številčni podatek o le-teh.

4.1 Dosedanje pozitivne in negativne izkušnje

Vsi intervjuvanci so zapisali primere pozitivnih izkušenj. Pri tem so navajali tako izkušnje s področja znanj (kognitivne izkušnje) kot izkušnje s področja razvoja geografskih veščin in sposobnosti, pa tudi izkušnje s področja psihološkega in socialnega razvoja učencev ter s tem izkazali svoje zavedanje pomembnosti vseh treh področij poučevanja.

> *»Kot primer res dobre izkušnje lahko zapišem, kako sem od učenca, ki ni kazal niti malo zanimanja za pouk (tudi geografije), uspel po nekaj individualnih razgovorih izvedeti, kaj ima rad, motivirati za delo. Pokazalo se je, da ga zanima samo nogomet. In to sem izkoristil (bil je tudi čas svetovnega prvenstva v nogometu), da je pri regionalni geografiji sveta dosegel minimalne standarde. Od kod so reprezentance (karta sveta), koliko igralcev ima kakšna država glede na število prebivalcev, kakšni so pogoji za trening (podnebje) ipd. ni bila več težava.«* (moški, 21 let delovne dobe, poučuje v osnovni šoli)

> *»V vseh teh letih se jih je nabralo kar nekaj. Ena deklica pa posebej izstopa. Čeprav je bila gibalno ovirana (bergle), je bila prisotna na vseh*

ekskurzijah in na terenskem delu. Predhodno sva se dogovorili, kaj bo počela, s sabo je imela zložljiv stolček. Res je hodila počasi, a nikoli ni zaostala, za to so poskrbeli tudi sošolci. Tudi ji ni bilo neprijetno, ko so jo dvignili na avtobus.« (ženska, 25 let delovne dobe, poučuje v osnovni šoli)

Med negativnimi izkušnjami intervjuvanih učiteljev je polovica (šest zapisov) na prvem mestu zapisala nerealna pričakovanja tako učencev kot njihovih staršev. Kot pomemben pogoj za svoje uspešnejše delo prepoznavajo vključenost staršev pri delu z učenci s posebnimi potrebami. Na drugem mestu po pogostosti zapisov (trije zapisi) pa je neupoštevanje dogovorjenega s strani učencev oz. dijakov.

»Starši učenca z motnjami koncentracije in hiperaktivnostjo, ki sem ga uspešno motiviral za učenje geografije s pomočjo »njegovega nogometa«, so mi očitali prav to, saj da fanta tako nič ne zanima razen nogometa, sedaj pa se še v šoli o tem uči. Vsi moji argumenti, zakaj je to dobro, niso zalegli in mati je dejala, da naj kar neham.« (moški, 21 let delovne dobe, poučuje v osnovni šoli)

»Med najpogostejše slabosti sodi velik primanjkljaj iz prejšnjih let. Ne učijo se sproti, saj se zanašajo na napovedano ocenjevanje znanja in na to, da se bo nekdo (npr. pedagoginja) z njimi učil. Naučeno snov hitro pozabijo. Ker imajo težave pri številnih predmetih, med poukom težko sledijo, so včasih tudi moteči, nimajo ustrezne podlage oz. ne usvojijo sproti minimalnih standardov znanja.« (ženska, 24 let delovne dobe, poučuje v osnovni šoli)

»Moje negativne izkušnje so z dijaki brez odgovornosti in delovnih navad, ki odločbe izkoriščajo za privilegije, ki jim sicer po odločbi pripadajo (podaljšan čas spraševanja in pisanja testov znanja, večje črke na testih znanja, dogovorjeno spraševanje ipd.). Se pa ne držijo nobenih ali večine dogovorov, npr. datume, kdaj želijo biti vprašani, si postavijo sami, pa jih takrat ni v šolo in starši se na to ne odzivajo.« (ženska, 33 let delovne dobe, poučuje v srednji tehnični šoli)

4.2 Pomoč, podpora, nasveti

Generalizacija odgovorov kaže, da so intervjuvani učitelji v prvi vrsti mnenja, da se morajo najprej zanesti sami nase in na svoje sposobnosti, izkušnje in iznajdljivost (sedem zapisov), na drugo mesto pa uvrščajo pomoč šolske svetovalne službe (pet zapisov). Pri tem so navedli pomoč pedagoga, specialnega pedagoga, psihologa in socialne delavke. Zapisali so tudi, da se zavedajo dejstva, da so njihovi svetovalni sodelavci omejeni tako s časom kot tudi znanjem ter da njihova pomoč ni vezana na geografske posebnosti poučevanja. Trije intervjuvanci so zapisali, da specifične prilagoditve na pouk geografije iščejo s pomočjo strokovne literature. Tovrstnega sodelovanja s svetovalci Zavoda za šolstvo niso omenili oz. je ena intervjuvanka izpostavila seminar s področja minimalnih standardov znanja pri pouku geografije kot dobrodošlo podporo pri njenem delu z učenci s posebnimi potrebami.

»Ostaja vtis, da smo učitelji dostikrat prepuščeni svojim sposobnostim, izkušnjam in iznajdljivosti.« (moški, 15 let delovne dobe, poučuje v splošni gimnaziji)

»Dobrodošlo je sodelovanje s pedagogi na šoli in upoštevanje minimalnih standardov znanja v učnem načrtu. Glede minimalnih standardov mi je prav prišlo izobraževanje, ki ga je organiziral Zavod za šolstvo v Ljubljani.« (ženska, 34 let delovne dobe, poučuje v osnovni šoli)

»V nepredvidenih situacijah pri poučevanju otrok s posebnimi potrebami se lahko vsak trenutek zanesemo na pomoč in svetovanje medicinskega osebja in strokovnega tima.« (33 let delovne dobe, poučuje v bolnišnični šoli)

»V primeru, da potrebujem pedagoški nasvet za delo z učencem s posebnimi potrebami, se vedno obrnem na našo specialno pedagoginjo. V posameznem primeru se je že zgodilo, da sem se obrnil na pomoč k matičnemu psihologu za posameznega učenca na Kliniki za pediatrijo. Glede posredovanja geografskih vsebin učencu s posebnimi potrebami do sedaj še nisem bil v takšni stiski, da bi potreboval pomoč strokovnjakov geografov na Zavodu za šolstvo ali npr. fakulteti.« (moški, 15 let delovne dobe, poučuje v splošni gimnaziji)

»Osebno sem že iskal in bral literaturo na tem področju. Na Zavod za šolstvo se v bolnišnični šoli ne obračamo na pomoč.« (7 let delovne dobe, poučuje v bolnišnični šoli)

4.3 Potrebe učiteljev

Realna pričakovanja učencev in podpora ter sodelovanje staršev so po mnenju intervjuvanih (pet zapisov) najpomembnejši za uspešno delo, vendar opažajo, da v praksi temu pogosto ni tako. Zato je med negativnimi izkušnjami pogosto omenjeno tudi nesodelovanje staršev oz. mnenje le-teh, da »*za geografijo ne potrebujejo inštrukcij*« (zapis srednješolskega učitelja geografije, 15 let delovne dobe).

»Tone je bil sicer prijazen fant z željo, da razred uspešno naredi. A njegova predstava, kaj je potrebno za to narediti, je bila popolnoma nerealna, »v oblakih«. V naši strukturirani šoli, ki »hiti naprej in navzgor«, kot učitelj tako težko od takega otroka pričakuješ delovne navade in miselno aktivnost, ki ga bo pripeljala do znanja. Bi bilo res tako težko kakšno leto ponavljati? Za večino staršev je to nepredstavljivo, čeprav njihov otrok res ne zmore.« (ženska, 33 let delovne dobe, poučuje v osnovni šoli)

»Mislim, da bi se morali bolj angažirati njihovi starši in otrokom pomagati tudi z inštrukcijami doma.« (ženska, 33 let delovne dobe, poučuje v srednji tehnični šoli)

Intervjuvani so kot ovire pri uspešnejšem delu (po štirje zapisi pri vsaki oviri) navedli: premalo možnosti za individualni pristop zaradi prevelikega števila učencev s posebnimi potrebami, premajhno število ur za individualno delo z njimi (letno 35 ur individualne

strokovne pomoči), togost sistema (predpisi, zakonodaja) in vprašanje glede upravičenosti tolikšnega števila odločb o posebnih potrebah. Pri tem se kaže tudi skrb intervjuvancev, da ostali učenci v razredu ne bi bili zapostavljeni (trije zapisi).

> *»Mislim, da so razlog tudi objektivni pogoji dela. Učitelj, ki se lahko v majhni skupini ali včasih celo individualno posveti otroku s posebnimi potrebami, verjetno s takšnim učencem vzpostavi pristnejši odnos, ga bolje spozna, kvalitetnejše poučuje, lažje oceni in lažje motivira kot v primeru enega učitelja in 28 otrok v razredu, kjer so trije s posebnimi potrebami.«* (7 let delovne dobe, poučuje v bolnišnični šoli)

> *»Obseg dela in normativi dela z dijaki s posebnimi potrebami bi morali biti prilagojeni številu dijakov in njihovi specifiki. Potrebna bi bila konkretna in bolj dodelana zakonodaja s tega področja, kakor tudi zagotovljena večja in dodatna strokovna pomoč za učitelje. Število dijakov s posebnimi potrebami narašča, imam pa občutek, da marsikdo to tudi izkorišča.«* (moški, 15 let delovne dobe, poučuje v splošni gimnaziji)

> *»Zavedam se, da učenci s posebnimi potrebami potrebujejo mojo dodatno pozornost, čas in veliko prilagojenega gradiva. Ampak včasih se vprašam: kaj pa ostali učenci v razredu? Pošteno je potrebno povedati, da če imaš v razredu več kot dva učenca z različnimi posebnimi potrebami, preprosto ne moreš enako kvalitetno delati tudi z ostalimi dvajsetimi ali več učenci.«* (ženska, 25 let delovne dobe, poučuje v osnovni šoli)

> *»Najbolj me moti, da psihologi, specialni pedagogi, defektologi, logopedi prevečkrat zahtevajo, da je pri vseh učencih potrebno prilagajati, npr. čas, hitrost, velikost črk ipd., tudi če iz dosedanjih izkušenj vemo, da to ni potrebno in bi z manjšimi prilagoditvami dosegli skoraj enak učinek. S takšnimi prilagajanji je učenec izločen iz skupine.«* (moški, 33 let delovne dobe, poučuje v bolnišnični šoli)

> *»Ker se število dijakov s posebnimi potrebami v razredih povečuje, bi veljalo razmisliti o veljavnih normativih. Pa seveda tudi o tem, ali dejansko vsi dijaki z odločbami te zares potrebujejo.«* (ženska, 33 let delovne dobe, poučuje v srednji tehnični šoli)

Tretji sklop predlogov intervjuvancev se veže na strokovno spopolnjevanje učiteljev (dva zapisa) in njihovo potrebo, da bi imeli ustrezne sogovornike pri iskanju povratnih informacij o opravljenem delu. Pri tem so izpostavili probleme, na katere naletijo, če se želijo udeležiti dodatnih izobraževanj. En zapis pa se veže tudi na sicer veliko obremenitev učiteljev.

> *»Učitelji bi potrebovali še več izkušenj oziroma da bi jih predebatirali s kom, ki to področje res pozna, in pa dodatne ure za individualno delo (z več učenci, ki imajo težave, hkrati).«* (ženska, 34 let delovne dobe, poučuje v osnovni šoli)

»Žal se učitelji med seboj ne pogovarjamo veliko o problematiki učencev s posebnimi potrebami. Niti kolegi v zbornici ne, še manj kolegi geografi. Pa ne, da nas to ne zanima, ampak je toliko različnih problemov in nalog, ki jih je potrebno narediti, da večinoma za to ni časa. Pa bi bilo potrebno. Žal tudi nekdanjih aktivov učiteljev geografije ni več, ko smo se »osnovnošolci« srečali in primerjali izkušnje, si pomagali z gradivi ipd.« (moški, 21 let delovne dobe, poučuje v osnovni šoli)

»Na šoli imamo finančne težave. Tudi za strokovno spopolnjevanje bom kotizacijo plačal iz svojega žepa. Mnogi učitelji raje na dodatna izobraževanja sploh ne gredo.« (7 let delovne dobe, poučuje v bolnišnični šoli)

4.4 Kompetentnost za poučevanje učencev s posebnimi potrebami

Intervjuvani učitelji geografije so bili pri zapisih ocen svoje kompetentnosti kritični in so odprto podali svoje pomisleke. Pri tem se je izpostavilo dejstvo, da razen osebne presoje *(»po občutku«*, kot je zapisala intervjuvanka s 25 leti delovne dobe, ki poučuje v osnovni šoli) nimajo mehanizma (kriterija), ki bi jim pomagal pri samoevalvaciji (pet zapisov). Tega se nekateri intervjuvanci tudi zavedajo in to ocenjujejo kot primanjkljaj (trije zapisi). Kot najzahtevnejše navajajo delo z učenci z vedenjskimi motnjami, ker po njihovem mnenju le-ti tudi najbolj vplivajo na razredno dinamiko. Trije intervjuvani učitelji geografije so mnenja, da jim učna gradiva, ki so jih do sedaj izdelali, olajšujejo delo z novimi generacijami. Le en intervjuvanec od trinajstih je zapisal, da se čuti ustrezno kompetentnega.

»Do sedaj sem bila v glavnem kos zahtevam za tovrstno delo, čeprav nekega usposabljanja nismo imeli. Metode dela prilagajam po občutku, glede na potrebe. Upoštevam pravice, ki so navedene v odločbah.« (ženska, 33 let delovne dobe, poučuje v srednji tehnični šoli)

»Na nekaterih področjih se čutim kompetentna, pri drugih pa spet ne. Po nekaj letih zbiranja in izdelovanja učnega gradiva je sedaj nekoliko lažje. Sploh za tiste učence, ki so omejeni na področju vida in sluha. Tudi z gibalno oviranimi ni toliko težav. Najtežje je z učenci, ki odklanjajo sodelovanje, so nemotivirani, nedisciplinirani. Tu ni težava le v enem učencu, ampak nastane težava za ves razred, npr. vseh 25 učencev. Kaj tu narediti, še vedno ne vem.« (ženska, 25 let delovne dobe, poučuje v osnovni šoli)

»Ne vem, ali sem kompetentna za tovrstne naloge. So učne ure, ko imam dober občutek in sem s svojim delom zadovoljna, skupaj z učenci se veselim njihovega napredka. A, žal, so to izjeme, večinoma se sleherno učno uro »borim« s tem, da učenci s posebnimi potrebami spremljajo vsaj organizacijska navodila za pouk: pripravi zvezke na mizo, zapiši, zalepi delovni list v zvezek, poglej na zemljevid na tabli in nato na zemljevid na klopi – jasno nam je, da se zemljevida razlikujeta (!!!), poglej sliko v učbeniku, video

predstavitev, zapiši si, kaj je za domačo nalogo. Ja, pa da preveč ne motijo ostalih.« (ženska, 33 let delovne dobe, poučuje v osnovni šoli)

»Osebno se počutim kompetenten za delo z učenci s posebnimi potrebami in tako nimam občutka, da bi nujno potreboval dodatno izobraževanje na tem področju.« (7 let delovne dobe, poučuje v bolnišnični šoli)

4.5 Zadovoljstvo in potrebe učiteljev geografije

Najmanj odzivov sodelujočih je bilo na vprašanji, kaj bi učitelji geografije potrebovali za lažje premagovanje ovir za še kakovostnejše delo oz. za doseganje želene kompetentnosti ter kaj doživljajo ob spremljanju rezultatov dela. Dva zapisa sta odražala občutke zadovoljstva pri delu z učenci s posebnimi potrebami ter osebno presojo o vloženem trudu učitelja v njihovo poučevanje.

»Delam po svojih najboljših močeh v okviru danih možnosti in res mislim, da se trudim. In enako počnejo kolegi.« (moški, 14 let delovne dobe, poučuje v srednji tehnični in strokovni šoli)

»Do sedaj sem imela že dve dijakinji, ki sta bili skoraj gluhi. Sedeli sta spredaj, snov sem razlagala nekoliko počasneje in tako, da sta ves čas videli moje ustnice. Obe sta šolanje zaključili zelo uspešno in zame nista predstavljali obremenitve, ampak samo določeno prilagoditev. Bila sem vesela njunega uspeha in zadovoljna, ker sem tudi jaz nekaj k temu prispevala.« (ženska, 33 let delovne dobe, poučuje v srednji tehnični šoli)

Na področju primanjkljaja se ponovijo zapisi, prisotni tudi v drugih sklopih odgovorov, kjer intervjuvanci poudarjajo preveliko število učencev s posebnimi potrebami, vključenimi v en razred (oz. potrebo po manjših učnih skupinah) ter slabo opremljenost z določenimi učili in učnimi pripomočki, ki bi olajšali tako individualno delo kot tudi strokovno spopolnjevanje in izmenjavo izkušenj ter mnenj med samimi učitelji geografije. Zabeležen je tudi zapis o občutku nemoči učiteljev pri iskanju rešitev in uvajanju sprememb.

»Problem je v tem, da je v nekaterih razredih dijakov z odločbo preveč. V letu 2014/15 jih je bilo v enem izmed razredov kar 8 od 29 dijakov. Tu mi je po vseh dogovarjanjih zmanjkovalo časa za ostale dijake. Če je dijakov z odločbo malo (do 3), v glavnem ni težav. Se pa število teh dijakov vsako leto povečuje.« (ženska, 33 let delovne dobe, poučuje v srednji tehnični šoli)

»Kot manko dojemam predvsem slabo opremljenost bolnišnične šole z učili in učnimi pripomočki/tehniko. Pogosto se dogaja, da ne morem v času pouka za pedagoške potrebe dostopati do interneta. Odlično bi bilo, če bi lahko šola kupila nekatera nova učila in učne pripomočke, ki so stari, obrabljeni in zastareli (atlasi, ročne karte, nov prenosni računalnik itn.), vendar so trenutno na šoli finance v takem stanju, da tega ravnatelju v kratkem ne bom predlagal.« (7 let delovne dobe, poučuje v bolnišnični šoli)

5 SKLEP

Na osnovi deskriptivne metode smo z analizo strokovnih podlag (Kavkler in sod., 2005; Magajna in sod., 2008) proučili vpeljevanje t. i. inkluzivne šole z vidika temeljnih izhodišč, ki se vežejo na to, da posebne potrebe učencev z učnimi težavami terjajo prilagojeno učno okolje. Zbiranje podatkov za raziskavo mnenj učiteljev geografije je temeljilo na kvalitativni empirični pedagoški raziskavi, kot osnovni raziskovalni inštrument pa smo uporabili individualni nestrukturirani pisni intervju, ki nam je omogočil bolj osredotočeno in poglobljeno razlago pojava raziskovanja. Le-ta je temeljil na predpostavki, da ima najpomembnejšo vlogo pri zagotavljanju prilagojenega in motivacijskega učnega okolja prav učitelj. Učitelj mora izvajati strategije dobre poučevalne prakse na vseh stopnjah petstopenjskega modela učne pomoči učencem. Pri tem se domači strokovnjaki pogosto sklicujejo tudi na mednarodne izkušnje pri spremljanju učiteljevega dela. Elliot, Doxey in Stephenson (2004) navajajo, da o inkluziji lahko govorimo le takrat, ko je vanjo zajeta refleksija prakse, razumevanje šolskega konteksta, poznavanje posebnih potreb učencev ter organizacija šole, ki je prilagojena učencem in učiteljem tako, da upošteva potrebe članov vse šole in obenem zahteva tudi njihovo odgovornost. Mitchell (2008) je mnenja, da ni inkluzije brez prilagajanja kurikula, prilagajanja učnih metod, prilagajanja tehnik preverjanja in ocenjevanja ter podpore in pomoči učitelju v razredu. Inkluzija je zanj večkomponentna vzgojno-izobraževalna strategija, ki jo je potrebno nenehno skrbno spremljati. Ob tem je Florianova že leta 1998 (Davis, Florian, 2004) predlagala niz nujnih (čeprav ne edinih) pogojev, ki jim moramo zadostiti, če želimo, da bo inkluzivno izobraževanje postalo pomemben model za učinkovito delo na področju posebnih izobraževalnih potreb. Mednje uvršča možnost učenčevega sodelovanja v procesih odločanja, pozitiven odnos do učnih sposobnosti vseh otrok, učiteljevo poznavanje učnih težav, ustrezno uporabo posebnih učnih metod ter podporo staršev in učitelja.

Naše osnovno raziskovalno vprašanje v kvalitativni pedagoški raziskavi, ki smo jo izvedli na osnovi pisnih intervjujev, je bilo, kako učitelji geografije slovenskih osnovnih in srednjih šol ocenjujejo lastno usposobljenost (kompetentnost) za poučevanje geografije učencev s posebnimi potrebami. Generalizirani odgovori trinajstih intervjuvanih učiteljev/ic geografije slovenskih osnovnih in srednjih šol kažejo, da se ti zavedajo pomembnosti in zahtevnosti njihove naloge ter jo tudi z vso odgovornostjo sprejemajo. V oceni lastne kompetentnosti so kritični. Pri svojem delu se najpogosteje zanašajo na dosedanje izkušnje, iščejo strokovno literaturo in se posvetujejo s strokovnimi sodelavci na šoli (pedagogi, specialni pedagogi, psihologi ipd.). Strokovnih spopolnjevanj s tega področja se niso udeleževali, ker jih tudi niso zasledili, čeprav so se, glede na njihove profesionalne reference, v zadnjih petih letih izredno aktivno vključevali v različna področja šolske geografije. Ugotavljajo, da jim manjka možnost primerjav dobrih praks med učitelji geografije in obžalujejo pomanjkanje sogovornikov pri refleksiji dela.

Izkušnje intervjuvanih učiteljev geografije pri poučevanju učencev s posebnimi potrebami so tako pozitivne kot negativne. Podpora staršev je po mnenju intervjuvancev tista, ki je najbolj zaželena; njen primanjkljaj zaznavajo kot pomembno oviro pri učenčevem napredku. Med največje pomanjkljivosti dosedanjega dela v inkluzivni šoli uvrščajo

preveliko število učencev s posebnimi potrebami, vključenih v posamezen razred, in obenem poudarjajo, da vključenost več kot dveh učencev z različnimi posebnimi potrebami lahko pomembno vpliva ne samo na samo zahtevnost dela temveč predvsem na njihovo zmožnost kakovostno voditi celoten razred. Žal tako v geografski pedagoški dokumentaciji kot tudi v domačih strokovnih virih ne najdejo dovolj ustreznih usmeritev za poučevanje učencev s posebnimi potrebami, obenem pa vsi niti nimajo ustrezne podpore pri svetovalnih delavcih na svojih šolah. Posledično intervjuvanci izražajo potrebo ne samo po dodatnem strokovnem usposabljanju temveč predvsem po prilagoditvi pedagoških normativov. Mnenje intervjuvancev ne podpira prepričanja Kavklerjeve (2009), da učitelji in drugi šolski strokovni delavci s pozitivnimi stališči do vključevanja otrok s posebnimi potrebami lahko najdejo toliko strategij in virov pomoči, da lahko v danih razmerah omogočijo optimalno vključevanje otroka.

Raziskave na področju implementacije kažejo, da je inovativna oz. efektivna praksa pogojena s časom, ki je na voljo za seznanjanje z novostjo, filozofskim sprejemanjem in videnjem pomena uvedbe novosti ter prepričanjem učiteljev o njihovi tehnični kompetentnosti in sposobnosti vpliva na učenčevo učenje (Davis, Florian, 2004). Raziskovanje tega področja mora po mnenju Davisove in Florianove vključevati sistematično, daljše razvojno delo, ki omogoča preverbo vpliva novosti na dosežke. Tako raziskovanje je nujno, če želimo razumeti, kako lahko kombinacijo učnih oz. t. i. multimodalnih pristopov uporabimo v različnih kontekstih in za različne namene. Tako se ob upoštevanju kompleksnosti in zahtevnosti problematike dela z učenci s posebnimi potrebami v inkluzivni šoli in odgovorov intervjuvanih učiteljev geografije postavlja vprašanje o zagotavljanju ustreznega in motivacijskega delovnega okolja za učitelje.

Na osnovi izkušenj intervjuvanih učiteljev geografije in ob ugotovitvi, da v strokovni literaturi ni mogoče zaslediti raziskav s področja poučevanja geografije učencev s posebnimi potrebami v Sloveniji, lahko zapišemo, da do sedaj ni bilo prisotne sistematične evalvacije vpliva inkluzije na dosežke učencev pri pouku geografije, tako z vidika učencev s posebnimi potrebami kot njihovih sošolcev, kot tudi ne glede učiteljevega dela (tako kompetentnosti kot obremenitev). Zato tudi ni moč predlagati dopolnitev ali izboljšav, če ni jasno ali jih dejansko potrebujemo oz. kaj želimo doseči. Tuje prakse poučevanja geografije v inkluzivnih šolah pa kažejo (Scruggs, Mastropjeri, 2007; Jitendra, Edvards, Sacks, 2004), da uporabljajo prilagojene oz. posebne učne načrte za učence s posebnimi potrebami pri pouku geografije in da pouk izvajata sočasno dva učitelja. Njuno delo se dopolnjuje tako, da se lahko eden med poukom vedno posveča individualnim potrebam posameznika.

Literatura in viri

Glej angleško različico prispevka.

WORKING WITH STUDENTS WITH SPECIAL EDUCATIONAL NEEDS: VIEWS AND EXPERIENCES OF GEOGRAPHY TEACHERS

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Abstract
In recent times characterised by rapid changes in knowledge, technology and also in values systems, children and adolescents with special educational needs have taken on a different place and role in the world compared to the past. Along with these changes, when it comes to people with special educational needs the ideas of integration, normalisation and, more recently, of inclusion have emerged and borne fruit. Through a qualitative pilot study we aimed to determine how geography teachers who teach in primary and secondary schools in Slovenia evaluate their own ability to work with students with special educational needs and garner their previous experience doing so. Geography teachers are aware of the importance of their tasks and accept them with full responsibility although they are critical about their own competencies. Among the main shortcomings of the current work in the inclusive school teachers mention an excessive number of pupils with special needs since the involvement of more than two pupils with different special needs can have a significant impact on their ability to achieve high quality teaching standards.

Keywords: student, teacher, geography lessons, special educational needs, education

1 INTRODUCTION

The term children/adolescents or persons with special educational needs (SEN) covers all those that require adjustments and assistance in their education for either a short or long period of time. Children with SEN are all children who have barriers, deficiencies, difficulties, problems and disorders when it comes to movement, perception, speech, cognitive processes, emotions, behaviour and learning (Bela knjiga o …,

1995). Zakon o osnovni šoli (*The Elementary School Act,* 2006) defines children with SEN as those that are gifted as well as those with learning difficulties due to various reasons. The integration of children and adolescents with SEN into the regular school system represents a big step towards fully integrating them in society. Since it is an extremely heterogeneous group of young people, it is impossible to utilise the same teaching approaches, materials and learning aids for everyone, for there is no set procedure when dealing with this population. As a result, teachers face an extremely challenging task that requires a lot of knowledge, flexibility and understanding on their part. In 2012 amendments to Article 11 (education of gifted and talented students), Article 12 (education of students with special educational needs) and Article 12a (education of students with learning difficulties) of the Elementary School Act (Zakon o spremembah ..., 2011) came into effect. The Act defines gifted and talented students as "[those] who demonstrate significantly above-average thinking abilities or outstanding achievements in various school subjects, in the arts or sport. Schools provide these students with adequate conditions for their education, to this end they adapt the content, methods and forms of instruction and enable them to be included in additional classes, other forms of individual and group instruction and other types of activities" (Zakon o spremembah ..., 2011, pp. 11317-11318). Students with SEN are students who "need adjusted implementation of elementary schooling programmes with additional expert assistance or adjusted programmes of primary schooling, or, in other words, special educational programmes. These students are, based on different types and degrees of deficiencies, difficulties or disorders, categorised in the *Act governing the placement of children with special educational needs*" (Zakon o spremembah ..., 2011, p. 11318). Students with learning difficulties are identified as students "who, without adjusted methods and forms of classwork, would find it difficult to attain standard knowledge levels. Schools adapt methods and forms of classwork for such students and provide them with supplementary lessons and other forms of individual and group assistance" (Zakon o spremembah ..., 2011, p. 11318). The placement of children, adolescents and adults with SEN as well as determinations on approaches to and forms of education are governed by the *Placement of Children with Special Needs Act* (Zakon o usmerjanju otrok …, 2011). It defines children with SEN as "children with intellectual disabilities, blind and partially sighted children or children with impaired visual functions, deaf and hearing impaired children, children with speech defects, children with mobility impairments, children with long-term illnesses, children with specific learning difficulties, children with autistic disorders as well as children with emotional and behavioural problems who need adjusted implementation of education programmes with additional expert assistance or adjusted educational programs, i.e. special education programmes" (Zakon o usmerjanju otrok ..., 2011, p. 8425).

Table 1: Educational characteristics of children with SEN.

SPECIAL NEEDS	CHARACTERISTICS
Children with intellectual disabilities	• Certain impairments in mental functioning and skills, such as communication, self-care and social skills. • Basic learning abilities are slower, lower than would be expected for their age. • Intellectual disabilities can be mild, moderate, serious or severe. • When it comes to mild intellectual disabilities, the primary issue regarding children's learning difficulties is the traditional attainment of prescribed knowledge that schools with equivalent educational standards expect. They are able to complete school programmes with lower educational standards. They learn basic vocational skills and knowledge and in adulthood they are relatively well socially adjusted and are essentially able to take care of themselves. • With moderate, serious and severe intellectual disabilities, the disorders are so severe that individuals, with rare exceptions, are almost incapable of functioning independently.
Blind and visually impaired children	• The Slovenian law concerning children with special needs has since 2000, when it was adopted, partly taken into account differences between the blind and visually impaired when it comes to the issue of technological aids and adaptations to spaces, but not in the provision of technical assistance or when it comes to attaining special skills and knowledge. • Blind children need a variety of additional expert assistance and support that can compensate for their lack of vision.
Deaf and hearing impaired children	• They are a heterogeneous population of people with disabilities that have to be dealt with selectively, or even individually, depending on the time, quality and degree of hearing impairment and abilities for spoken and social communication. • Special attention needs to be paid to children with hearing loss who require adjusted conditions for their optimal development and functioning at school. • Deaf children cannot receive information via the auditory pathway, their mother tongue is sign language. • If a child's auditory pathway is open and supported by a cochlear implant, it is likely that the child will be able to receive information through the auditory pathway and develop speech.
Children with speech and language disorders	• They have difficulties in acquiring and understanding information as well as expressing themselves verbally, though not as a result of hearing loss. • Disorders are reflected in understanding of speech and spoken-language expression, on a spectrum from slight delay to speech not developing. • Specific disorders in understanding, structuring, processing and expression are also reflected in the conflict between verbal and nonverbal abilities. • Secondary effects of spoken-language communication disorders are also reflected in reading and writing as well as in learning on the whole. Functional knowledge of reading and writing can be impaired on a spectrum from a slight lag to illiteracy.
Mobility impaired children	• They have congenital or acquired impairments, injuries of the locomotor system, central or peripheral nervous system. • Mobility impairment is reflected in forms of functional and movement disorders.

SPECIAL NEEDS	CHARACTERISTICS
Children with long-term illnesses	• Chronic disorders and illnesses that hinder school work. A long-term illness is one that is not cured within three months.
Children with certain learning deficiencies	• Due to known or unknown disorders in the functioning of the central nervous system, developmental lags are seen in connection with attentiveness, memory, thinking, coordination and communication. • In the development of social and emotional skills marked difficulties are revealed in reading, writing, spelling and arithmetic skills. • Deficiencies last a lifetime and influence learning and behaviour. • Difficulties in communicating with their peers, clumsy when using stationary (pens, scissors, etc.), they are slow following instructions and carrying out routine tasks as well as have difficulty in temporal and spatial orientation.
Children with behavioural and emotional disorders, who need adjusted implementation of educational programmes with additional expert assistance or adjusted educational programmes, or in other words, special education programmes	• Anti-social behaviour that is intense, repetitive and sustained and is also associated with a failure to integrate socially. • The child's anti-social behaviour is often characterised by symptoms including aggressive behaviour, autoaggressive behaviour, alcohol and drug abuse, destruction of other people's property, running away from home and emotional disorders.

Source: Jošt, 2010, pp. 13–17.

Since this is an extremely heterogeneous group of young people, it is impossible to choose the same teaching processes and the same learning and teaching materials for all. There is no dominant process in the treatment of this population. As a result, teachers are before an extremely challenging task that requires a lot of knowledge, understanding and adaptation. After reviewing the theoretical bases, the paper focuses on the results of the survey among teachers of geography on their qualifications and experience in educational work with pupils/students with special needs in geography lessons.

2 INTEGRATION OF CHILDREN WITH SPECIAL EDUCATIONAL NEEDS IN THE EDUCATIONAL PROCESS

Integration of children with SEN into mainstream classes was formalised in Slovenia in 1996 through the Elementary School Act and in 2000 through the Placement of Children with Special Needs Act. In particular, the Act regulates the placement of subjects in a variety of programmes, determines the procedures of placements and the work procedures of the expert committees responsible for placement decisions, as well as investigates and determines possibilities for placement of children with SEN in educational programmes. Integration of children with SEN among peers without SEN enables them to develop their capabilities, while also acknowledging differences and disorders that persist throughout their lives (Kranjc, 2011).

In the literature different terms have been used by authors to denote the placement of children with SEN in mainstream educational institutions. Among the most frequently cited are integration and inclusion, which until not long ago, particularly before 2000, were understood by many as synonyms, since it was considered they represent the same ideas, practices and objectives. Today, most authors make a distinction between the terms and highlight significant differences between them regarding the quality of work and practical implementation of the integration of children with SEN (Kavkler et al., 2008).

Integration is defined as the achievement of integrity in the sense of restoration or else "bringing together individual units, parts into a larger whole, combining ..." (SSKJ, 2016). Often it means simply placing a child with SEN within a mainstream institution, where the school and wider environment try to adjust/adapt the individual into an "average" student such that the child could be included in the regular education system and could thus achieve the prescribed standard of knowledge, reading, writing, numeracy skills, as well as be able to adapt to the method of receiving information, the social environment, obstacles to movement in the environment, etc. If the child is not able to attain the prescribed minimum educational achievements and adapt to the learning environment, they cannot achieve full integration into the school environment (Kavkler et al., 2008). Resman (2003) and Corbett (1999) also suggest that integrated individuals are only those who have adapted or conformed to the dominant standards in a particular (school) environment. It is expected of integrated students that they have the strength and willingness along with an ability to perform the same duties that are expected of every other student or child.

In contrast to integration, inclusion enables every individual to participate, as much as they can, since attaining the average achievement is not an essential condition for inclusion in the school and wider social environment. Here, the differences between individuals are primarily considered as a basis for social interactions (Kavkler et al., 2008). An inclusive culture supports a variety of needs and accommodates idiosyncrasies, which are influenced by gender, ethnicity, linguistic origin, different social status, educational level, along with certain deficiencies, problems, disorders and diseases (Corbett, 1999). While with integration, the education system remains unchanged despite the introduction of certain measures, inclusion encourages professional school practitioners to reflect on their performance and think about different approaches to teaching, various forms of assistance and ways of responding to the needs of all children (Farrell, 2005).

The education system is based on important general principles of democracy, autonomy and equal opportunities (Košir, 2008). The principles are based on human rights and the rule of law. For the education of students with SEN, in addition to the mentioned general principles, various other principles are also important, including: promoting integration, providing suitable conditions, ensuring equal opportunities, involving parents in the education process, arranging education of children and youth with SEN as close as possible to home, providing individualised approaches featuring differentiated and individualised programmes, ensuring continuity of programmes, and, referring individuals to an appropriate education programme in a timely manner, as well as encouraging interdisciplinarity, which dictates that various experts (from education, health care and social protection) are involved in educating children and youth with SEN (Kranjc, 2011).

Successful development of inclusion is influenced by several factors:

- professional support for teachers;
- additional expert and physical assistance for children and adolescents with special needs, prescribed in the *Regulations on additional expert and physical assistance to children with special needs* (2013);
- material resources (appropriate environment, learning, teaching and technical aids).

In addition to professional assistance provided to the teacher, technical and material resources influence the successful development of inclusion, since without additional material resources (appropriate environment, teaching, learning and technical aids) teachers cannot ensure the optimal opportunities for children with SEN to develop their skills. Since the inclusion of children with significant SEN is a very sensitive subject, with many proponents and even more opponents, it needs to be well planned and implemented utilising all available technical and material resources (Kavkler et al., 2008). Problems faced in the process of integrating children with SEN stem from, *inter alia*, the financial capacity of the country, poorly developed advocacy for inclusiveness in society, excessive stressing of the importance of educational performance, an extensive system of special institutions, teachers and other resources, poor conditions of education in mainstream schools, class size, organisational barriers, the different positions of teachers and professional workers, as well as their knowledge and strategy management (Kavkler et al., 2008).

At the same time it is important not to overlook the relationships between students themselves. Research shows (Pijl, Frostad, Flem, 2008) that students with SEN may have difficulty in establishing relationships with non-SEN peers. They are often less popular, have fewer friends and do not belong to a group of peers. Belonging to a group does not always happen of its own accord; therefore, we must be aware that children with SEN might need extra help in this regard. In order to maximise and optimise the development and success of every student, it is necessary to acknowledge the importance of differentiated and individualised teaching, encapsulated in the process of teaching and learning of students with different abilities (Dervarič, 2013). According to Pulec Lah teachers can differentiate and individualise the educational process by adjusting the four elements of the curriculum (content, procedures, tests and evaluation) and environment (Pulec Lah, 2008 in Dervarič, 2013).

3 RESEARCH METHODS

3.1 Definition of the research subject and goals

In October 2007 the Council of Experts of the Republic of Slovenia for General Education adopted the Working Concept paper on Learning Difficulties in Primary School (Magajna et al., 2008), in which the Council laid out a technical foundation for the development of more effective approaches to the management of students with learning difficulties. It is based on a five-stage model of learning support, covering a continuum of learning difficulties ranging from mild to severe, from specific to general, from simple to complex and from short term to lifelong, as well as from those that require little learning assistance and

support to those who require a great deal of specific learning assistance and support. The model also calls for early management of students with learning difficulties (Magajna et al., 2008). In this study we followed the mentioned model and did not focus on specific types of learning difficulties, as geography teachers have to deal with students with different types of difficulties. Primary and secondary school teachers were thus faced with having to master strategies for best teaching practices along with general strategies for teaching children with SEN. Teaching assistance and support envisaged in the five-stage model include a range of measures, from assistance of teachers in the classroom, involvement of school counsellors or visiting specialist educators, to organisation of individual or group teaching assistance and support of external specialised institutions. Only through such measures can students with severe specific learning difficulties, or else those with certain deficiencies in individual aspects of learning, be directed towards an education programme featuring "adaptive implementation with additional professional assistance" (Magajna et al., 2008). Our research focused on various forms of assistance to the teacher in the classroom, the potential involvement of school counsellors or specialist educators, organisation of individual or group learning assistance and support of external specialised institutions, in so far as teachers participating in the survey expressed interest in these topics.

The survey of geography teachers' views about their qualifications and experience teaching students with SEN in geography classes was conducted in the summer of 2015. The study sought to answer our primary research question, which was aimed at finding out what previous experience geography teachers had in inclusive schools and also how they rated their own ability (competence) to teach geography to students with SEN.

We wanted to provide answers to the following research questions:

- What previous experiences do geography teachers have working with children with SEN (both positive and negative experiences or problems they have faced)?
- Where do geography teachers get (or not get) support, assistance, advice and from whom (other geography teachers, professional support at the school, counsellors from the National Education Institute, pedagogical documents – i.e. curriculum, professional development training, in the literature, etc.)?
- What would geography teachers need to overcome barriers and achieve higher quality of their work and/or desired competency?
- To what extent do geography teachers feel they can cope with the requirements (skills, competences) for this type of work, what areas do they consider most lacking/problematic (working methods, learning and teaching materials, organisation of work, volume of work, teaching standards and norms, the number of students with SEN or else the variety of their specific needs, etc.)?

3.2 Methodology and research sample

In August and September 2015 15 selected geography teachers were asked in writing to participate in our qualitative research. The criteria for selection of participants was based on: varied duration of employment as a geography teacher (thus the extent of experience), different levels and programmes of education (primary school, secondary school: three- and

four-year technical programmes, economic grammar school, general grammar school, hospital schools), equal gender representation, their previous documented pedagogical activity/engagement in the last five years (participation in expert consultations, professional excursions, professional training, academic publishing, mentoring of student teachers on practical placements, continued formal education, etc.) and dispersed spatial distribution of schools. However, their willingness to participate was of key importance. We received responses from eight female and five male geography teachers. Eleven participants had a university degree and held the title of teacher of geography, two other participants had master's degrees in geographic education. One of the participants mainly worked as an educator, to a lesser extent also as a geography teacher. Based on written interviews, the participating geography teachers had an average of 15.9 years of work experience (the lowest being seven years of experience and the highest being 34 years of work experience). Eight of them were employees at primary schools (five women and three men) and five at secondary schools (two men and three women). Interviewed geography teachers taught at schools in Koper, Ljubljana, Tržič, Jesenice, Slovenj Gradec, Celje, Krško, Maribor and Murska Sobota.

Our primary starting point for approaching the research topic centred on descriptive method with analysis of written documented sources. Data collection for the study was based on qualitative empirical pedagogical research. The basic research instrument we used was a written unstructured individual interview, which enabled us to gather more focused and in-depth explanations on the research topic. Interviewed teachers were presented with wide-ranging and open questions on the research topic, allowing them the opportunity to provide their personal opinions as a narrative and as such they were not limited in the scope of their responses. "Narrative inquiry and reflection allows the teachers to develop new meaning and interpretations, to organise their personal knowledge of teaching and learning, therefore altering their teaching practices, personal and professional development" (Konečnik Kotnik, Javornik Krečič, 2011, p. 10). The authors of the book "Kompetence v kadrovski praksi" (2005) found that when it comes to determining job competencies interviews can be a very appropriate method for obtaining data. A feature of in-depth interviews, such as those carried out by Legard et al. (2003), is their potential for being generative since they encourage the articulation of independent responses, which reflect the knowledge and understanding of the interviewee.

It is important to note that our qualitative pedagogical research is not intended to reveal representative situations within the studied topic (that is why we did not endeavour to match responses with statistical categories), rather we sought to examine whether participants, irrespective of their level of teaching (primary or secondary school), gender and work experience conform to key observed assumptions. This approach was based on our specific selection of an (exceptionally active) segment of geography teachers in terms of the amount they had cooperated, as well as variety of ways they had cooperated within their respective professions.

Data was analysed in descriptive terms and presented as generalised descriptions with selected individual responses as examples. When presenting the results in order to ensure the anonymity of the interviewees we did not use any names, rather we wrote only their gender, years of work experience and the type of school they worked in (except in two cases where we did not provide data on gender on account of the type of school - a small

number of hospital schools in Slovenia). Individual responses presented in the results section were copied word for word from the original interviews.

4 RESULTS AND DISCUSSION

We sorted the opinions of interviewed geography teachers into designated thematic areas in which we, alongside the generalised description of the most common responses, highlighted also individual concrete answers as illustrations of noted generalisations. Along with the generalised descriptions we also provided their frequency in parentheses.

4.1 Previous positive and negative experiences

All of the respondents wrote down examples of positive experiences. In doing so they shared experiences both in terms of knowledge (cognitive experiences) and the development of geographical skills and abilities, as well as experiences relating to students' psychological and social development, thereby demonstrating their awareness of the importance of all three areas of teaching.

> *"As an example of a really good experience I can describe how following a few individual discussions I succeeded in motivating a student who did not show even the slightest interest in lessons (also in geography) to work. It turned out that he was only interested in football. And I took advantage of that (the World Cup was also on at the time), such that for regional geography of the world he reached the minimum standard. Questions like where the teams are from (world map), how many players a particular country has compared to its population and what the training conditions (climate) are like, were no longer a problem for him."* (male, 21 years of work experience, teaches at a primary school)

> *"In all these years, there have been quite a few. One girl in particular stands out. Although she was physically impaired (walked with crutches), she attended all the excursions and participated in fieldwork. Before departing we agreed what she would do, she took a folding chair with her. She did walk slowly, but never fell behind, her classmates also took care of her in this regard. And, it wasn't an issue for her when they carried her onto the bus."* (female, 25 years of work experience, teaches at a primary school)

Among the negative experiences of interviewed teachers, foremost were unrealistic expectations of both students and their parents which featured in half of the responses (six). They considered the engagement of parents in activities with students with SEN as an important prerequisite for their successful work. In second place in terms of frequency of responses (three) was the failure to comply with agreements on the part of students.

> *"The parents of a student with attention deficit disorder and hyperactivity, that I had successfully motivated for learning geography through "his football", confronted me on just that, arguing that the boy was, as it were, not*

interested in anything other than football, and now he was learning about it in school as well. All my arguments why it was good didn't help at all and the mother said that I should stop." (male, 21 years of work experience, teaches at a primary school)

"Among the most common disadvantages is a significant deficit in knowledge carried over from previous years. They do not keep up with regular study, relying instead on learning for scheduled exams and the fact that they would have someone (e.g. a teacher) with them to help them learn. They quickly forget learnt material. Since they have problems in a number of subjects they find it hard to follow lessons, also they are sometimes distracting, do not have an adequate background knowledge or else do not keep up with the minimum standards of knowledge." (female, 34 years of work experience, teaches at a primary school)

"*My negative experiences were with students who weren't responsible and lacked work habits, those who exploited directives for privileges which they were actually entitled to based on the directives (extended time for spoken and written exams, larger letters on exams, pre-scheduled exams, etc.). They did not stick to any or most of the arrangements, for example they picked the dates for when to be assessed themselves and then were not at school on the scheduled day and their parents didn't do anything about it."* (female, 33 years of work experience, teaches at a technical secondary school)

4.2 Assistance, support, advice

Generalised responses of interviewed teachers reveal they believe that, above all, teachers need to rely on themselves and on their own skill, experience and ingenuity (seven responses). The next most common response cited was assistance from school counselling services (five responses). In these responses they listed educators, specialist educators, psychologists and social workers. They also noted that they were aware of the fact that their counsellor colleagues are limited both in time and knowledge, and that their assistance does not relate to geographical advice. Three interviewees noted that they consulted professional literature in order to make specific adjustments in their geography lessons. They did not mention cooperation with counsellors from the National Education Institute, however one interviewee mentioned a seminar focusing on minimum standards of knowledge in geography lessons as a welcome support in her work with children with SEN.

"The impression remains that we teachers are often left to rely on our own abilities, experience and ingenuity." (male, 15 years of work experience, teaches at a general grammar school)

"It is good to cooperate with educators at the school and comply with the minimum standards of knowledge in the curriculum. In terms of minimum standards, I got a lot out of the training organised by the National

Education Institute in Ljubljana." (female, 34 years of work experience, teaches at a primary school)

"In unforeseen situations when teaching children with special needs we can always rely on the assistance and advice of the medical staff and professional team." (33 years of work experience, teaches at a hospital school)

"In cases when I need pedagogical advice for working with students with special needs, I always turn to our specialist educator. On occasions I have gone to the attending psychologist at the Paediatric Clinic for help with an individual student. In terms of teaching geographic content to a student with special needs, so far I have not had such troubles that I would require the assistance of geography experts from the National Education Institute or from the faculty." (male, 15 years of work experience, teaches at a general grammar school)

"Personally, I have already sought out and read literature on this subject. At the hospital school we don't turn to the National Education Institute for help." (7 years of work experience, teaches at a hospital school)

4.3 Teachers' needs

According to the respondents realistic expectations of the students as well as the support and cooperation of parents are the most important factors for successful work (five responses), though they note that this is often not the case. Therefore, non-cooperation of parents is often mentioned among negative experiences (written by a secondary school teacher, 15 years of work experience).

"Although Tone was a nice boy with a desire to successfully pass the class, his perception of what it takes to achieve that was completely unrealistic, "in the clouds". In our structured schools, which "rush onwards and upwards," as a teacher it's so hard to expect such a child to have the work habits and mental activity required to learn and keep up. Would it really be so unacceptable to repeat a year? For most parents it is unthinkable, even though their child really cannot keep up." (female, 33 years of work experience, teaches at a primary school)

"I think parents should be more engaged and help children also through home tutoring." (female, 33 years of work experience, teaches at a technical secondary school)

Drawing on a number of responses (four responses), too few opportunities for individualised approaches, due in part to the excessive number of students with SEN, as well as insufficient hours for individual work with them (35 hours of individual professional assistance per year), the rigidity of the system (regulations, laws) and the question whether such a large number of children designated as having SEN is justified, present an obstacle to more effective work. The responses also reveal the interviewees' concerns about other students in the class being neglected (three responses).

> *"I think objective working conditions are also an important factor. A teacher who is able to devote more attention to a child with special needs because they work with a small group of children or in certain cases even one on one, probably establishes a more genuine relationship with the student; gets to know them better, teaches them more effectively, better evaluates them and more easily motivates them compared to a teacher in a classroom of 28 children, where three have special needs."* (7 years of work experience, teaches at a hospital school)

> *"The scope of work and the standards and norms of working with students with special needs should be adapted to the number of students as well as their specific characteristics. There should be concrete and more sophisticated legislation in this area, while more extensive and additional professional support for teachers should also be provided. The number of students with special needs is rising, and I have a feeling that many people are also exploiting this."* (male, 15 years of work experience, teaches at a general grammar school)

> *"I am aware that students with special needs need more attention, time and a lot of adapted material. But sometimes I ask myself: what about the rest of the students in the classroom? You have to be honest and admit that if you're in a class with more than two students with different special needs then you simply cannot work to the same quality with the other twenty or more students as well."* (female, 25 years of work experience, teaches at a primary school)

> *"What bothers me most is that psychologists, specialist educators, defectologists and speech therapists too often insist that it is necessary to make adjustments for each student, e.g. time, tempo, font size, etc., even if from previous experience we know that this is not necessary and that with minor adjustments we could achieve almost the same results. These types of adjustments lead to students being excluded from the group."* (33 years of work experience, teaches at a hospital school)

> "*As the number of students with special needs in a class increases, it would be worth considering the relevant standards and norms. And, of course, in this regard, also consider whether all children designated as having special needs really have them."* (female, 33 years of work experience, teaches at a technical secondary school)

A third set of proposals relates to professional development for teachers (two responses) and their need to have appropriate interlocutors when they seek feedback on their work. In this section respondents highlighted the problems encountered when seeking to attend additional training. There was also one response that mentioned the already heavy workload of teachers.

> *"Teachers would need even more experience or else that they could have discussions with someone that really knows the field, as well as additional hours for individualised work (with several students who have problems at the same time)."* (female, 34 years of work experience, teaches at a primary school)

"Unfortunately, we teachers do not talk much amongst ourselves about the problems of students with special needs. Neither with colleagues in the staffroom, and even less with fellow geographers. It's not that we are not interested, but there are so many different problems and tasks that need to be completed that most people don't have time for it. Though it is needed. Unfortunately, there are no longer any geography teacher working groups. In the past we "elementary [teachers]" used to meet and compare experiences, and help each other with materials, etc." (male, 21 years of work experience, teaches at primary school)

"Our school has financial problems. Even for professional development training I need to pay the fee out of my own pocket. Many teachers prefer to completely avoid additional training." (7 years work of experience, teaches at a hospital school)

4.4 Competency for teaching students with special educational needs

In their responses interviewed geography teachers critically rated their own competencies and openly shared their views. In doing so they highlighted the fact that, apart from their own judgement (*"by feeling",* as described by one interviewee with 25 years of work experience, teaching at a primary school), they do not have the mechanisms (criteria) that would help them in self-evaluation (five responses). Furthermore, some interviewees are aware of that and assessed it as a deficiency (three responses). They consider working with students with behavioural problems most demanding, because in their view such students have the largest influence on classroom dynamics. Three of the interviewed geography teachers felt that the teaching materials they had thus far created, facilitate working with newer generations of students. Only one interviewee out of thirteen wrote that they felt adequately competent.

"Up until now I have been able to cope with this type of work, even though we never had any kind of training. I customise working methods by feel, depending on the needs. I follow the rules outlined in decisions - determining SEN status." (female, 33 years of work experience, teaches at a technical secondary school)

"In some areas I feel competent, while in others I do not. After several years of collecting and producing teaching materials it is now a fair bit easier. Especially with students who have impaired vision and hearing. With the physically handicapped there are also not many problems. Most of the difficulties arise with students who refuse to participate, are unmotivated, undisciplined. This is not just a problem for the individual student, but it becomes a problem for the whole class, i.e. all 25 students. I still don't know what should be done in these situations." (female, 25 years of work experience, teaches at a primary school)

"I don't know if I am competent for such tasks. There are lessons when I have a good feeling and am pleased with my work, where the students and I appreciate their progress. Unfortunately, these are the exceptions, in most

cases each lesson is a "fight" to make sure students with special needs at least understand and follow the organisational instructions for the lesson: place notebooks on the table, write, paste the worksheet into the notebook, look at the map on the board and then also at the map on the desk - it's clear to us that the maps are different (!!!), look at a picture in a textbook, a video presentation, write down what there is for homework. Oh, and that they don't disturb the others too much." (female, 33 years of work experience, teaches at a primary school)

"Personally, I feel competent working with students with special needs and so I don't have a feeling that I would necessarily need additional training in this area." (7 years of work experience, teaches at a hospital school).

4.5 Satisfaction and needs of geography teachers

The questions about what the geography teachers need to overcome obstacles and achieve higher quality of their work or to achieve the required competency and what they experience during the monitoring of the results of their work had the lowest response rate.

In this section two responses ascribed satisfaction of working with students with SEN to students' progression or their success, as well as feelings that as a teacher they had done all that was necessary.

"I'm doing my best under the given circumstances and I really think that I put in an effort. And my colleagues do the same." (male, 14 years of work experience, teaches at a secondary technical and vocational school)

"I've already had two students who were almost completely deaf. They sat in the front, I explained things somewhat slower, so that they always saw my mouth. Both finished school very successfully and they were not a burden for me, all that was needed was a little bit of accommodating. I was glad of their success and satisfied, because I also contributed something to it." (female, 33 years of work experience, teaches at a technical secondary school)

When it comes to deficiencies there was repetition of responses from other sets of questions, where respondents stressed the excessive number of students with SEN included in a single class (i.e. there is a need for smaller study groups) and inadequate supply of specific learning and teaching aids that would facilitate individualised work, as well as additional professional development training and sharing of experiences and views amongst geography teachers. One response also mentioned that teachers have a feeling of being powerless when seeking solutions and implementing changes.

"The problem lies in the fact that in certain classes there are too many students classed as having special educational needs. In 2014/15 in one of the classes there were as many as 8 out of 29 students. In this situation after all the discussions I ran out of time for other students. If there are not many special needs students (up to three), then generally there are no problems.

However, the number of these students is increasing every year." (female, 33 years of work experience, teaches at a technical secondary school)

"A deficiency that I consider critical is the poor equipment of the hospital school with teaching and learning materials/equipment. It often happens that during the class I cannot get access to the internet for teaching purposes. It would be great if the school would buy some new teaching and learning materials to replace the old, worn and outdated (atlases, flashcards, a new laptop, etc.), however at the moment the school finances are in such a state that I won't be proposing this to the headmaster anytime soon." (7 years of work experience, teaches at a hospital school)

5 CONCLUSION

Using the descriptive method we analysed various expert publications (Kavkler et al., 2005; Magajna et al., 2008) to study the introduction of the so-called inclusive school from the perspective of the fundamental principles which state that, *inter alia*, the SEN of students with learning difficulties require adapted learning environments. Data collection for the survey dealing with geography teachers' opinions is based on the qualitative empirical pedagogical research. As a basic research instrument we used individual written unstructured interview which provided us with a more focused and in-depth explanation of the researched phenomenon. This was based on the assumption that teachers have the most important role in providing accommodating and motivational learning environments. The teacher must implement strategies for best teaching practices at all stages of the five-step model of learning support for students. In this regard, national experts often refer to international experience in monitoring the work of teachers. Elliot, Doxey and Stephenson (2004) suggest that we can only speak about inclusion when it incorporates reflective practice, understanding of the school environment, knowledge of the SEN of students and the organisation of a school tailored to students and teachers, such that it takes into account the needs of all schools members and at the same time demands they fulfil their responsibilities. Mitchell (2008) argues that there cannot be inclusion without adaptation of the curriculum, teaching methods and techniques of testing and assessment, as well as support and assistance for teachers in the classroom. He considers inclusion as a multi-faceted educational strategy, which needs constant careful monitoring. Furthermore, going back as far as 1998 Florian (Davis, Florian, 2004) proposed a set of essential (though not the only) conditions that must be met if we want inclusive education to become an important model for effective special needs education. Listed among them were the possibility for a student to participate in decision-making processes, a positive attitude towards learning capacities of all children, teachers' knowledge of learning difficulties and appropriate use of specific teaching methods, along with the support of parents and teachers.

The basic research question underpinning our qualitative pedagogical research, conducted on the basis of written interviews, was how geography teachers in Slovenian primary and secondary schools assess their own capabilities (competency) to teach geography to

students with SEN. Generalised answers from thirteen interviewed Slovenian primary and secondary school geography teachers show that they are aware of the importance and complexity of their role, while they fully accept the responsibility for performing it. They critically assessed their own competencies. In their work they most frequently rely on previous experience, they seek out expert literature and consult with counselling services at the school (educators, specialist educators, psychologists, etc.). Respondents had not in the past attended professional development training in this field, because they did not come across it, although, based on their professional references, in the past five years they were very actively involved in various facets of school level geography. They find that they do not have enough opportunities to compare best practices among geography teachers and they regret the lack of interlocutors with whom to discuss and reflect on their work.

They have both positive and negative experiences teaching students with SEN. According to respondents, support from parents is most appreciated, while lack of support is perceived as a significant impediment to progress. Among the major shortcomings of current practices in inclusive schools they list individual classes containing excessive numbers of students with SEN. Furthermore, they stress that the inclusion of more than two students with different SEN can have a significant impact not only on the difficulty of the work with such students itself but also on their ability to effectively manage the entire class. Unfortunately, be it in the geographical pedagogical materials or else in national professional resources, they cannot find sufficient suitable guidance for teaching students with SEN, moreover not all of them have adequate support from counselling services in their schools. Consequently, respondents expressed the need not only for additional professional training but, above all, for the adaptation of standards and norms for teaching. Their views do not support the position of Kavkler (2009), who argues that teachers and other school professionals who hold positive attitudes towards the inclusion of children with SEN can find enough strategies and forms of assistance in current settings to ensure optimal inclusion of these children.

Studies into implementation indicate that the innovativeness or effectiveness of practice is contingent on time being devoted to understanding new approaches, philosophical acceptance and perception of the importance of introducing innovations, as well as teachers' confidence in their technical competency and ability to impact on student learning (Davis, Florian, 2004). According to Davis and Florian research in this area should include systematic, long-term development work, which allows for verification of the impact of innovations on performance. Such research is essential if we want to understand how a combination of approaches to learning, or else so-called multimodal approaches are used in different contexts and for different purposes. Taking into account the complexity and challenges of working with students with SEN in inclusive schools along with the responses of the interviewed geography teachers, the issue of ensuring appropriate and stimulating working environments for teachers arises, as does the question to what degree geography teachers have in the past been able to use the prescribed expert guidelines for effective work with SEN students.

Based on the experience of the interviewed geography teachers and due to the fact that in the professional literature there is no research in the field of teaching geography SEN

students in Slovenia, we can say that so far there has been no systematic evaluation of the impact of inclusion on students' achievement in geography lessons, neither from the perspective of SEN students or their classmates nor from the perspective of the teacher's work (e.g. their professional competence and workload). Since it is not clear what amendments and improvements are actually needed it is rather difficult to propose any of them. Geography teaching in foreign inclusive schools (Scruggs, Mastropjeri, 2007; Jitendra, Edwards, Sacks, 2004) is often based on adapted or special curricula for SEN students and teaching is carried out simultaneously by two teachers allowing them to focus on individual needs of students.

(*Translated into English by James Cosier*)

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QUALITY OF THE LIVING ENVIRONMENT IN THE NEIGHBORHOOD OF MURGLE – SCANDINAVIAN URBANISM IN LJUBLJANA

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Abstract
The main characteristic that distinguishes the Murgle housing estate from other residential areas in Ljubljana is its specific and unique urban design inspired by Scandinavian urbanism. The main goal of the paper is to present an evaluation of residents' satisfaction with the quality of the living environment, 50 years after its construction commenced. We also analyzed gradual spatial, urbanistic and social transformations of the neighborhood over time. On the basis of the survey carried on among the residents we established that the neighborhood, despite many unregulated interventions not in accordance with its urban design, maintained a high quality of living environment.

Key words: Ljubljana, Murgle, quality of the living environment, urbanism, France Ivanšek

KAKOVOST BIVALNEGA OKOLJA V SOSESKI MURGLE – SKANDINAVSKI URBANIZEM V LJUBLJANI

Izvleček
Osnovna značilnost, po kateri se soseska Murgle razlikuje od preostalih stanovanjskih območij v Ljubljani, je njena edinstvena urbanistična zasnova, ki izhaja iz tradicije skandinavskega urbanizma. Glavni namen prispevka je ocena zadovoljstva stanovalcev s kakovostjo bivalnega okolja 50 let po nastanku soseske. Poleg tega smo preučili postopno prostorsko, urbanistično in socialno preobrazbo soseske skozi čas. Na osnovi anketiranja prebivalstva smo ugotovili, da je soseska kljub številnim nedovoljenim posegom, ki niso skladni z osnovnim urbanističnim konceptom, zadržala visoko kakovost bivalnega okolja.

Ključne besede: Ljubljana, Murgle, kakovost bivalnega okolja, urbanizem, France Ivanšek

1 INTRODUCTION

The Murgle neighborhood was constructed between the end of the 1960s and the middle of the 1980s during the most intensive period of public housing development in Ljubljana and Slovenia. The vast majority of public housing in this period was built in the form of high-rise housing estates. High-rise housing estates were considered as the most suitable form of residential developments from an economic, urbanistic and ideological point of view. Public construction of individual family houses was seen as not "appropriate" given the values of the socialist society. On the other hand, public opinion surveys (Toš, 2014) showed that the majority of Slovenes wanted to live in a single family house with a small garden, but close to services offered by urban centers. Architects France and Marta Ivanšek proposed constructing a completely different housing estate of low atrium houses. Due to its location on the Ljubljana Marshes (Ljubljansko Barje) the terrain had low carrying capacity and high-rise construction would be very expensive if not impossible, while the location close to the city center demanded a relatively high population density. With his urban layout, which was inspired by Scandinavian urbanism, France Ivanšek managed to obtain population density above 100 inhabitants per hectare (compared to around 30 to 50 with detached single family houses). The urban form and architecture of the estate were deliberately simple; the costs of construction were low. In the first phase of the construction, at the end of the 1960s, social housing in small and very basic atrium houses was offered. However, in the second phase, in the 1970s, higher quality construction and bigger houses, together with the neighborhood's very green and quiet environment close to the city center, attracted residents with higher socio-economic status. With further expansion, Murgle turned into a very popular and "elite" neighborhood.

The main characteristic that distinguishes Murgle from other residential areas in Ljubljana is its specific and unique urban design inspired by Scandinavian urbanism that will be presented in more detail in a separate chapter. For that reason, the Murgle neighborhood is protected as an area of architectural and urban heritage and all interventions are strictly regulated by a building plan. Our research hypothesis was that this kind of urban design results in a high-quality living environment. The main goal of the paper is thus to present an evaluation of the satisfaction with the quality of the living environment and more specifically with the neighborhood's urban design expressed by its residents, 50 years after its construction began. We also analyze gradual spatial, urbanistic and social transformation of the neighborhood over time. Despite strict architectural and urban planning regulations, spatial development in the form of different renovations, enlargement of houses and other kinds of interventions has been more or less uncontrolled and for that reason chaotic. In this way, the urban heritage of the neighborhood is being degraded. In contrast, we wanted to establish whether the neighborhood, despite its many unregulated interventions not in accordance with its urbanistic concept, maintained a high quality of the living environment. In addition, we wanted to find out what the position of Murgle is in the modern social geography of Ljubljana and what kind of further development and transformation processes we might expect in the future.

The research was based on analysis and interpretation of statistical data (Population Census 1991 and 2011), fieldwork analysis of the spatial and urbanistic transformation of the neighborhood and, to the greatest extent, on surveys conducted among residents of the neighborhood.

2 THEORETICAL AND METHODOLOGICAL FRAMEWORK OF THE RESEARCH

The study of the quality of the living environment is an important research topic in geography. Pacione (2003) considers that studying the relationship between society and its environment is one of the basic research questions in social geography. The research on the quality of living environments in cities is also an important element of modern urbanism (Leitmann, 1999). It can contribute to better and more efficient urban planning and urban policies. Very popular are methods of measuring and comparing the quality of living environments in cities, the results of these approaches are different quality of living rankings for world cities, for example Mercer Quality of Living Ranking. Research on the quality of living environments in Slovene towns has been carried out by geographers (Špes, 1998; Drozg, 1994; Rebernik, 2002; Krevs, 1998; 2002), and also by sociologists and economists (Mlinar, 1983; Uršič, Kos, 2004; Mandič, Cirman, 2006).

One of more general definitions of the living environment is "a space in which an individual fulfills its basic needs and social functions" (Tiran, 2015). Living environments have different spatial dimensions and most authors distinguish three levels: dwelling, neighborhood, city (Pacione, 2003). Our research is limited to the level of dwelling and neighborhood. In this research, based on different theoretical and methodological approaches, we defined the living environment as the characteristics of a dwelling and its surroundings which are important for the fulfillment of basic human needs and functions. The quality of the living environment is an evaluation of living conditions and circumstances. There are two main approaches to evaluate the quality of living environments: objective and subjective. An objective approach is based on a quantitative measurement of the quality of a living environment. Its main advantage is objective evaluation of different characteristics of living environments, its weakness is the impossibility of measuring all elements of living environments and available data is often of poor quality (Tiran, 2015). In the subjective approach, we measure the quality of a living environment on the basis of residents' subjective evaluation of the studied area. The subjective approach derives from behaviorism (Tiran, 2015) and is based on surveying local population. In this way, we can evaluate a much wider range of quality of living environment elements.

The study of the quality of the living environment can include different dimensions: quality of housing, quality of services, quality of environment, accessibility, aesthetic evaluation, security, quality of social interactions and similar. In our research, we focused on selected dimensions of the quality of the living environment: quality of housing, quality of urban layout, security and aesthetic evaluation. The main aim of the research was to evaluate the level of satisfaction of residents with the quality of the living environment

in their neighborhood based on the characteristics of its urban design. In other words, we wanted to establish if residents are satisfied with the living conditions that result from the unique and specific architectural and urban design of their neighborhood.

The main empirical method used in our research was surveying of local population. Apart from that, we conducted basic statistical analysis and an expert evaluation of the spatial transformation in our study area. In the statistical analysis, we compared selected data on socio-economic and demographic characteristics of the population in the Murgle neighborhood with those for the Municipality of Ljubljana in its entirety. In this manner, we evaluated the position of the neighborhood of Murgle in the context of the social geography of Ljubljana. We also compared data from the 1991 and 2012 Population Censuses to delineate the main processes of social transformation. One of the goals of our study was to evaluate spatial transformation of the neighborhood from an architectural and urbanistic point of view. In the expert evaluation, we tried to identify the most widespread and common interventions that had occurred not in accordance with urban planning regulations.

The survey was carried out in January 2016 by geography students from the Department of Geography, University of Ljubljana. 380 surveys were completed. In the entire neighborhood, there are around 750 houses, so approximately 50% of households were interviewed. We applied a simple random sample where each individual was chosen randomly and entirely by chance, such that each individual had the same probability of being chosen at any stage during the sampling process. Our sample, which included 50% of the neighborhood, is thus highly representative. A detailed analysis of the survey results is presented in chapter 5.

3 URBANISM OF MURGLE NEIGHBORHOOD

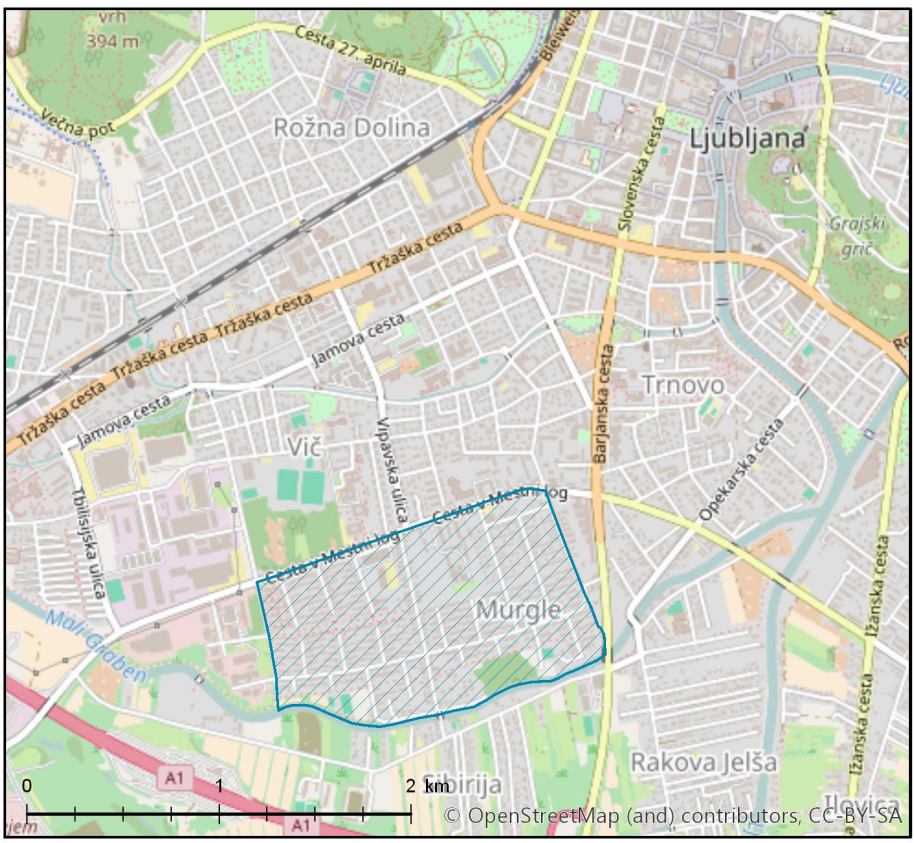
The Murgle neighborhood is an example of low density urban design. Its creator, architect France Ivanšek, was a great advocate of this type of urban layout; he stressed its advantages in his book "Single Family House: from single standing to low density layout" (Ivanšek, 1988). In all surveys about living preferences (Toš, 2014), the vast majority of the Slovene population expressed a preference for living in a single family house with a garden, though practically all public housing construction was in the form of apartments in smaller or larger condominiums. Ivanšek was trying to unify the advantages of both types of housing in a new type of housing development. On the one hand, he was very critical towards the widespread practice in Slovenia of building individual single family houses on large building plots (on average 500 m² to 1000 m²) with the house usually located in the middle of the building plot. Houses were most often also too large for one family. This kind of housing is very demanding of space, energy and maintenance costs, and is therefore not suitable for urban areas. On the other hand, public housing in the form of large high-rise housing estates, whilst much more effective from the standpoint of population density, was not popular among its residents and offered relatively low quality of living environment. He proposed a new type of neighborhood, composed of low row or atrium houses, which in Slovenia were not very common in organized public housing developments. He was convinced that this kind of residential neighborhood would be very suitable for Slovene urban areas. It would

be possible to obtain high enough population densities (up to 200 inhabitants per hectare) and a much better quality of living environment than in high-rise housing estates.

The main characteristics of urban layout and design of Murgle neighborhood are as follow:

- The urban layout is to the greatest extent possible in accordance with the environment of Ljubljansko Barje for example with local streets being located along natural rows of trees, which gave the neighborhood right from its construction the patina of being old. In addition, the streets are named after the variety of trees planted along them, which strengthens even more the atmosphere of a green neighborhood.
- The street system is designed according to Radburn, New Jersey (USA) with *cul-de-sac* streets and groups of around 35 houses lined by two streets and accessible only by pedestrian paths, but never more than 50 meters from the garage. This kind of street layout with separation of houses and garages provides a very calm environment almost free of car traffic. According to many experts and local inhabitants this is at the same time one of the main advantages as well as shortcomings of the urban design of the neighborhood.

Figure 1: Location of the Murgle neighborhood in Ljubljana.
Slika 1: Lokacija soseske Murgle v Ljubljani.



- The whole neighborhood has a uniform urban design with low atrium houses, closed internal gardens (with two meter high fences) and abundant public green spaces. This, on the one hand, enables a very intimate and calm living space including house and internal garden and, on the other hand, a complete fusion of private and public green areas.
- The houses are typified by unified architecture and a very rational internal plan, which is adapted to the needs of a typical four-member family. The interior of the house and the garden are visibly united by large windows. All this contributes to a very high quality living environment with relatively low construction and maintenance costs and efficient use of precious urban land.
- One of the main characteristics of the urban layout is the simplicity and neutrality of the architecture and its subordination to the surrounding environment. Public green spaces are abundant and a very important element of the neighborhood. The whole neighborhood is divided into three elements: the house; the internal atrium garden, which is an extension of the living room and offers complete intimacy; and public spaces with roads, paths and public green areas. The designers had the intention to achieve the complete interconnection of internal and external living space on the one hand, and of public and private living space on the other hand.

Figure 2: View of the Murgle housing estate in the year 1980.
Slika 2: Pogled na sosesko Murgle v letu 1980.

Source/Vir: France in Marta Ivanšek Foundation, 2016.

As mentioned in the introduction, the Murgle housing estate is protected as an example of high-quality urban heritage. All renovations, extensions and other kinds of interventions are regulated by a building plan (Odlok o prostorskih ureditvenih pogojih za območje urejanja Murgle, 1999), in order to preserve the architectural and urban character of the neighborhood. The building plan describes in detail the allowed types and techniques of renovations, materials used, the dimensions of extensions and similar. The main goal of these regulations is protection of the architectural and urbanistic unity and quality of the housing estate as designed by its architects. In this way, the neighborhood can maintain its high-quality architecture and urbanism. In spite of detailed regulations, many illegal and unapproved spatial interventions took place in Murgle over the last decades. There are many examples of unregulated interventions that are diminishing the quality of architecture and urbanism, and at the same time the quality of the living environment in the housing estate. The most frequent types of unregulated interventions are:

- Unapproved extensions of private atrium gardens on private or even public land. In this way green areas outside private atrium gardens are devalued. Especially problematic is the shifting of the fence at the end of the atrium garden towards the pedestrian path.
- Adding an upper floor to a typical Murgle house. For a variety of reasons all houses in Murgle were designed as ground floor buildings.
- Inappropriate renovations that alter and devalue the architectural unity of the neighborhood.

Figure 3: An example of adding an upper floor to a house in Murgle (photo: D. Rebernik, 2016).
Slika 3: Primer dograditve hiše s prvim nadstopjem (foto: D. Rebernik, 2016).

Figure 4: An example of extension of private atrium garden into public green space (photo: D. Rebernik, 2016).
Slika 4: Primer podaljšanja zasebnega atrijskega vrta na javne zelene površine (foto: D. Rebernik, 2016).

Figure 5: An example of moving the fence towards the pedestrian path (photo: D. Rebernik, 2016).
Slika 5: Primer prestavitve ograje tik ob pešpot (foto: D. Rebernik, 2016).

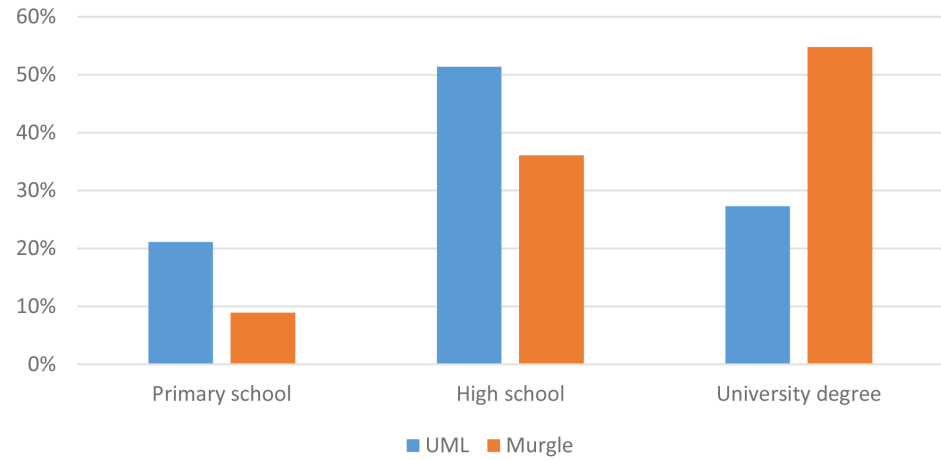
4 SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

At the beginning of construction at the end of the 1960s Murgle was conceived of as a housing estate for public social housing. The first prefabricated houses were deliberately small (around 60 to 80 m² of living space) and the construction very economical. However, very soon, even in the second phase of construction in the beginning of the 1970s, the upper middle class recognized the advantages and attractiveness of this new neighborhood. Murgle thus became the most "elite" residential area in Ljubljana as early as the 1970s and 1980s. Intellectual, political and economic elites chose Murgle as a place of residence. In spite of declared social equality, social segregation occurred in the socialist socio-economic system as well. At the end of the socialist period, socio-economic polarization and distinct socio-economic areas were identifiable in Ljubljana (Rebernik, 1999). Statistical data from the 1991 Population Census thus confirms that out of all residential areas in Ljubljana the then population of the Murgle local community had the highest socio-economic status. At the time the local community of Murgle had the highest percentage of population with high education attainment (university degree), 42% compared to 18% for Ljubljana and 9% for Slovenia. The Population Census also gathered data on professional structure of the active population, revealing that out of all local communities Murgle was home to the second highest percentage of professionals (49% compared to 27% for Ljubljana and 16% for Slovenia). Additionally, the population of Murgle was distinct with the highest income per capita. Income per capita was calculated based on tax base income, which every employed person has to declare and includes all income earned in a single year. Data is also available for 1993 and 1999. In 1993 average income per capita in the local community of Murgle exceeded the average for Ljubljana by 75% and in 1999 by 78% (Rebernik, 1999; Krevs, 2002).

In spite of the emergence of many new high socio-economic areas and changes in the social geography of Ljubljana (Rebernik, 2013), the neighborhood of Murgle has retained the position of the residential area with the highest average socio-economic structure. From the 2011 Population Census it is evident that the local community of Murgle had retained the most favorable educational structure among all residential areas in Ljubljana. The proportion of the population with a university degree was 54.8% compared to the average value for the whole Urban Municipality of Ljubljana (UML) of 27.3% (Figure 6). The data for income per capita was not available. The neighborhood was characterized by a very low unemployment rate as well (Figure 7).

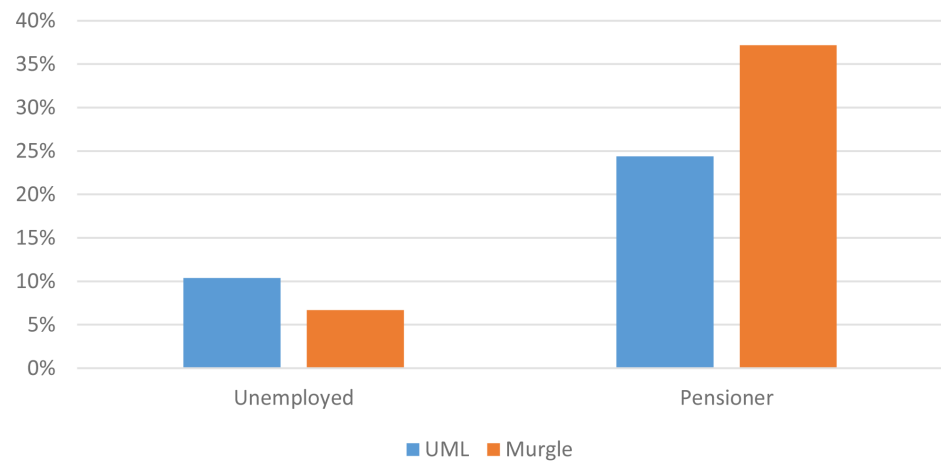
The main characteristic of the demographic structure in Murgle is the ageing of its population. Similar to other residential areas in Ljubljana built in the 1970s and 1980s (Rebernik, 1999) the sharp predominance of older and older middle-aged population is typical. This is a consequence of a relatively homogeneous demographic structure of the population at the time of the construction of the new housing estate with a predominance of young families with small children and low mobility of residents. The process of gradual ageing of the population in a housing estate ensues. Similar processes were identified in other housing estates in Ljubljana (Rebernik, 1999). The proportion of the population aged over 55 years in Murgle is thus 48%, compared to 31% in the UML.

Figure 6: Educational structure of the population in Murgle and the UML in 2011.
Slika 6: Izobrazbena sestava prebivalstva v soseski Murgle in v Mestni občini Ljubljana (UML) v letu 2011.



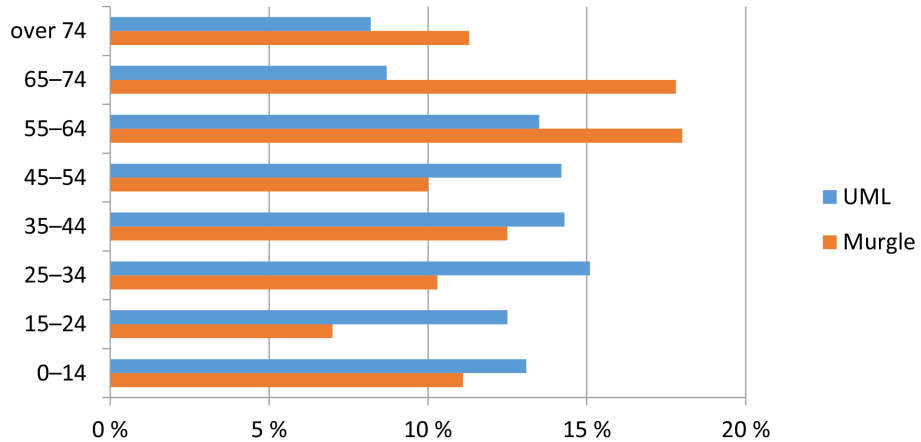
Source/Vir: Population Census, 2011.

Figure 7: Unemployment rate and percentage of pensioners in Murgle and the UML in 2011.
Slika 7: Delež brezposelnih in delež upokojencev v soseski Murgle in v Mestni občini Ljubljana (UML) v letu 2011.



Source/Vir: Population Census, 2011.

Figure 8: Age structure of the population in Murgle and the UML in 2011.
Slika 8: Starostna sestava prebivalstva v soseski Murgle in v Mestni občini Ljubljana (UML) v letu 2011.



Source/Vir: Population Census, 2011.

5 QUALITY OF THE LIVING ENVIRONMENT

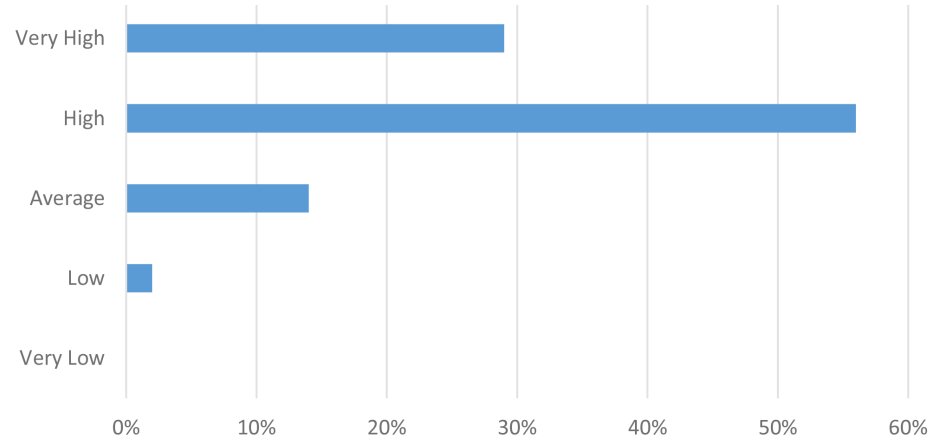
At the time of the construction of the first part of Murgle, namely at the end of the 1960s, the media and public considered the neighborhood a great urbanistic failure. The first rows of small prefabricated houses with little greenery were even compared to the Dachau concentration camp. Gradually, due to improvements in building materials and techniques, but mostly due to its urbanistic concept that provided a green and high-quality living environment close to the city center, public opinion about the neighborhood changed. It soon became one of the most favorable locations to live in Ljubljana. The popularity of Murgle housing estate is to a great extent a reflection of its high-quality urbanism.

The survey conducted among residents of Murgle in January 2016 included 380 or 50% of all households in the neighborhood and is therefore highly representative. Exactly 50% of included households were composed of original residents and 40% of households composed of people who had moved to Murgle after 1990, which indicates relatively high mobility of population in the neighborhood. The main reasons for choosing the neighborhood were, in order of importance: good location close to the city center, single family house with a garden in a central location, good quality of the living environment, the status of an elite neighborhood, and good price.

Only 6% of households expressed an intention to move in the next five years, which is an indicator of a high level of satisfaction with the quality of the living environment in the neighborhood. General satisfaction with the quality of the living environment was evaluated with an average score of 4.1 out of 5 (Figure 9). 85% of respondents evaluated the general quality of the living environment as high or very high. The respondents were also

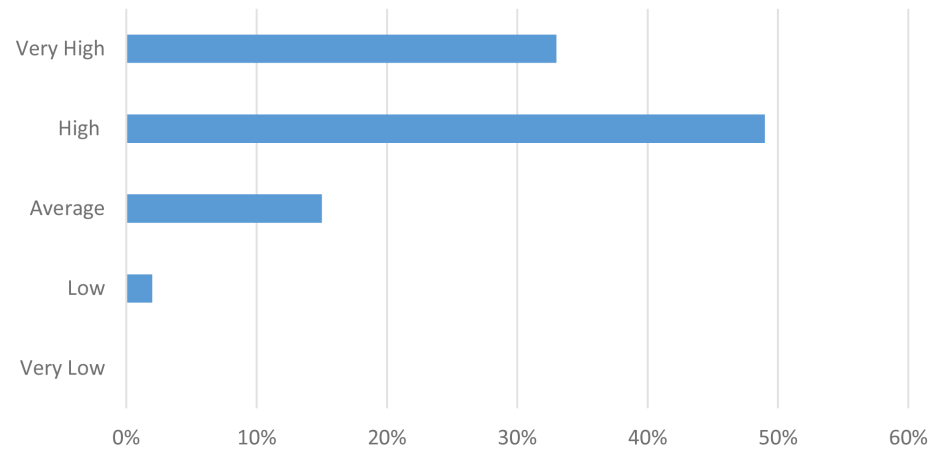
very satisfied with the quality of their house, with the same average score of 4.1 out of 5 (Figure 10). This proves that the neighborhood remains very popular among its residents.

Figure 9: What is your general level of satisfaction with the quality of the living environment?
Slika 9: Kakšno je vaše zadovoljstvo s kakovostjo bivalnega okolja?



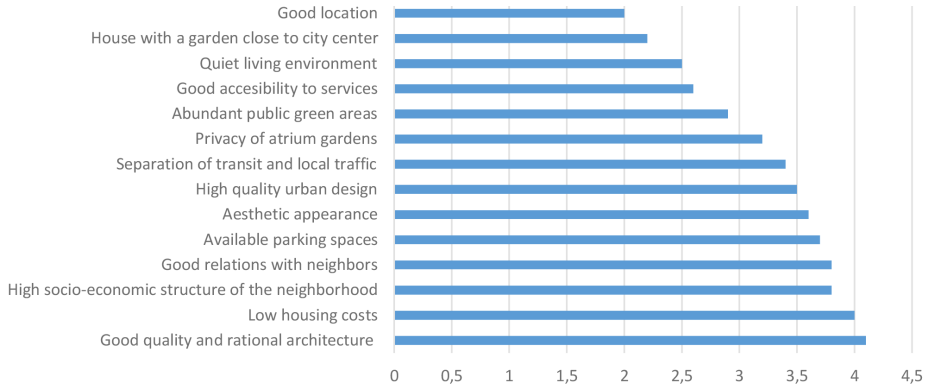
Note/Opomba: 1-very low, 2-low, 3-average, 4-high, 5-very high./1-zelo nizko, 2-nizko, 3-povprečno, 4-visoko, 5-zelo visoko.
Source/Vir: Own survey.

Figure 10: What is your level of satisfaction with the house?
Slika 10: Kakšno je vaše zadovoljstvo s stanovanjsko hišo?



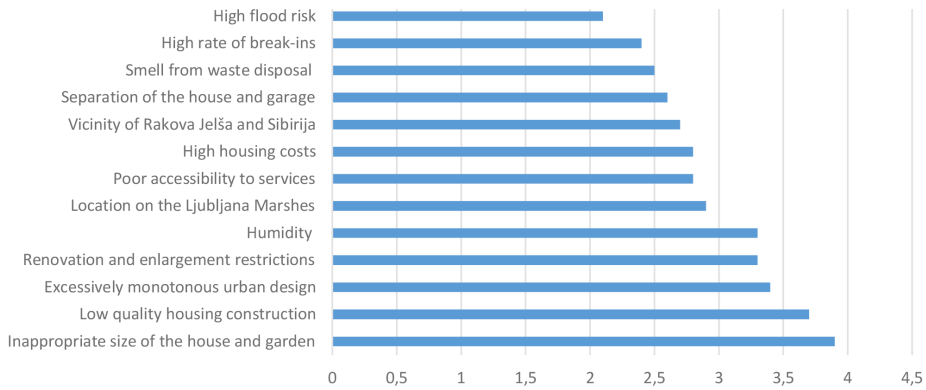
Note/Opomba: 1-very low, 2-low, 3-average, 4-high, 5-very high./1-zelo nizko, 2-nizko, 3-povprečno, 4-visoko, 5-zelo visoko.
Source/Vir: Own survey.

Figure 11: How do you evaluate the importance of the following qualities/advantages of your neighborhood?
Slika 11: Kako ocenjujete pomembnost naslednjih prednosti vaše soseske?



Note/Opomba: 1-very low, 2-low, 3-average, 4-high, 5-very high./1-zelo nizko, 2-nizko, 3-povprečno, 4-visoko, 5-zelo visoko.
Source/Vir: Own survey.

Figure 12: How do you evaluate the importance of the following weaknesses/shortcomings of your neighborhood?
Slika 12: Kako ocenjujete pomembnost naslednjih pomanjkljivosti vaše soseske?



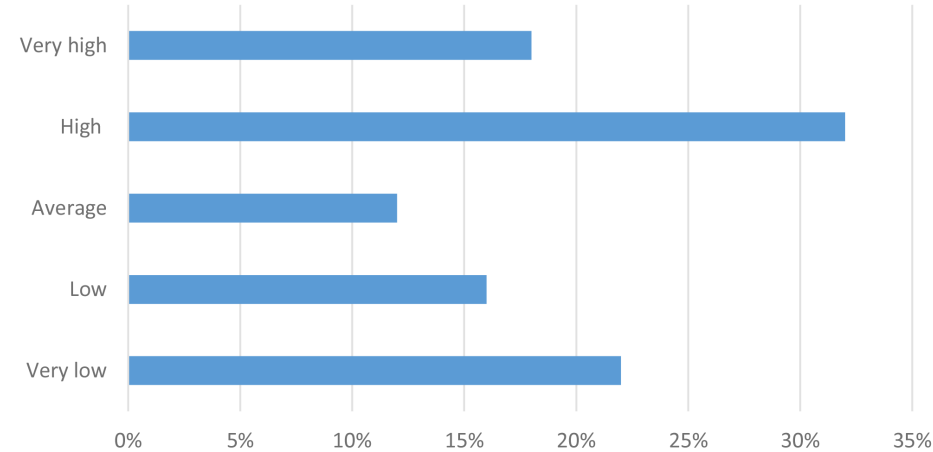
Note/Opomba: 1-very low, 2-low, 3-average, 4-high, 5-very high./1-zelo nizko, 2-nizko, 3-povprečno, 4-visoko, 5-zelo visoko.
Source/Vir: Own survey.

In the next group of questions, the respondents were asked to evaluate the importance of selected qualities/advantages and weaknesses/shortcomings of their neighborhood on a scale from 1 (very low) to 5 (very high). The proposed qualities/advantages and

weaknesses/shortcomings were selected on the basis of the author`s expert evaluation. In the proposed options, we were trying to include the main advantages and shortcomings of the neighborhood. Proposed qualities/advantages and weaknesses/shortcomings were chosen in a way to highlight the specific characteristics of the neighborhood, based on its architectural and urbanistic concept and design, location, social structure and similar. From the results of the survey it is evident that the residents evaluated key urbanistic characteristics as very important qualities of the neighborhood, including: good quality and rational architecture of houses, low housing costs, high quality of the urban design, aesthetic appearance, privacy of atrium gardens, abundant public green areas, low traffic – separation of transit and local traffic, and a quiet living environment. As main weaknesses/shortcomings the respondents highlighted the following characteristics: inappropriate size of the house and garden, low quality housing construction, excessively monotonous urban design, restrictions on renovations and enlargement of houses, separation of the house and garage, humidity, location on the Ljubljana Marshes, vicinity of neighborhoods Rakova Jelša and Sibirija, poor accessibility to services, smell from waste disposal, and a high rate of break-ins. It is evident that some weaknesses/shortcomings are connected with the urbanistic concept of the neighborhood (inappropriate size of the house and garden, low quality housing construction, excessively monotonous urban design, restrictions on renovations and enlargement of houses, and separation of the house and garage, high housing costs) and others to the location of the neighborhood (humidity, location on the Ljubljana Marshes, vicinity of neighborhoods Rakova Jelša and Sibirija, poor accessibility to services, smell from waste disposal). Approximately 50% of respondents were not satisfied with the size of the house. This was most often the case for households with old, single members for whom the house is too big and housing costs too high. Around one third of respondents considered the separation of the house and garage problematic. For some respondents, the unified urban design of the whole neighborhood is a good quality, but others consider it as "excessively monotonous". Opinions on renovations and enlargement of houses and gardens were divided: around one third of respondents oppose the practice of unregulated renovations and enlargements, while around a half do not consider this a problem and are unhappy with restrictions on renovations. Several weaknesses/shortcomings of the neighborhood are on account of its location: close to ethnic and low income neighborhoods of Rakova Jelša and Sibirija (around one third of respondents consider this as "a problem"; Rebernik, 2015); on the humid terrain of the Ljubljana Marshes; and close to the Barje regional waste disposal.

One of the main problems of the neighborhood is safety. The characteristics of the urban design (atrium gardens with high fences, low houses) and its socio-economic structure mean that break-ins occur very frequently. More than a third of respondents stated that their house had been broken into already. Over half of respondents have a security system (alarm, security camera) installed in the house. More than half of respondents also considered that a common security service financed by all residents is necessary. Initiatives to organize this common security system (night security guards etc.) had already been proposed but not yet realized.

Figure 13: How do you evaluate the level of safety in the Murgle housing estate?
Slika 13: Kako ocenjujete stopnjo varnosti v soseski Murgle?



Note/Opomba: 1-very low, 2-low, 3-average, 4-high, 5-very high./1-zelo nizko, 2-nizko, 3-povprečno, 4-visoko, 5-zelo visoko.
Source/Vir: Own survey.

6 CONCLUSION

After a sharp decline in the 1990s, in the new millennium new housing construction increased in Ljubljana and other Slovene urban areas. The majority of new housing in Slovene urban and suburban areas is in the form of planned and organized construction of small housing estates by private investors (Rebernik, 2007). The quality of urbanism and resulting quality of the living environment of those new housing estates are very often low, featuring: too high population densities, limited green space, lack of parking spaces and traffic congestion, lack of privacy, etc. The urbanistic concept of Murgle on the other hand proved to be very successful and the neighborhood maintained a very high quality of living environment. The Murgle housing estate could thus be an example and inspiration for further housing development in Slovene urban and suburban areas.

The Murgle housing estate was developed between the end of the 1960s and the middle of the 1980s, during the most intensive period of housing construction in Ljubljana and Slovenia. The vast majority of public housing construction in that period was in the form of high-rise housing estates. Murgle on the other hand offered an alternative solution in the form of a housing estate with a lower density urban layout inspired by Scandinavian urbanism. Its architects, France and Marta Ivanšek, wanted to create a housing estate of single family houses with a high-quality living environment, maintaining a relatively high population density with low construction costs. At the beginning of the construction, Murgle was envisaged as a housing estate for public social housing, but it soon became a high income residential area.

Our research confirmed that Murgle, 50 years after the beginning of its construction, remains a very popular housing estate with a high quality living environment. From the results of the survey conducted, it is evident that the majority of residents are very satisfied with the quality of the living environment. The main advantages of the Murgle housing estate are: abundance of green areas, a very quiet living environment with separation of traffic and pedestrian areas, low housing costs, rational separation of public and private spaces with a high degree of privacy of houses and gardens, and a unified urban layout and architectural design. All these qualities are achieved whilst maintaining a very rational use of precious urban land: high population density, low construction and housing costs, and high proportion of public and private green areas.

France and Marta Ivanšek designed the Murgle housing estate at the end of the 1960s. The original urbanistic concept was respected throughout its construction. The majority of the neighborhood was completed in the middle of the 1980s; a small part at the southern edge is still not finished. The main aim of the architects was to create a housing estate with a high quality of living environment, whilst maintaining low construction costs and achieving a relatively high population density. The architecture and urbanism of the neighborhood are deliberately simple and rational. The sizes of houses and gardens are relatively small and adapted to the minimal needs of a four-member nuclear family. The architects wanted to offer an alternative to living in apartments in high-rise housing estates while maintaining similar construction costs. 50 years after the beginning of its construction, the standard of housing in Slovenia has improved and the housing market developed dramatically, offering much more varied and high quality housing. Despite the change in conditions and housing expectations, Murgle has maintained a position as one of the most desirable housing estates in Ljubljana, which is an additional proof of its remarkable urbanism.

(*Translated by James Cosier*)

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KAKOVOST BIVALNEGA OKOLJA V SOSESKI MURGLE – SKANDINAVSKI URBANIZEM V LJUBLJANI

Povzetek

Soseska Murgle v Ljubljani je bila zgrajena med koncem šestdesetih in sredino osemdesetih let 20. stoletja in s svojo urbanistično zasnovo z nizko gostoto zazidave prestavlja alternativo prevladujoči stanovanjski gradnji v obliki blokovskih sosesk. Njena avtorja, arhitekta France in Marta Ivanšek, sta želela ustvariti sosesko z zelo kakovostnim bivalnim okoljem, ob tem pa ohraniti relativno visoko gostoto poselitve in racionalno rabo dragocenega mestnega prostora. Zaradi lokacije blizu mestnega središča in na slabo nosilnih barjanskih tleh je bil izbran koncept nizke goste zazidave v obliki pritličnih atrijskih hiš. Zaradi svoje edinstvene urbanistične zasnove je soseska Murgle zavarovana kot primer kakovostne urbanistične kulturne dediščine. Kljub temu pa prihaja do številnih prostorskih posegov, ki niso skladni z določitvami prostorskih ureditvenih pogojev. Na ta način prihaja do razvrednotenja kakovostne urbanistične dediščine. V prispevku želimo ugotoviti, če soseska kljub prostorski preobrazbi ohranja visoko kakovost bivalnega okolja.

Preučevanje kakovosti bivalnega okolja, ki izhaja iz tradicije behaviorizma, je pomembno raziskovalno vprašanje v geografiji ter hkrati element urbanističnega načrtovanja, ki lahko veliko prispeva k bolj učinkovitemu urbanemu načrtovanju in razvoju. Bivalno okolje lahko opredelimo kot »prostor, kjer posameznik zadovoljuje svoje osnovne življenjske potrebe in socialne funkcije«. Običajno ločimo tri prostorske ravni bivalnega okolja: stanovanje, soseska in mesto (Tiran, 2015). V naši raziskavi smo se omejili na preučevanje kakovosti bivalnega okolja na ravni stanovanja in soseske. Poglavitni metodološki pristop, ki smo ga uporabili v raziskavi, je anketiranje lokalnega prebivalstva. Anketa je bila zasnovana z namenom, da odgovori na naše temeljno raziskovalno vprašanje: kako lokalno prebivalstvo vrednoti kakovost bivalnega okolja (in še zlasti značilnosti urbanistične zasnove)? Anketiranje je zajelo 380 oziroma več kot 50 % gospodinjstev v soseski Murgle, izvedeno je bilo v mesecu januarju 2016.

Poglavitne značilnosti oziroma posebnosti urbanistične zasnove soseske Murgle so sledeče:

- urbanistična zasnova se v največji možni meri prilagaja naravnemu okolju Ljubljanskega barja;
- ulični sistem z dosledno ločitvijo tranzitnega in avtomobilskega prometa ter pešpoti zagotavlja zelo mirno bivalno okolje;
- celotna soseska ima enotno urbanistično in arhitekturno zasnovo s pritličnimi atrijskimi hišami in ograjenimi vrtovi, kar zagotavlja visoko stopnjo zasebnosti ter hkrati odlično povezanost zasebnih in javnih zelenih površin;
- arhitekturna zasnova stanovanjskih hiš je namenoma enostavna in racionalna, kar zagotavlja odlično rabo stanovanjskih površin.

V soseski Murgle prihaja do številnih nedovoljenih posegov, ki predstavljajo razvrednotenje kakovostne urbanistične zasnove. Najpogostejši primeri so neprimerna obnova stanovanjskih hiš, podaljševanje ograjenih atrijskih vrtov na javne zelene površine in dodajanje prvega nadstropja pritličnim stanovanjskim hišam.

Ob začetku izgradnje je bila soseska Murgle zasnovana kot soseska javnih socialnih stanovanj za ljudi z nižjimi dohodki. Že kmalu pa je zaradi bolj kakovostne gradnje, predvsem pa zaradi kakovostnega bivalnega okolja v bližini središča Ljubljane, soseska postala socialno območje višjega sloja in najbolj »elitno« stanovanjsko območje v Ljubljani. Analiza statističnih podatkov je pokazala, da je soseska tudi v sedanjosti obdržala položaj območja s visokim socio-ekonomskim položajem prebivalstva in prevlado starejših gospodinjstev.

Anketiranje lokalnega prebivalstva je pokazalo, da je velika večina stanovalcev zadovoljna s kakovostjo bivalnega okolja v soseski in stanovanju. Kot najpomembnejše prednosti soseske so anketiranci izpostavili: kakovostno in racionalno arhitekturno zasnovo stanovanjskih hiš, nizke stanovanjske stroške, kakovostno urbanistično zasnovo, visoko estetsko vrednost, visoko stopnjo zasebnosti, obilje zelenih površin ter ločenost avtomobilskega prometa in pešpoti. Kot poglavitne pomanjkljivosti so anketiranci navedli: neprimerno velikost stanovanjske hiše, omejitve pri prenovi, ločitev hiše in garaže, vlažnost bivalnih prostorov in smrad z odlagališča odpadkov (Zbirni center Barje).

Eden poglavitnih problemom v soseski je tudi pomanjkanje varnosti, saj je bilo že vlomljeno kar v tretjino hiš (lastno anketiranje, 2016). Na osnovi rezultatov anketiranja lahko zaključimo, da stanovalci vrednotijo kakovost bivalnega okolja kot zelo dobro (lastno anketiranje, 2016).

Soseska Murgle je torej 50 let po začetku izgradnje ohranila visoko kakovostno bivalno okolje in predstavlja enega najbolj kakovostnih stanovanjskih območij v slovenskih mestih. Urbanistična zasnova soseske bi lahko postala zgled pri nadaljnji stanovanjski gradnji v slovenskih mestih in obmestjih.

SPATIAL PLANNING AND TRANSFORMATIONS IN THE SPATIAL STRUCTURE OF ZAGREB

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Abstract
Paper discusses the characteristics of the urban development of the City Zagreb by analysing the development of spatial planning and the changed power relations. During the last 20 years, the transformations have been mainly negative and have had important impact on changing the structure of residential, commercial and business zones, and on conversion of the industrial and military areas.

Key words: Zagreb, spatial planning, urban transformations, economic transition, urban spatial structure

PROSTORSKO NAČRTOVANJE IN PREOBRAZBE PROSTORSKE STRUKTURE ZAGREBA

Izvleček
Prispevek naslavlja značilnosti urbanega razvoja Zagreba z analizo razvoja prostorskega načrtovanja in spremenjenih odnosov moči. V zadnjih dvajsetih letih so bile preobrazbe večinoma negativne in vplivajo na spreminjanje strukture stanovanjskih, trgovskih in poslovnih con, pa tudi na preureditev industrijskih in vojaških območij.

Ključne besede: Zagreb, prostorsko načrtovanje, urbane preobrazbe, gospodarski prehod, urbana prostorska struktura

1 INTRODUCTION

Post-socialist cities in Europe have been largely transformed during the last 20-30 years. The new economic, political and institutional framework had multiple effects on the development and management of cities. This is particularly evident in redefining the activities

of spatial planning (Dimitrovska Andrews, 2005), which directs the development of the city and its parts in accordance with the new power relationships, and this directly affects the changes in the spatial structure of the city (physiognomic and morphological, functional and social components; Kostinskiy, 2001; Sýkora, 1994, 1999). Furthermore, the transformations are reflected in housing construction, the increased tertiarisation, neglect of industrial and military complexes, etc. Kovács (1999) speaks of a new urban order and transition cities are marked by significantly different characteristics from those from the socialist period.

Accordingly, the new socio-economic and institutional context encouraged considerable urban transformations in the spatial structure of Zagreb. Under the influence of transitional changes, new or modified existing spatial patterns have appeared in Zagreb. They are similar to those in other post-socialist cities, and increasingly take on the characteristics of the cities in the developed countries of Western and Central Europe, and in some respects even of Anglo-American cities (e.g. in the construction of business centres; Zlatar, 2013).

Due to the strengthening of private property, the real estate market and increasing liberal activities of foreign and domestic investors, the neoliberal framework of development significantly influenced the changes in the spatial structure of Zagreb. New power relationships are primarily evident in the strengthening of economic actors, constructing mostly negative impact on that activity, and consequently on the development of the city in the transition period. In the newer period, the legal framework and the resulting planning documents defining and directing the development of the city have undergone frequent changes.

Paper analyses the transitional characteristics of the development of Zagreb by analysing the development of spatial planning and the changed power relations. Furthermore, it will present key urban transformations that have occurred over the last 20 years. More specifically, in the context of strategic thinking and public interest, in the transitional period the Zagreb area was threatened more than ever, mainly by negative interventions in housing construction, commercial and business zones, and the conversion of industrial and military areas. The objective is to detect changes in the spatial structure of Zagreb that have occurred under the influence of the transition processes. We argue that the frequent changes within the legislative and spatial planning framework and the economic transition are key factors that have contributed to urban transformations. The spatial framework of the research is the City of Zagreb, which is a territorial and administrative unit with the status of local and regional government. The City of Zagreb includes 70 statistical settlements (including the two urban settlements of Zagreb and Sesvete, which are completely fused in terms of morphology and physiognomy) within 17 city districts on a surface of 641 square kilometres.

2 METHODS

The methodology in this paper includes an analysis of the legal framework of spatial planning in Croatia and Zagreb during the transition period. The acts (Act on Spatial Planning, Act on Spatial Planning and Construction) that were passed in 1990s and

2000s, with several amendments, significantly changed the way of creating and implementing decisions. In this context, particular emphasis is given on the impact that acts had on the creation of spatial plans. Furthermore, at the City level the role of strategic and implementation plans is analyzed, with emphasis on significance of certain spatial planning documents. Therefore, the focus is put on the implementing documents (urban plans) that directly affect the changes in the spatial structure of the city, which is evident in residential construction, especially on the city edge. The special attention is payed to the emergence of new actors and changed power relations in spatial planning, which consequently, affects the planning process that is driven primarily by locational requirements and profits. Areas that were transformed during the last 20-25 years (residential, commercial, business and industrial/military) were analyzed using the data from official statistical sources of the City and field research conducted during the summer and fall of 2016. The field research was a ground for functional zoning of the city. Four areas were identified in which the visible changes occurred during the transition period, and often at odds with the official documents.

3 LEGISLATIVE AND SPATIAL PLANNING FRAMEWORK

Zagreb has a long tradition of spatial planning which has been affected by different socio-economic and political conditions in which the city has developed. Since the mid-19th Century, when the first spatial plans were developed, a number of plans have been adopted to direct and follow the development of the city.

The second half of the 20th Century was especially important period of affirmation of the spatial planning practice, which coincided with intense and dynamic spatial expansion, demographic and economic growth, when Zagreb surpassed the local dimension and became a city of broader regional and national importance. Thus, during the socialist period, the development of planning documents for the city and some of its parts had a clearly defined hierarchical organisation. The practice was very intense when, in accordance with the ideology of self-managing socialism as a combination of planning, market and self-management, a specific relationship to space was defined. In accordance with the legal and institutional development, which was based on community planning, spatial planning institutes were developing various regional, general, master and detailed plans (Crljenko, 2012). During certain periods, the preparation of detailed planning documentation was completely ignored, whilst today it is the most important instrument for the development of the city. Its implementation was usually based on strict zoning of area purposes and rational settings which were difficult to achieve in practice. The role of individual groups in the planning process, such as citizens, public institutions, municipalities and investors, was determined by law, but in practice they did not have a big role because the main role was played by leading politicians and planning experts who monitored the technical aspects and implemented their ideas. At the beginning of 1990s, the relations between planners and other stakeholders concerned by the issues of local development management, such as the public, city government and economic actors, were replaced by a more flexible approach to space (Cavrić, Nedović-Budić, 2007).

Croatian independence was followed by political and institutional changes that greatly affected spatial planning in the new socio-economic, i.e. transitional context (Mrak-Taritaš, 2008). A prerequisite to establishing new laws and regulation of relations between actors in the spatial planning was the new territorial organisation adopted in 1992 through the Act on Counties, Cities and Municipalities [*Zakon o područjima županija, gradova i općina*] (1992), which divided the Croatian territory into 21 counties including the City of Zagreb. The new legislative framework in the field of planning started in 1994 by passing the Act on Spatial Planning [*Zakon o prostornom uređenju*] (1994) with a number of amendments (Act on Spatial Planning, 1994; 1998; 2000; 2002; 2004). It defined the structure and hierarchy of spatial planning documents and a system of spatial planning for the entire Croatian territory, with a commitment to harmonise the spatial planning documents of lower territorial units with spatial planning documents of higher territorial units.

However, the legislation of the 1990s and early 2000s has shown some weaknesses as it prescribed the development of a large number of spatial plans requiring a long period of preparation, low potential for public participation in its development, and weak monitoring of plan implementation. Furthermore, due to lack of time, sub-legal acts were passed quickly, unprepared and unconnected. Given the visible consequences in space, it can be said that spatial planning has failed to adapt to new social and economic circumstances, which opened the way to a liberal and more flexible development of space, in some places with chaotic and irreversible consequences. This reduced the importance of the spatial planning profession, thus enabling a large number of interventions, which are often difficult to control. The competence for the preparation of spatial planning documents in this strict system of spatial plan development was assigned to numerous public and private companies, resulting in a large number of conflicting plans based on unrealisable goals, which is evident in today's planning practice.

In 2007 the new Act on Spatial Planning and Construction [*Zakon o prostornom uređenju i gradnji*] (2007) was adopted. This act began the adaptation of legislation to European practices of planning; it established the system of planning and construction, the competence of government bodies and bodies of local and regional governments and the division of the planning documents on strategic and implementation.

Apart from the legislative framework, the documents important for the development of Zagreb, are spatial planning documents used since the 1990s, which are defined by these laws. Strategic plans are the following: Spatial Plan of the City of Zagreb and Master Plan of Zagreb and Sesvete, while the implementation plans are: Urban Plan, Detailed Plan (which was later abolished) and Urban project.

The Spatial Plan of the City of Zagreb defined conditions for the development of the City, which determines the purposeful use, purpose, design, renovation and repair of the construction and other land, protection of the environment and cultural monuments and valuable parts of nature (Mrak-Taritaš, 2008). The area for which the above conditions apply covers an area of 641 square kilometres with 70 settlements, and 17 city districts in which the objectives of regulation are achieved.

The Master Plan of Zagreb and Master Plan of Sesvete have a dual role as they are both the strategic and implementation documents determining the future shape of the

city through regulations, the requirements of building and defining urban rules for certain parts of the city. They define the use and purpose of areas, a network of economic and social activities, transport and utility infrastructure and conditions for the use, development and protection of the area (urban policies, procedures for urban spatial planning, protected natural areas and immovable cultural property; Master Plan, 2015). Master plans prescribe the use and purpose of areas, which is a very important item for the drafting of implementing documents of lower levels that determine the spatial development of settlements or parts of settlements. The proper zoning of certain purposes in the urban area achieves basic spatial and functional solutions and creates conditions for the planning of certain parts of the city.

Urban Plan in the City of Zagreb serves as the implementing document. It is usually adopted for parts where there is new spatial regulation and construction. It can be conversion of land (former industrial plants or former military barracks) and completion of areas for residential and mixed use. In terms of urban transformations, master plans are the most visible and the most common form of transformation of the spatial structure of the city, and are reflected in the demolition, new construction and revitalisation.

Urban projects represent an important implementation document. The practice of urban projects in European cities is based on different concepts of defining the urban project, but what they have in common is the existence of their long-term, well planned, and controlled implementation. This is usually accomplished through stages from 20 to 30 years. In Croatia, this is not the case due to inadequate political support, funding sources and non-defined relationships of public-private partnership. Compared with other Croatian and European cities, Zagreb has vague criteria for defining urban projects, leading to confusion in the way of their announcement and a number of other problems (Jukić, 2012). Most cities use projects to perform urban renewal, urban reconstruction and revitalisation of abandoned areas, to improve the quality of housing through the new construction of residential areas in the abandoned brownfield or greenfield sites, while in Zagreb, it is mostly a way to circumvent the drafting of implementing documents and interpolating content to specific locations. Urban projects in Zagreb include all buildings with more than nine floors and areas of more than 1 hectare that are owned by the city, state, or companies and public institutions owned by the City. According to this decision, all surfaces larger than 1 hectare and owned by the city are exempt from existing rules of the Master Plan and maximum building coverage can be allowed there regardless of the area's actual purpose.

From 1998 to 2013, there were 229 implementing documents in the City of Zagreb of which 87 were adopted, and the remaining 142 were required to be drafted. The majority of 87 adopted plans relates to the edges of the city, mainly focused in the residential new construction, which is associated with larger building surfaces.

From the foregoing, it is clear that the legal framework and spatial planning documents play a very important role in the transformation of transitional Zagreb. *Ad hoc* legislation adoption, frequent discrepancies between acts and spatial planning documents have contributed to the image of the spatial structure of Zagreb nowadays.

4 TRANSITIONAL PROCESSES IN ZAGREB

Undoubtedly, the changed and the emerging legal framework with spatial planning documents have triggered changes in the spatial structure of the city. Transition planning, therefore, borders two social and economic systems. Socialist planning forms have been replaced by a rather centralised city government, and the planning process is being developed within the framework of neoliberal strategies, in which the private, and the associated privatisation, is gaining importance. The transition from one to another system crash means the collision of the public, i.e. social interest with private interests at the expense of the planning practice. City planning becomes more flexible, the city is no longer planned as a whole, but as an object, and the management was replaced by urban entrepreneurship (Gulin-Zrnić, 2013).

During the transition, the market becomes a major regulatory mechanism in the development planning of a city. In the context of the weakening of the planning system, there is a growing trend of private investment in the land, and their value is becoming the main resource of the development policy. Placing the emphasis on site investment leads to the absence of developmental impact, while the participation of relevant stakeholders takes second place. Therefore, the critics of transition in Zagreb list the dangers and threats to spatial planning and its sustainability (Svirčić Gotovac, 2012; Pegan, 2012; Zlatar, 2013).

Čaldarović (2012) explains that transition is characterised by the disruption of planning an integrated city; instead, there is construction of individual units scattered within the city. A transition city thus becomes an arena where planning "happens" based on individual projects. The modern "rampant capitalism" determined by the transitional character of "incompleteness" causes various forms of "manoeuvring" and the result is a specific "project", "spot" or "object" planning driven primarily by site requirements. Unlike the key role played by the state in the field of spatial planning in the previous system, the revised relations of stakeholders in the modern city have reduced its impact and introduced the private sector into the system. The participation of the public in this relationship is often symbolic (Čaldarović, 2012). Seferagić (2007) calls into question the very existence of urban planning based on disadvantaged relations of urban planners and their role in protecting the public interest in the neoliberal stage of planning considerations.

In the 1990s, the development of Zagreb and other post-socialist cities faced a change in power relations between stakeholders who have an impact on spatial changes. In his 11 theses, Bassand (2001) explains the complex, conflicting urban reality composed of a system of stakeholders within which a certain group of actors manages, while other groups oppose. He associates the stakeholders with a certain position in society, resulting in interests, relations with other actors, identities and unequal access to resources within society, which then create a hierarchy of power. Stakeholders may be divided into:

- political stakeholders: political parties and political leaders, stakeholders from strong companies with political influence;
- economic actors: entrepreneurs, both foreign and domestic companies, banks and developers;
- professional actors: architects, planners, surveyors, geographers, ethnologists, sociologists, ecologists and all the other spatial experts;

- civil actors: civil organisations and citizens identified according to social position, age, education, etc. (Bassand, 2001; Seferagić, 2007; Svirčić Gotovac, Zlatar, 2015).

The new system of stakeholders in the transition conditions leads the processes of transformation of urban structures that now make up the contemporary reality of post-socialist cities. In Zagreb, a number of examples of urban change is considered as a result of altered power relations among stakeholders, which led to a new, post-socialist stage of urban development.

Slavuj, Cvitanović and Prelogović (2009) in their research of the spatial structure of Zagreb, listed four types of problem areas, taking into account the characteristics and changes in functional and morphological components:

- converted: parts of the city transformed into commercial, residential and private areas during the 1990s and 2000s;
- new built: mainly residential and commercial construction on the peripheral areas of the city triggered by suburbanisation, tertiarisation and market opening;
- densely built: unplanned residential areas within existing settlements of Zagreb, without adequate infrastructure or compliance with existing morphological characteristics, and as a result of poor or even a lack of spatial planning and law enforcement;
- neglected: mostly non-validated industrial sites, areas along the rail road and old factories in suitable locations in the wider city centre.

The above problem areas reflect the transformations of post-socialist Zagreb with often chaotic forms of spatial development as a result of a decreasing importance of spatial planning and the marginalisation of some stakeholders such as citizens and professionals.

During the transition, substantial transformation has occurred on the real estate market, which has experienced tremendous growth. Consequently, it has affected the price increases, causing a boom in housing construction and the construction of business premises at some stages of development. Furthermore, the development of the real estate market has led to a differentiation of urban space. The value of real estate and land in the central parts of the city grows, which attracts different investors in commercial facilities such as retail stores, restaurants and banks. There is a change of the social component of the city's spatial structure, and also a socio-spatial polarisation (Prelogović, 2004; 2009). For example, in the central city districts Donji grad and Gornji grad-Medveščak, total population was reduced to just over 30,000 in the period from 1991 to 2011. At the same time, the suburbanisation process intensified, especially in the marginal urban areas of eastern, south eastern and southern periphery.

Residential suburbanisation was followed by the decentralisation of various commercial functions, business areas, and industries on the edges of the city and along the main roads of favourable transportation position, while in the broader city centre, less specialised shops, crafts and workshops are closed due to overwhelming competition (Jakovčić, 2006; Seferagić, 2007; Sić, 2007).

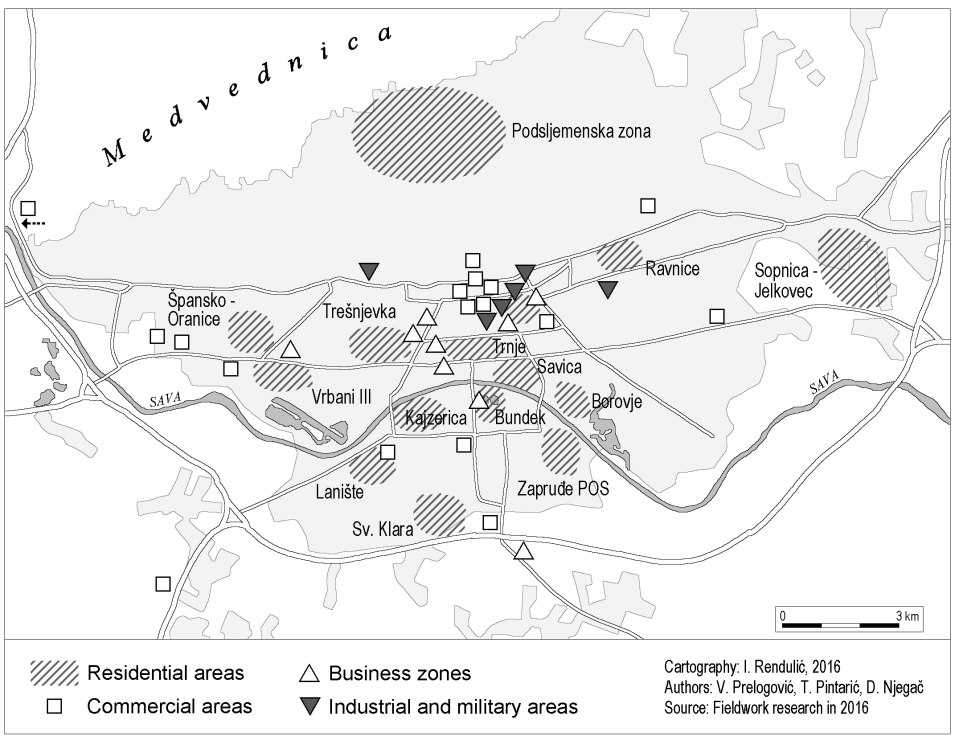
In the central parts of city, there are deserted areas remaining behind some industrial sites, the legacy of the former socialist industry. Due to unresolved property relations, weak profitability and high costs required for their rehabilitation, brownfields are kept within the city. The investment cycle is initiated by the construction of shopping centres,

new housing and commercial complexes at the expense of existing land and their (degrading) infrastructure and public spaces. Land becomes an extremely valuable resource in the transitional urban development.

5 URBAN TRANSFORMATIONS IN ZAGREB

In the transition period, especially after the 2000s, there were major changes in the spatial structure of Zagreb. Centuries-long development of the city adapts to the neoliberal context leading to changes in all spheres of life, which encourages a dynamic and turbulent development. Changes in land use associated with the strengthening of private initiatives have created new elements in the spatial structure of the city, especially in the functional and morphological component. The city changed significantly through the construction and the introduction of new elements, the conversion of the old and the completion of certain parts of the urban fabric through reconstruction and revitalisation. Urban transformation in Zagreb will be explained in a more detailed analysis of residential, commercial, business and industrial-military areas (Figure 1).

Figure 1: Transformed residential, commercial, business and industrial-military areas in the City of Zagreb.
Slika 1: Preobrazba stanovanjskih, trgovskih, poslovnih in indusrijsko-vojaških območij v Zagrebu.



5.1 Residential areas

Transitional changes significantly affected the residential function in Zagreb. As has been repeatedly pointed out, privatisation was a key process allowing the change of ownership relations in the management of real estate and land (Mlinar, 2009). The pre-transition chronic lack of housing was additionally aggravated by the arrival of people from war zones and migrations within the city. In particular, this relates to the events during the war that had a negative impact on investment in residential construction during the 1990s. During the transition, the dynamics of the construction of residential buildings was in line with economic trends which started to improve in the late 1990s as a result of the increase in demand and purchasing power.

Although in the inter-census period (2001-2011) Zagreb had an increase in population of several thousand, this did not play key role in the growth of the housing market, but in a reduction in average household size. This means that intensive housing construction decreased the quantitative statistical housing shortage, i.e. the negative difference between households and flats, while in qualitative terms that number was much higher, because a larger number of flats are located in buildings of lower quality. Thus, increased demand is a result of the need to improve the quality of housing (Bašić, 2005).

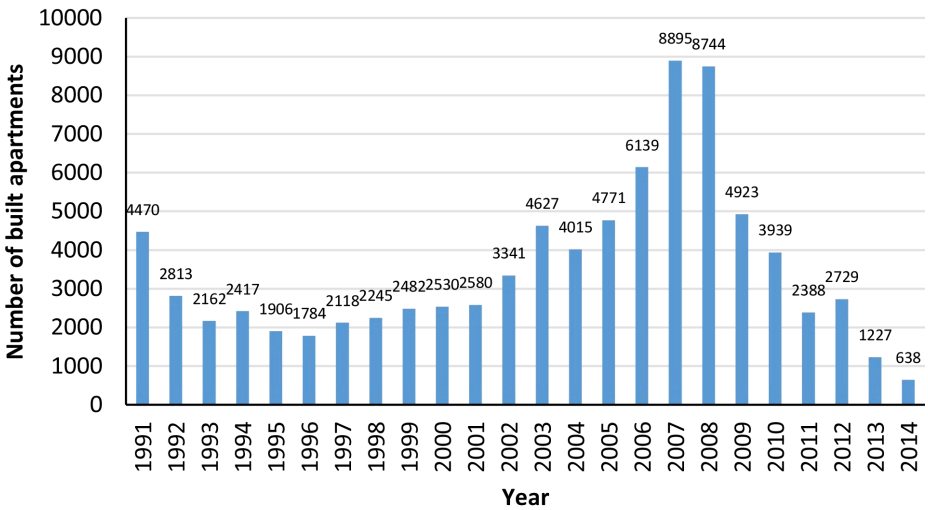
The quantitative indicator clearly reflecting the dynamics and changes in housing is the number of apartments built. In the period from 1991 to 2014, 83,883 new apartments were built in Zagreb. During the first ten years of transition, 24,927 or 29.7% of the apartments were built. This was a stage of transition marked by war and post-war events and weaker economic opportunities, so the level of housing construction was quantitatively lower. The real boom in housing construction and major changes in the real estate market began in the early 2000s, leaving an indelible mark in the function and morphology of the city.

The key stage of housing construction occurred in the period between 2001 and 2010, during which increase was recorded year by year. The peak was reached in 2006, 2007, and 2008, when more than 6,000 apartments were built at an annual level (8,895 apartments in 2007 and 8,744 in 2008). 57.3 % of all apartments in the transition period were built during this construction boom. A large disturbance in the construction sector came in 2010 when an abrupt decrease in new buildings occurred as a result of the economic crisis; for example, only 638 apartments were built in 2014, which is 14 times less than in the record year of 2007 (Figure 2).

During the transition, construction activities occurred in almost all parts of Zagreb. The new planned housing developments were built on the free undeveloped or converted land (former industrial sites and military barracks) mainly in the outskirts of the city (Borovje, Lanište, Sopnica-Jelkovec, Špansko, Vrbani III, etc.). Sopnica-Jelkovec is the best-known example of a new residential area on the outskirts of the city, located on the site of a former pig farm in Sesvete. The construction was financially supported by the so-called Zagreb model of housing construction, which sought to provide apartments for low-income families. Accordingly, a large residential area was built, with around 2,700 apartments which were exposed to a series of criticisms by residents and

experts following the opening. Criticisms were directed at the poor planning of the settlement and construction: too dense buildings, lack of green areas, parking lots and other services.

Figure 2: Number of built apartments in the City of Zagreb between 1991 and 2014.
Slika 2: Število izgrajenih stanovanj v Zagrebu v obdobju 1991–2014.



Source/Vir: Statistical Yearbook of the City of Zagreb (Statistički ljetopis Grada Zagreba), 1999; 2015.

In other parts of the city, there were also numerous interventions by various individual users (residents), investors, builders and developers who often fail to comply with the regulations or to interpolate objects, which do not fit into the urban landscape visually and morphologically. Those solutions are often partial as a result of poor control, failing to contribute to quality design, but suggest an inappropriate approach to urban development. Since the goal is to create the largest possible profit, oversized buildings are constructed and there is a significant increase in building density. Examples of such construction are observed throughout the city, especially in Trešnjevka, Trnje, Dubrava, Kajzerica, Pešćenica-Žitnjak and in the Podsljeme zone (*Podsljemenska zona*; Figure 3). The central parts of the city that are also the most expensive and offer the highest quality of housing, are dominated by the old housing stock and the most valuable land, faced the influx of various private investors aiming to create the greatest possible profits. Some authors point out that this is a first sign of gentrification, which is not a widespread phenomenon in Zagreb, unlike in many post-socialist cities (Čaldarović, Šarinić, 2008; Svirčić Gotovac, 2010).

Figure 3: Examples of residential zones in the City of Zagreb: Sopnica-Jelkovec in Sesvete (A), Španski-Oranice (B), Kajzerica (C), and (D) Urban villas in Podsljeme zone (Podsljemenska zona; photo: V. Prelogović, 2016).
Slika 3: Primeri stanovanjskih območij v Zagrebu: Sopnica-Jelkovec v Sesvetah (A), Španski-Oranice (B), Kajzerica (C), Urbane vile v Podsljemenski coni (D) (foto: V. Prelogović, 2016).

A typical example of inadequate housing, the construction of the so-called "urban villas", was recorded in the late 1990s in the hills of Medvednica, a traditionally elite residential area. These new housing areas reflect the typical transition processes resulting from the lack of spatial planning regulation. The main characteristics of this zone are over-construction, lack of green spaces, and poor availability of basic central functions such as stores.

Three types of housing may be identified in the post-socialist Zagreb, present more or less in all parts of the city, and sometimes a dominant morphological and physiognomic element of the spatial structure. They are the following:

- planned housing developments built with an incentive from the City or the State;
- planned residential areas built by private capital, the so-called commercial construction;
- residential areas including individual and small apartment buildings were built without a clear vision, often outside of the legislative and spatial planning framework.

5.2 Commercial areas

Significant changes affected tertiary activities, too, especially retail. The changes are reflected in the location and the organisation with the emergence of new forms of retail trade, i.e. shopping malls. Trade is affected by privatisation, there are new trading companies of local owners and international retail chains are opened. Both processes were present in Croatia during the 1990s, with the arrival of foreign chains

starting a bit later as a result of the unstable business conditions due to the low purchasing power of citizens, undeveloped real estate market and unsettled ownership relations (Lukić, 2002).

The development of trade became more pronounced since the late 1990s when there was an increase in the purchasing power of the population and changes in consumer habits, or a rise in real estate prices and rents in certain locations within the city. In other words, Zagreb became attractive to foreign investors, which entailed the arrival of foreign retail chains.

Changes in trade began in the central parts of the city, or in the traditional CBD, encompassing the immediate city centre with the central square (Ban Josip Jelačić Square), Zagreb's main shopping street (Ilica), and parts of Frankopanska, Jurišićeva, Vlaška, Masarykova, Teslina, and Petar Preradović Square (Flower Square). It is a prestigious and transport accessible part of the city with valuable historical and cultural buildings, the area with the highest average prices of rent or business premises purchase. Accordingly, in the early 1990s, various shops and supporting commercial facilities (cafés, restaurants, banks, travel agencies, office spaces, etc.) were opened. The concentration of business activities through citification had a negative impact on the lives of the local population and public spaces so there was a decline in housing functions and population.

Shopping malls (shopping centres) certainly represent the biggest innovation in trade. The emergence of shopping centres in Zagreb is related to the increasing importance of tertiary activities, and to the increase in the purchasing power of the population who aims to follow the trend of modern consumer society due to the strengthening of overproduction and consumerism, i.e. the mass consumption of goods and services. In general, there are three types of shopping mall locations in Zagreb: in the city centre, near the major city roads (Zagrebačka avenija, Slavonska avenija, etc.) and near traffic junctions on the outskirts of the city. Considering the functions, the shopping malls of Zagreb may be divided into those in the city centre which, aside from the commercial ones, offer residential, business and social functions, and those in peripheral areas with a predominantly commercial function (Jakovčić, Spevec, 2004).

The first shopping centres in Zagreb were built in the central part of the city during the mid-1990s. The first shopping centre (Importanne centre) was built in 1994 in the area of the Main Railway Station. This was followed by the opening of several shopping centres in the broad city centre, some being located on former industrial land (e.g. Kaptol Centre). After the 2000s, Zagreb witnessed a strong decentralisation of trade and the construction of shopping centres on the outskirts of the city. The first shopping centre on the edge of the city was King Cross, which was built in 2002 near the Jankomir junction, i.e. the Zagreb ring road at the western entrance to the city.

Table 1: Characteristics of shopping centers in City of Zagreb.
Preglednica 1: Značilnosti nakupovalnih središč v Zagrebu.

Shopping centre	Year of construction	Typology by functions	Gross surface (in 000 m^2)
Importanne centar	1994	shopping mall	12
Importanne galleria	1999	mixed functions (retail-housing-business)	15
Mercatone	2000	shopping mall	24
Centar Kaptol	2000	mixed functions (retail-housing-business)	15
King Cross	2002	shopping mall	17
Branimir centar	2003	mixed functions (retail-business)	10
City Centar One West	2006	shopping mall	50
Avenue Mall	2007	mixed functions (retail-business)	26
Garden Mall	2009	shopping mall	26
West Gate	2009	shopping mall	80
Arena Centar	2010	shopping mall	59
Centar Cvjetni	2011	mixed functions (retail-housnig)	8
Green Gold Centar	2011	shopping mall	15
City Centar One East	2012	shopping mall	50
Point Shopping Centar	2013	shopping mall	13
Ban centar	2013	mixed functions (retail-housnig)	3
Shopping centar Supernova	2014	shopping mall	30
TOTAL			**453**

Source/Vir: Jakovčić, Spevec, 2004; Zane nekretnine, 2016.

The rapid development of shopping centres has occurred after 2006. Most shopping centres of a newer generation have an average size of over 20,000 m^2, including catering functions aside from the commercial ones.

Apart from shopping sites, shopping centres became the premises for the realisation of social and cultural functions, and some of them have even become a kind of tourist attractions. Thus they increasingly started to change the traditional public space and become a metaphor for the semi-public space with the main purpose of consumption, but also offering the possibility of spending free time and socialising (Lukić, 2002; Zlatar, 2013). This trend has been observed in almost all shopping centres, which means that the development of the city in the last 20 years has focused on the consumer economy, which has led to uniformity and loss of identity of the city.

5.3 Business zones

One of the main features of the functional and morphological changes in the post-socialist Zagreb is the increase in office premises and the formation of a new CBD (Sić, 2007). The dynamic development of business activities was accompanied by the

construction of office buildings in the eastern part of Trnje, specifically in the area between the streets of Vukovarska, Heinzelova, Zavrtnica and Radnička cesta (Figure 4). The new CBD has grown at the site of the former industrial complex. Today skyscrapers and large commercial buildings, with branch offices of local and foreign companies, dominate the aforementioned space.

Figure 4: New CBD with business buildings in Radnička street (photo: V. Prelogović, 2016).
Slika 4: Novi CBD s poslovnimi stavbami na Radnički ulici (foto: V. Prelogović, 2016).

Conversion of land and construction of office buildings point to growing internationalisation or contribute to painting an imitation of Western cities through the construction of large office buildings and skyscrapers that act as symbols of financial and economic elites (Zlatar, 2013). It should be noted that the construction started following the changes to the Master Plan, allowing the construction of commercial and residential skyscrapers higher than nine floors after more than 20 years. In this sense, the sites where there was free land or land suitable for conversion were mostly used.

The construction of office buildings was also present in other parts of the city, and the prominent examples are Savska cesta, Ulica grada Vukovara, Zagrebačka avenija and Buzin Trade Zone on the southern outskirts of Zagreb, by the road to the airport.

Zlatar (2013) points out that this situation in which the towers are scattered throughout the city reflects the impossibility of urban planners and other experts in place to

determine whether there will be a formation business clusters of skyscrapers such as those in the Anglo-American cities or the construction of high-rise skyscrapers in the area of low family houses will continue. In most cases, the new buildings were not built in accordance with existing regulations and spatial planning documents. This means that the public interest was compromised by the joint activities of political and economic stakeholders. On this basis, business buildings are being inserted in the already built zones which creates huge problems because most of space located near them does not have the infrastructure to withstand new skyscrapers. This results in the reduction of public space, over-construction and a lack of utilities and transport infrastructure, especially parking. However, there are positive arguments for the construction of this type of office buildings, because they enable the implementation of modern architecture, have tourism potential, and adapt to the standards of green building.

5.4 Industrial and military areas

In the today's area of Zagreb, there are a number of locations that make up neglected and unused areas from the pre-socialist and socialist period. Land plots of old industrial and military complexes are a great resource for future development, and especially those located near the city centre.

Today many of them decay, regardless of their historical, cultural and architectural value. They are located in almost all parts of the city, the following ones being especially prominent: cement factory "Sloboda" in Podsused, knitwear factory "Nada Dimic", oil factory "Zvijezda", factory of railway vehicles "Gredelj", cookware factory "Gorica", factory of alcoholic beverages "Badel", and the barracks in Borongaj and Črnomerec.

The knitwear factory "Nada Dimić", parts of which were destroyed by fire during the preparation for the construction of new residential and commercial complex, can serve as an example of an abandoned industrial space. Although it is protected as a cultural monument at a valuable location near the Main Station, it is still waiting for its redevelopment. Another example of the city authorities' neglect of the protection and development of the industrial heritage is the demolition of the industrial complex Paromlin which is also the most important protected cultural monument of Zagreb industrial heritage. Parts of the plant burned in a fire in the late 1980s and its future use has not been resolved to date.

This and many other examples point to a series of non-compliances with the regulation, which actually undermines the public interest. Conservation and renovation of buildings are often not performed because such interventions are more expensive for investors, and since most of those sites are owned by the city, which bought them, they are now perishing due to the lack of clear vision of the future use and financial resources. If a new public content is not built on these sites, they will become an object of interest for the entrepreneurs, which will result in the construction of new residential and commercial complexes. Such interventions are supported by existing legislation, which allows bypassing the creation of detailed spatial plan, i.e. implementing parts of the Master Plan.

Some factories have been converted into business premises, such as the former tobacco factory in Klaićeva Street (building "Adris") or the company "Gorica" which hosts

catering objects. On the periphery, slightly larger land is converted to residential areas, the most prominent being the already mentioned housing estate Sopnica-Jelkovec on the site of the former pig farm "Sljeme" in Sesvete.

The former military land has undergone a somewhat better fate. Under the subsidised housing policy, the large housing estate Španska-Oranice was built at the site of the Španska military barracks. The barracks in Borongaj converted into a University campus in the east, while a part of the barracks in Črnomerec was ceded to the Croatian Catholic University.

6 CONCLUSION

The transitional period has left an indelible mark in the spatial structure of Zagreb over the last 20 years. Understanding the development of post-socialist Zagreb is very complex, since there was a change in the political, economic, social and cultural spheres in a very short period. The complexity of the transition period is evident in the actions of the interior (national, regional, local) and external (global) processes that are reflected in the specific transformation processes in the spatial structure of the city, expressed mainly in residential, commercial and business functions and the conversion of industrial-military land.

The reflection of transitional changes which altered the power relations in the space affected the "on the fly" adoption of frequently unrelated laws and spatial planning documents, thus failing to prevent negative patterns of development, but creating new ones. It is increasingly difficult to respond to the needs of economic development by means of spatial planning and adopted documents. A number of private initiatives and free decision-making led to inadequate infrastructure and architectural solutions throughout the urban area, which fail to contribute to the urban renewal of the city and long-term needs of the population. As in many post-socialist cities, the ideas defined in local (general) master plans are generally not implemented. This was influenced by the very fast restructuring of the legislative and institutional framework of planning. Furthermore, the development and strengthening of the market and spatial planning were influenced by the neo-liberal doctrine, to which a range of private initiatives and a number of actors had to be adapted in the new conditions. Economic stakeholders act in favour of their own interests, which often comes into conflict with civil stakeholders. Legal acts managing urban processes are frequently amended and adapted to the current situation in which individual citizens, investors, developers, private contractors and construction companies enter inadequate spatial patterns. The spatial structure of Zagreb was changed in the transition period as a reflection of the complex relationship between economy, politics and the activities of spatial planning.

We are able to confirm that the development of Zagreb in the transitional conditions was defined by the emergence of new urban structures in the city. The privatisation and introduction of the private sector in spatial planning significantly guided the development of the city. The new legislative framework established by the disintegration of socialism reduced the influence of political actors in spatial planning and insufficiently trained the

local community to act, while the modified power relations have not been affirmed as leading holders of spatial planning in the new socio-economic context. The criticism of the academic community, the citizens of Zagreb and the growingly important NGO sector highlights the lack of coordination between the stakeholders and the dominance of individual stakeholders, particularly the economic ones. The above shows the necessity of redefinition of their influence and spatial planning activities.

(Translated by Jasenka Kuček)

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PROSTORSKO NAČRTOVANJE IN PREOBRAZBE PROSTORSKE STRUKTURE ZAGREBA

Povzetek

Prispevek predstavlja značilnosti razvoja Zagreba v obdobju tranzicije, ki ga obravnava z analizo razvoja prostorskega načrtovanja in spremenjenih odnosov moči. Predstavlja glavne urbane preobrazbe, značilne za zadnjih dvajset let. Z vidika strateškega razmišljanja in javnega interesa je bil Zagreb v tranzicijskem obdobju izjemno ogrožen zaradi negativnih posegov v stanovanjsko gradnjo, trgovske in poslovne cone ter preobrazbe industrijskih in vojaških območij. Raziskava je osredotočena na mesto Zagreb, prostorsko in administrativno enoto, ki znotraj 17 mestnih okrožij na površini 641 km^2 vključuje 70 naselij, med drugim dve mestni naselji (Zagreb in Sesvete, ki sta popolnoma zliti z vidika morfologije in fiziognomije).

Zagreb ima dolgo tradicijo prostorskega načrtovanja, na katero so vplivali raznovrstni družbenogospodarski in politični pogoji, v katerih se je mesto razvijalo. Od sredine 19. stoletja, ko so bili pripravljeni prvi prostorski načrti, so sprejeli številne načrte za usmerjanje razvoja mesta. Druga polovica 20. stoletja je bila zelo pomembno obdobje uveljavitve prostorskega načrtovanja v praksi, kar je sovpadlo z intenzivno in dinamično prostorsko širitvijo, prebivalstveno in gospodarsko rastjo. V začetku 90-ih let 20. stoletja so se spremenili odnosi med načrtovalci in drugimi deležniki lokalnega razvoja (npr. javnost, mestna vlada in gospodarski akterji); njihove odnose je vse bolj zaznamoval bolj fleksibilen pristop do prostora (Cavrić, Nedović-Budić, 2007). Neodvisnosti Hrvaške so sledile politične in institucionalne spremembe, ki so močno vplivale na prostorsko načrtovanje v novih družbenogospodarskih, tj. tranzicijskih okoliščinah (Mrak-Taritaš, 2008). V obdobju tranzicije je trg postal glavni regulacijski mehanizem pri načrtovanju razvoja mesta. V kontekstu slabitve načrtovalskega sistema je vedno večji pomen pridobivalo zasebno vlaganje v zemljišča, ki so postala glavni vir razvojne politike. Poudarek je bil predvsem na posameznih investicijah, kar vodi k odsotnosti širših razvojnih vidikov, obenem pa tudi izključevanju relevantnih deležnikov.

Urbana preobrazba Zagreba je v prispevku pojasnjena s podrobno analizo stanovanjskih, trgovskih, poslovnih in industrijsko-vojaških območij. Tranzicijske spremembe so pomembno vplivale na bivalno funkcijo Zagreba. V obdobju od 1991 do 2014 je bilo v

Zagrebu zgrajenih 83.883 stanovanj. V prvih 15 letih tranzicije je bilo zgrajenih 29,7 % stanovanj (24.927). To fazo tranzicije so zaznamovali: vojna in povojni dogodki ter skromnejše gospodarske priložnosti. Pravi razrast v gradnji stanovanj in glavne spremembe na trgu nepremičnin so se pričele v prvih letih 21. stoletja, kar je pustilo neizbrisen pečat v funkciji in morfologiji mesta. Ključna faza v stanovanjski gradnji se je pojavila v obdobju 2001–2010, ko je bil zabeležen vsakoletni porast. Vrh je bil dosežen v letih 2006, 2007 in 2008, ko je bilo zgrajenih več kot 6000 stanovanj v enem letu (8895 stanovanj v letu 2007 in 8744 v letu 2008). 57,3 % vseh stanovanj, zgrajenih v tranzicijskem obdobju, je bilo zgrajenih med tem graditeljskim valom. Večja motnja v gradbeništvu je prišla leta 2010, ko se je nepričakovano pojavil upad pri novogradnjah kot posledica ekonomske krize: leta 2014 je bilo zgrajenih le 638 stanovanj, kar je 14-krat manj kot v rekordnem letu 2007. V postsocialističnem Zagrebu je mogoče prepoznati tri tipe stanovanjske gradnje: načrtovana stanovanjska gradnja na pobudo mesta ali države; načrtovana stanovanjska gradnja, ki jo je investiral zasebni kapital; t. i. »komercialna gradnja«, pri kateri gre za stanovanjsko gradnjo, ki vključuje individualno gradnjo in gradnjo manjših stanovanjskih enot brez jasne vizije, pogosto izven pravnega in prostorsko načrtovalskega okvirja.

Ena glavnih značilnosti funkcionalnih in morfoloških sprememb v postsocialističnem Zagrebu je dinamičen razvoj pisarniških prostorov in oblikovanje novega CBD-ja (Sić, 2007). Dinamičen razvoj poslovnih dejavnosti je spremljala izgradnja poslovnih prostorov v vzhodnem delu Trnja, zlasti med Vukovarsko, Heinzelovo, Zavrtniško in Radničko ulico. Novi CBD raste na območju nekdanjega industrijskega kompleksa, kjer danes dominirajo nebotičniki in velike trgovske stavbe s podružničnimi pisarnami domačih in tujih podjetij.

Na preučevanem območju Zagreba so številne lokacije, ki so neurejene in neuporabljene še iz časa pred- in socialističnega obdobja. Zemljiške parcele (zlasti tiste, ki so blizu mestnega središča) starih industrijskih in vojaških kompleksov so pomemben prostorski potencial za prihodnji razvoj. Številna tovrstna zemljišča in stavbe propadajo ne glede na njihovo zgodovinsko, kulturno in arhitekturno vrednost.

V tranzicijskih pogojih je bil razvoj Zagreba definiran s pojavom novih urbanih struktur v mestu. Privatizacija in vključevanje zasebnega sektorja v prostorsko načrtovanje je pomembno usmerjalo razvoj mesta. Novi pravni okvir, ki je bil osnovan z razpadom socializma, je zmanjšal vpliv političnih akterjev v prostorskem načrtovanju in je nezadostno usposobil lokalno skupnost za delovanje, medtem ko se spremenjeni odnosi moči niso izkazali kot uspešni pri prostorskem načrtovanju v novem družbenogospodarskem kontekstu. Kritičnost akademske skupnosti, prebivalcev Zagreba in rastoča pomembnost nevladnega sektorja kažejo na pomanjkanje usklajenosti med deležniki in prevlado posameznih deležnikov, zlasti gospodarskih. Zapisano nakazuje potrebo po ponovni opredelitvi tako njihovega vpliva kot tudi aktivnosti prostorskega načrtovanja.

(V slovenski jezik prevedla Irma Potočnik Slavič)

HEAT STRESS IN THE URBAN AND SUBURBAN LANDSCAPE AND ITS SPATIAL DIFFERENTIATION THROUGH THE EXAMPLE OF A MEDIUM-SIZED CITY

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Abstract
The spatial distribution of heat stress in a Central European city and its surroundings was examined. We evaluated the length of time for which the threshold values of Humidex and air temperatures were exceeded at individual stations. The longest interval of temperature discomfort was detected at the border of open mid-rise development and open spaces. The shortest intervals were found in compact mid-rise development and near a forest. There are spatial differences between locations with long periods of high temperatures and locations with long intervals of high Humidex values. However, when the heat stress is being assessed in relation to the mortality rate, Humidex does not show better results than the air temperature.

Key words: air temperature, heat stress, heat wave, Humidex, humidity, mortality, urban climate

TOPLOTNI STRES V URBANEM IN SUBURBANEM OKOLJU TER NJEGOVA PROSTORSKA SPREMENLJIVOST NA PRIMERU SREDNJE VELIKEGA MESTA

Izvleček
Članek obravnava prostorsko razporeditev toplotnega stresa v srednjeevropskem mestu in njegovi okolici. Preučevali smo čas, ko so bile na merskih postajah presežene mejne vrednosti indeksa Humidex in zračnih temperatur. Najdaljše obdobje neugodnih temperatur je bilo na stiku med srednje visokimi zgradbami in odprtim prostorom, najkrajše v sklenjeno pozidanih delih in blizu gozda. Ugotovili smo razlike v razporeditvi postaj z dolgimi obdobji visokih temperatur in postaj z dolgimi intervali visokih vrednosti indeksa

Humidex. Pri vrednotenju toplotnega stresa z vidika mortalitete pa Humidex ni dal boljših rezultatov kot podatki o temperaturah zraka.

Ključne besede: temperatura zraka, toplotni stres, vročinski val, Humidex, humidnost, mortaliteta, mestna klima

1 INTRODUCTION

The World Meteorological Organization (WMO) and the Intergovernmental Panel on Climate Change (IPCC) have repeatedly warned of the serious impact of climate change on human health (recently IPPC, 2014a). Patz et al. (2005) marked the temperate latitudes for areas with the assumption of high excess mortality resulting from thermal stress. Studies on the effects of extremely hot weather and the mitigation of its impact on human health in these areas therefore rightfully belong to the very topical and frequent research subjects.

Over the last decade dozens of papers were published which deal with heat stress. Gradually, a paradigm has come into existence in which the main environmental factors causing heat stress, besides the dry bulb temperature, also include the wet bulb temperature, radiant temperature, air humidity, and air movement (Epstein, Moran, 2006). Apart from the individual parameters of each person (e. g. clothes, age, gender or health condition), it appears that the impact of extremely hot weather on human health also depends on the amplitude of the temperature, the time of the occurrence of a heatwave within the climate season, the overall state of public health, and the age structure and experience of the population with heatwaves (Curriero et al., 2002; Kovats, Hajat, 2008).

Disproportionately less attention is paid to the study of the environment in which the individual happens to be at the time of the event. Clarke (1972), Tan et al. (2010) and some others describe the relationship between the urban heat island and mortality in extremely hot weather; however, the new findings about the urban climate suggest that the differentiation of the temperature field of the city is higher than previously assumed (Houet, Pigeon, 2011; Bokwa, 2011; Stewart, Oke, Krayenhoff, 2014; Lelovics et al., 2014; Bokwa et al., 2015; Lehnert et al., 2015; Středová, Středa, Litschmann, 2015). These new findings call for more detailed studies of the spatial differentiation of the heat stress in cities and their surroundings.

The primary objective of the study is to evaluate the spatial variability of heat stress in the medium-sized city through the example of Olomouc and its surroundings (Czech Republic). Following this evaluation, we will compare the explanatory power of the heat stress values provided by standard temperature characteristics and by Humidex as one of the direct bioclimatic indices that is frequently applied in moderate climate in Europe (Lavalle et al., 2006; Dankers, Hiederer, 2008; Litschmann, Rožnovský, 2009; Tomáš, 2012; Błażejczyk, Twardosz, 2010; Bokwa, Limanówka, 2014).

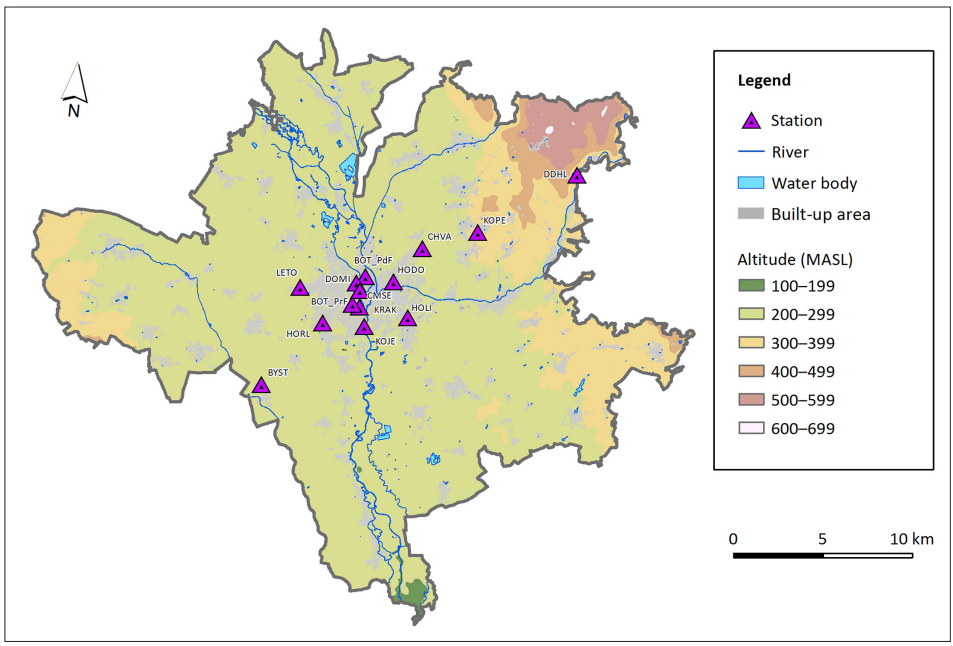
2 METHODS

2.1 Station network

From administrative point of view, the area of interest corresponds with Olomouc administrative districts of municipality with extended powers excluding Libavá military area. The height range of the area is between 200 and 600 meters above sea level. More than 90% of the total of 162,000 inhabitants live at an altitude of 300 meters above sea level. About 60% of the population live in the largest city Olomouc. The city of Olomouc has passed through several substantial stages of development. Consequently, there are historic buildings in the city center, parks, brownfields, housing estates, residential areas, industrial parks, shopping centers, and satellite settlements. The landscape around the towns has a mainly agricultural character. The climate in Olomouc has a typical Central European character (for more details see Vysoudil et al., 2012).

The Metropolitan Station System Olomouc was established in 2009 to study the specific needs of the urban and local climate. In 2011, it had 24 stations, its maximum number, and, therefore, this year was selected for a detailed spatial analysis of temperature and humidity characteristics. The network design is approximately radial. Of the total number of 24 stations, 14 stations of two different types recorded simultaneously the air

Figure 1: Olomouc and surroundings and selected stations of the Metropolitan Station System of Olomouc.
Slika 1: Razporeditev izbranih merskih postaj metropolitanskega omrežja postaj v Olomoucu in okolici.



temperature and relative humidity at a height of 1.5 m and therefore were suitable for this particular study. The stations BOT_PdF, BYST, DOMI, HOLI, LETO, and KOPE were fully automated (Figure 2a). The reading interval at these stations was 10 minutes. On the other hand, the stations BOT_PrF, CMSE, HODO, HOLI, CHVA, and KOJE measured only the temperature and humidity (Figure 2b). The data were recorded in the internal memory sensor at 30-minute intervals. The temperature and humidity sensors of all the stations were located in the radiation shield and were not actively ventilated. Detailed information on the individual stations is provided in Table 1. The surrounding of stations was described using the local climate zones (Lehnert et al., 2015); see Table 2.

Figure 2: Examples of the stations of Metropolitan Station System Olomouc: a) DOMI; b) CHVA.
Slika 2: Primera merskih postaj iz metropolitanskega omrežja postaj Olomouc: a) DOMI; b) CHVA.

Table 1: Metadata of selected stations of the Metropolitan Station System of Olomouc.
Preglednica 1: Metapodatki za izbrane merske postaje metropolitanskega sistema postaj Olomouc.

Station	Start-up date	Status	Sensor type	Sensor accuracy	Altitude (above see level)	Latitude	Longitude
BOT_PdF	8.4.2010	working	SHT75K (Sensirion)	±0.3°C	211 m	49° 36.016′ N	17° 15.457′ E
BOT_PrF	1.4.2008	stopped (1/1/2012)	MicroLog EC750 (Fourier)	±0.2°C	213 m	49° 35.155′ N	17° 15.849′ E
BYST	23.10.2009	working	SHT75K (Sensirion)	±0.3°C	218 m	49° 35.557′ N	17° 11.261′ E
CHVA	24.3.2009	working	MicroLog EC750 (Fourier)	±0.2°C	216 m	49° 37.010′ N	17° 17.882′ E
CMSE	27.4.2007	stopped (1/1/2012)	MicroLog EC750 (Fourier)	±0.2°C	237 m	49° 35.591′ N	17° 15.243′ E
DDHL	4.4.2007	working	SHT75K (Sensirion)	±0.3°C	307 m	49° 39.597′ N	17° 24.555′ E
DOMI	8.4.2010	working	SHT75K (Sensirion)	±0.3°C	220 m	49° 35.810′ N	17° 15.044′ E

Station	Start-up date	Status	Sensor type	Sensor accuracy	Altitude (above see level)	Latitude	Longitude
HODO	1.1.2009	stopped (1/1/2012)	MicroLog EC750 (Fourier)	±0.2°C	214 m	49° 35.994′ N	17° 16.738′ E
HOLI	8.5.2009	working	SHT75K (Sensirion)	±0.3°C	217 m	49° 34.664′ N	17° 17.578′ E
HORL	1.2.2010	stopped (1/1/2012)	MicroLog EC750 (Fourier)	±0.2°C	233 m	49° 34.606′ N	17° 13.949′ E
KOJE	30.5.2007	working	MicroLog EC750 (Fourier)	±0.2°C	210 m	49° 34.545′ N	17° 15.625′ E
KOPE	8.4.2010	working	SHT75K (Sensirion)	±0.3°C	362 m	49° 37.646′ N	17° 20.330′ E
KRAK	1.4.2009	stopped (1/1/2012)	MicroLog EC750 (Fourier)	±0.2°C	211 m	49° 35.109′ N	17° 15.317′ E
LETO	27.3.2007	working	SHT75K (Sensirion)	±0.3°C	257 m	49° 35.482′ N	17° 12.582′ E

Table 2: Characteristics of the stations' surroundings.
Preglednica 2: Značilnosti bližnje okolice merskih postaj.

Station	Local climate zone	Representativeness for local climate	Significant microclimate effect	Sky view factor (%)	Active surface in microscale radius (20 m)
BOT_PdF	9_5	high	no	84	grass, buildings, trees
BOT_PrF	9_5	limited	no	72	grass, trees, pavement
BYST	9	high	no	81	grass, trees
CHVA	B_{Dw}	high	no	78	grass, trees, buildings
CMSE	2_{cc}	limited	yes	25	grass, pavement, buildings, bush
DDHL	A_B	limited	no	73	grass, trees, pavement, buildings
DOMI	2_{Boc}	limited	yes	70	grass, trees, pavement, buildings
HODO	5	limited	yes	48	grass, asphalt, buildings
HOLI	5_6	high	no	84	grass, asphalt, buildings
HORL	4	high	no	49	grass, trees, gravel, asphalt, buildings
KOJE	9_5	limited	yes	70	grass, trees, asphalt, buildings, pavement
KOPE	9_5	limited	no	74	grass, trees, gravel
KRAK	5	limited	yes	67	grass, buildings, pavement, trees
LETO	9_5	high	no	100	grass, asphalt, buildings

2.2 Data processing

Considering the heat stress characteristics presented, we worked with the data for the summer half-year. The data series used underwent basic quality control and incorrect or missing data were corrected and/or calculated using standard methods in accordance with WMO (2008). The averages were calculated as the arithmetical average of all the measurements at 30-minute intervals. The total number of hours during which the threshold values of 25.0°C, 30.0°C, and 35.0°C were exceeded was determined from the measurements at 30-minute intervals. If the temperature exceeded the given threshold temperature in a certain time period, the whole half-hour was counted (i.e., we assumed that a given limit was or was not exceeded during the entire interval of 15 minutes before and after the measurement).

Humidex was calculated according to a standard formula [1] as presented in the original paper by Masterton and Richardson (1979):

$$HD = t_a + \frac{5}{9} \cdot (p_{as} - 10) \qquad [1]$$

$$p_{as} = 6{,}112 \cdot \left(10^{\frac{7{,}5 \cdot t_a}{237{,}7 + t_a}}\right) \cdot \frac{RH}{100} \qquad [2]$$

where t_a is (ambient) temperature (°C) and RH relative humidity (%).

Using data series of temperature and humidity measured at 30-minute intervals, Humidex data series was established for the same intervals at the same time resolution. The cumulative time values exceeding certain Humidex values were then calculated analogously as in the case of the temperatures. The threshold Humidex values of 30 (some discomfort), 40 (great discomfort), and 46 (dangerous) were chosen as standardly used. To obtain detailed results, in some of our calculations we also used the less frequently used level of 35 (evident discomfort). Besides Humidex, we also separately presented water vapor pressure according to formula [2] for a detailed spatial analysis of the causes of the spatial variability of heat stress.

We selected a station that on average best represents the selected area to determine representative Humidex temperature characteristics and values on regional level. The selection of such a representative station for Olomouc and its surroundings was performed by calculating the daily temperature differences at the individual stations from the average of all measurements throughout the summer half-year at 30-minute intervals, as well as for the days on which the Humidex value reached 30 (to exclude any distortion caused by a state that corresponded to lower temperatures or Humidex values).

The mortality data for the Olomouc and surroundings for individual days were provided by the Czech Statistical Office in Olomouc. These are the official statistics compiled on the basis of individual record sheets up to the level of municipalities. We always included all the dead people domiciled in the area of interest. The boundary

of temperature intervals, or Humidex values, which were then compared with mortality, were established in order to reflect the selected threshold values of the maximum temperatures and Humidex values. The second criterion was adherence to the absolute frequency of intervals with a value of at least 10. No values below 10.0°C or Humidex values under 10 (H10) were included because of the nature of the Humidex equation and the objectives of the study.

3 RESULTS

3.1 Detailed spatial distribution of heat stress in 2011

Primarily, we focused on the description of the extent to which the threshold air temperature values at individual stations were exceeded. In 2011, as well as in all the other years in the reference period 2010–2014, the occurrence of daily maximum temperatures above 35.0°C was not very frequent. According to the detailed analysis of 2011, the air temperature value only exceeded 35.0°C at seven of the fourteen stations monitored (Table 3). Therefore, any meaningful information is provided mainly by the data on the length of the time interval of temperatures above 30.0°C. In this case, the longest intervals were found at the stations KOJE, BOT_PrF, BOT_PdF, DOMI, and KRAK. Their common denominator is their location at the boundary of a medium, but not quite compact urban development (open mid-rise) and in relatively open and well sunlit surfaces with low vegetation, scattered trees and communication networks.

The ratio of the length of time intervals at the individual stations does not change much even when the length of the interval of temperatures above 25.0°C is analyzed. The exceptions are the KOJE and CHVA stations, which belonged among those stations with the highest values with regard to the periods exceeding temperatures above 35.0°C or 30.0°C, while for the total time in which the temperature exceeded 25.0°C it belonged among the rather average stations (Table 3). Such behavior has its cause in the shape of the curve of the daily temperature at the onset of the daily maxima which, like the subsequent decline, is steep because of the high level of insolation near the stations and generally below-average mean temperatures of these stations.

The stations with the lowest total of intervals with temperatures exceeding 30.0°C and 25.0°C include HODO and – by a huge margin – DDHL and CMSE. All these stations were located in shady environments. In the case of CMSE and HODO, the shady environment is created by buildings. CMSE is located in an enclosed courtyard in the historic downtown area and HODO in older development consisting of multi-storey houses and former workshops. DDHL is located in an enclosed valley extending in a north-south direction with wooded slopes and minimal development (see Table 2).

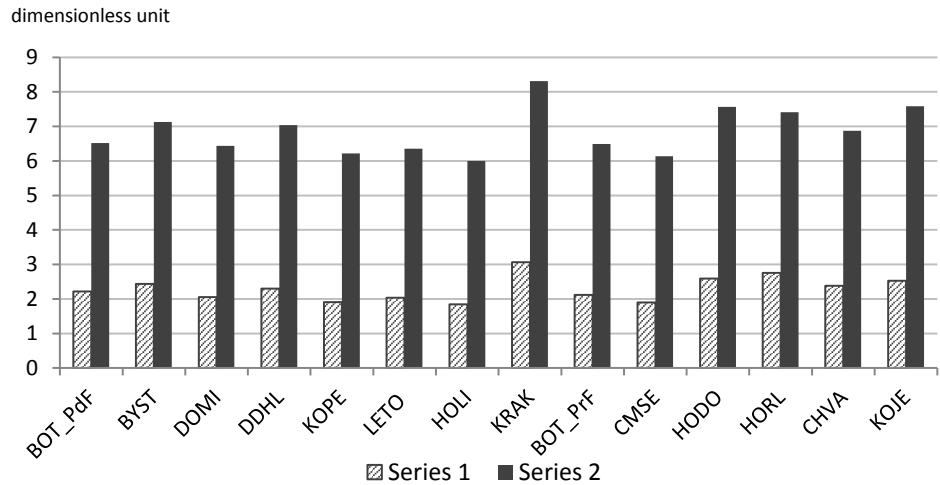
Table 3: The number of hours in which the given threshold temperatures and Humidex values at Metropolitan Station System Olomouc stations were exceeded in 2011.
Preglednica 3: Število ur, ko so bile presežene mejne temperature in vrednosti indeksa Humidex na merskih postajah metropolitanskega sistema postaj Olomouc.

Ranking	Station	Humidex H40	Station	Humidex H35	Station	Humidex H30	Station	Temperature 35°C	Station	Temperature 30°C	Station	Temperature 25°C
1.	KRAK	32.0	KRAK	130.5	KRAK	539.0	BOT_PrF	5.0	KOJE	96.5	BOT_PrF	573.0
2.	BYST	30.0	KOJE	122.0	BOT_PrF	423.0	KRAK	4.5	BOT_PrF	92.5	BOT_PdF	556.0
3.	KOJE	25.5	BOT_PrF	112.0	HORL	413.0	CHVA	4.0	BOT_PdF	88.4	KRAK	541.5
4.	HORL	24.5	HORL	111.5	CHVA	411.5	KOJE	2.0	DOMI	84.5	HOLI	503.0
5.	BOT_PdF	23.0	BOT_PdF	110.0	BOT_PdF	402.0	DOMI	1.5	KRAK	84.5	DOMI	498.0
6.	CHVA	21.5	CHVA	108.0	KOJE	400.0	BOT_PdF	1.0	CHVA	76.0	CHVA	493.0
7.	DOMI	20.0	BYST	100.5	DOMI	382.5	HOLI	0.5	HOLI	75.5	KOJE	445.0
8.	BOT_PrF	16.5	DOMI	98.0	BYST	382.0	BYST	0.0	KOPE	61.0	BYST	422.0
9.	KOPE	16.0	HODO	91.0	HODO	362.5	DDHL	0.0	BYST	55.5	HORL	414.0
10.	HODO	15.5	KOPE	87.5	HOLI	359.0	KOPE	0.0	HORL	51.0	KOPE	395.0
11.	LETO	13.5	DDHL	75.5	KOPE	327.0	LETO	0.0	LETO	41.0	LETO	393.0
12.	HOLI	11.0	HOLI	75.5	LETO	322.0	CMSE	0.0	HODO	29.5	HODO	371.0
13.	DDHL	8.5	LETO	68.5	DDHL	293.0	HODO	0.0	DDHL	27.5	CMSE	316.5
14.	CMSE	0.0	CMSE	31.0	CMSE	231.0	HORL	0.0	CMSE	19.0	DDHL	280.0

From Table 3 it is obvious that the spatial distribution of the length of the intervals during which the selected Humidex values were exceeded does not completely correspond to the distribution of the length of the intervals during which the selected temperatures were exceeded. These differences are caused by the spatial-temporal variability of water vapor pressure. The impact of the water vapor pressure and its spatial variability on the formation of heat stress is obvious from Figure 3, where the differences between the average temperature and Humidex at individual stations are shown. As indicated in Figure 3, the greatest impact of water vapor pressure on the formation of heat stress can be expected especially at the KRAK station and also at the stations KOJE, HODO, HORL, and BYS, while, on the contrary, the smallest impact is at the stations CMSE, HOLI, and KOPE.

It was found that in the case of intervals that exceed the Humidex threshold values the most affected station is KRAK (Table 3). Figure 4g shows that higher totals of the occurrence of discomfort temperatures at this station are caused by a combination of high midday and afternoon air temperatures and the high mean water vapor pressure. The high vapor pressure values at the KRAK station occur as a result of a microclimatic effect caused by the artificial irrigation of the nearby garden. The high growth in temperature at the HODO station has the same reason. The temperatures and vapor pressures do not reach such high values here because of the substantial shadowing of the station.

Figure 3: The difference between the average Humidex value and average air temperature at the Metropolitan Station System Olomouc stations (Series 1 for the summer half-year, Series 2 during the heatwave between August 22nd to August 26th, 2011).
Slika 3: Razlike med povprečno vrednostjo indeksa Humidex in povprečnimi temperaturami zraka na merskih postajah metropolitanskega sistema postaj Olomouc (niz 1 za poletno polovico leta, niz 2 za čas vročinskega vala od 22. do 26. avgusta 2011).



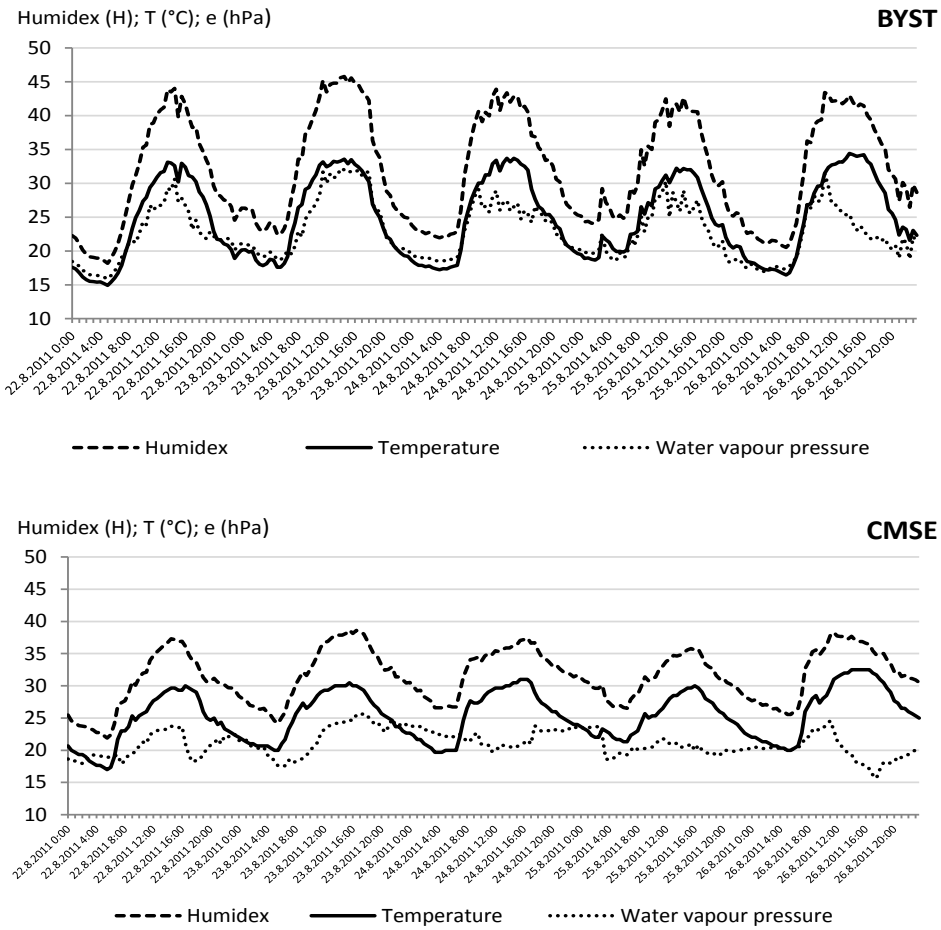
A significant influence of the local climate can be seen in the high total of intervals of great discomfort (H40) at the BYST station, especially because the totals of some discomfort (H30) at this station are only average (see Table 3). It is obvious (Figure 4a) that this condition is due to a significant amplitude in the daily course of the air temperature and water vapor pressure. Reason for this may be the low plants on the waterlogged black soil in the immediate vicinity of the station. Another station with high totals of intervals of great discomfort (H40) but relatively moderate totals of interval of some discomfort (H30) is the KOJE station, which again lies near a source of air moisture, in this case a river. At both the KOJE and BYST stations, the daily course in the middle of the day and in the afternoon hours shows large variations in the vapor pressure caused by turbulence, which indicates the pulling of humid air masses from nearby locations with high evaporation.

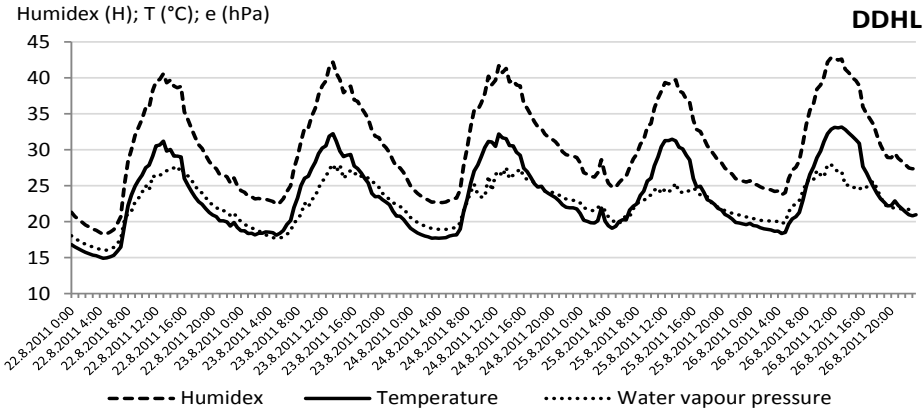
The lowest totals of interval with some discomfort (H30) were found at the CMSE station (LCZ 2). In 2011, great discomfort (H40) did not occur at all at the CMSE station. This was due to the microclimate of the enclosed courtyard, with small daily amplitudes of air temperature and water vapor pressure (Figure 4b).

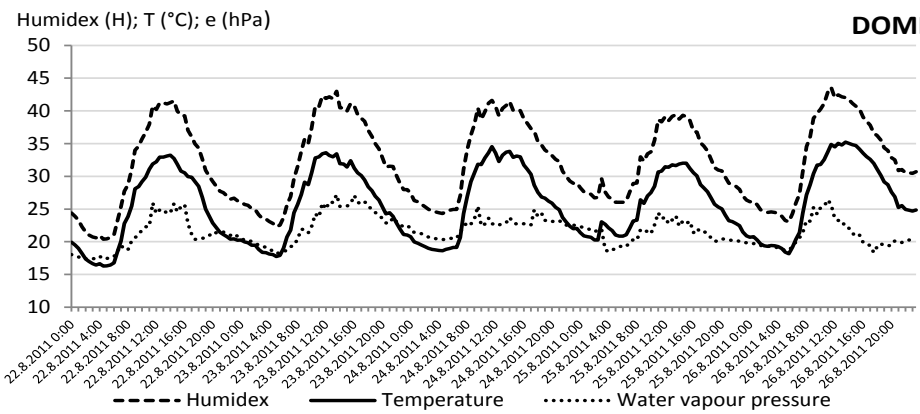
As expected, low totals of interval with great discomfort (H40) and some discomfort (H30) were also found on the DDHL station. On the contrary, the low totals of intervals of discomfort at the HOLI station seem unusual, particularly because of the fact that the majority of stations with a similar location (BOT_PdF, BOT_PrF, and KOJE) and even

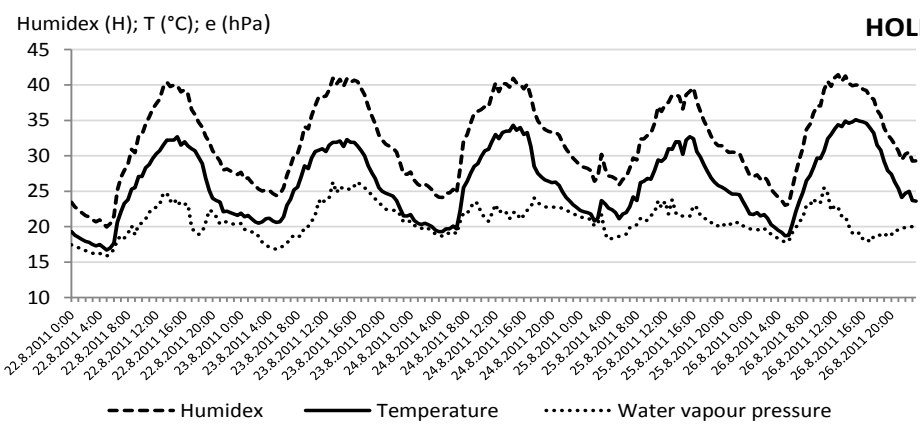
the shady HODO station which has a very low impact of high temperatures on the formation of heat stress, showed relatively higher totals of intervals not only of great discomfort (H40), but also of some discomfort (H30). The reason is in the low water vapor pressure at this station. In comparison with other stations, the HOLI station has only a few potential sources of moisture.

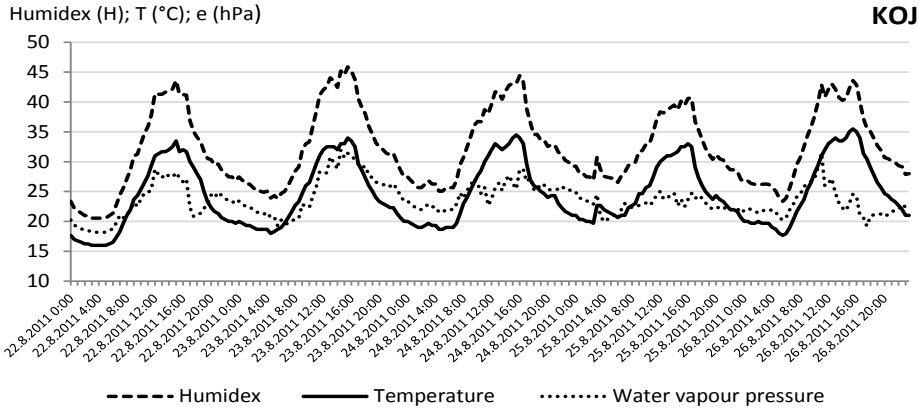
Figure 4: The development of air temperature, water vapor pressure, and Humidex values at selected Metropolitan Station System Olomouc stations during the heatwave between August 22nd to August 26th, 2011: a) BYST; b) CMSE; c) DDHL; d) DOMI; e) HOLI; f) KOJE and g) KRAK. Slika 4: Spreminjanje temperature zraka, parcialnega tlaka vodne pare in indeksa Humidex na izbranih merskih postajah metropolitanskega sistema postaj Olomouc v času vročinskega vala med 22. in 26. avgustom 2011: a) BYST; b) CMSE; c) DDHL; d) DOMI; e) HOLI; f) KOJE in g) KRAK.

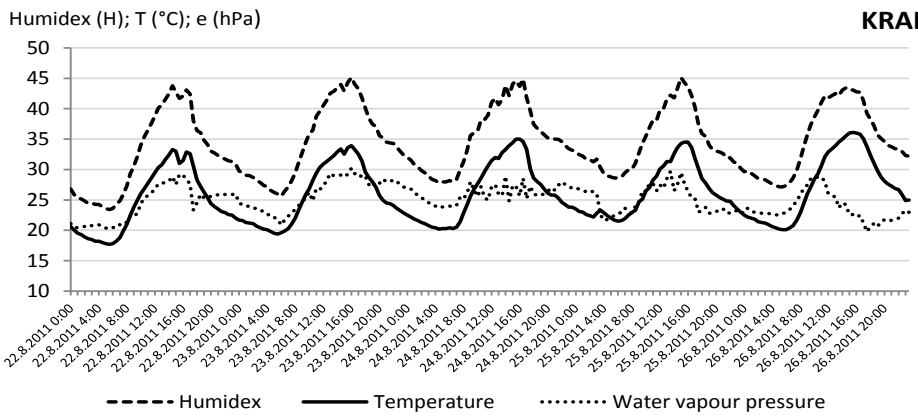



Humidex (H); T (°C); e (hPa)
DDHL
45
40
35
30
25
20
15
10
Humidex
Temperature
Water vapour pressure


Humidex (H); T (°C); e (hPa)
DOMI
50
45
40
35
30
25
20
15
10
Humidex
Temperature
Water vapour pressure


Humidex (H); T (°C); e (hPa)
HOLI
45
40
35
30
25
20
15
10
Humidex
Temperature
Water vapour pressure





3.2 Impact of heat stress on the population of the region through the example of mortality

From the analyses of the spatial variability of the lengths of the intervals during which the threshold values of the air temperature above 25.0°C, 30.0°C, and 35.0°C and Humidex values of H30, H35, H40, and H46 were exceeded, it is clear that the stress of the temperature-humidity conditions on the population during the summer has considerable intra-regional spatial heterogeneity because of the significant influence of the local climate and microclimate. Because of the dense network of stations, we were able to select a station that shows typical (average) temperature and Humidex values for the area of interest and, therefore, it can be considered representative on the regional level. Our analyses (Table 4) show that such a station is DOMI. The DOMI station is located in a

courtyard of a park type with urban greenery and partially impermeable surfaces (Figure 2a). With regard to the spatial distribution of the population, such an environment can be considered as typical of Olomouc and its surroundings.

The DOMI station shows a typical daily course of temperature and Humidex values for Olomouc and its surroundings and, therefore, it was possible to further analyze the relationship between the maximum daily temperatures and mortality and between the maximum daily Humidex values and mortality. Notwithstanding other related factors or accompanying circumstances of the influence of heatwaves on mortality, it is clear that it is possible to find a clear relationship between the maximum daily temperature and mortality and the maximum daily Humidex values and mortality (Figures 5 and 6). Shifting days or the respective maximum daily temperature values/Humidex values back by one or more days because of the date of death unexpectedly did not improve the correlation coefficient.

Differences in trends of mortality with temperature and Humidex are negligible. In both cases the increase is statistically significant and non-linear (Figures 5 and 6). With maximum daily temperatures above 30°C, the increase in mortality is still modest. When Humidex values extend above H40 (great discomfort) the increase in mortality is more significant, but in comparison with the sharp increase corresponding to Humidex values of 46 and higher, it is still relatively low. A significant increase in mortality therefore occurred only on days when the daily maximum Humidex value reached the level of 46 (dangerous) or the daily maximum temperature reached 35.0°C. This is demonstrated in Figure 7, where the sharp increase in mortality during heatwave from 17th June to 23rd June 2013 can be seen.

Figure 5: Relationship between the daily maximum Humidex value (categorized) and the change in the mortality rate (in % of the mean mortality as 3-days moving average) in Olomouc and surroundings in the years 2010 to 2014.
Slika 5: Razmerje med dnevnimi maksimalnimi vrednostmi indeksa Humidex (kategoriziranimi) in spreminjanjem mortalitete (v % od 3-dnevne drseče aritmetične sredine) v Olomoucu in okolici med letoma 2010 in 2014.

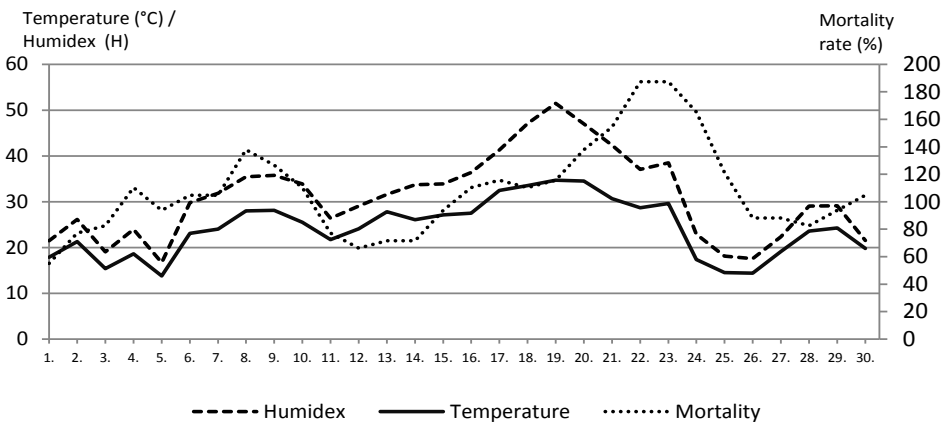


Figure 6: Relationship between the maximum daily temperature (categorized) and changes in mortality rates (in % of the mean mortality) in Olomouc and surroundings in the years 2010 to 2014.
Slika 6: Razmerje med maksimalnimi dnevnimi temperaturami (kategoriziranimi) in spreminjanjem mortalitete (v % od povprečne mortalitete) v Olomoucu in okolici med letoma 2010 in 2014.

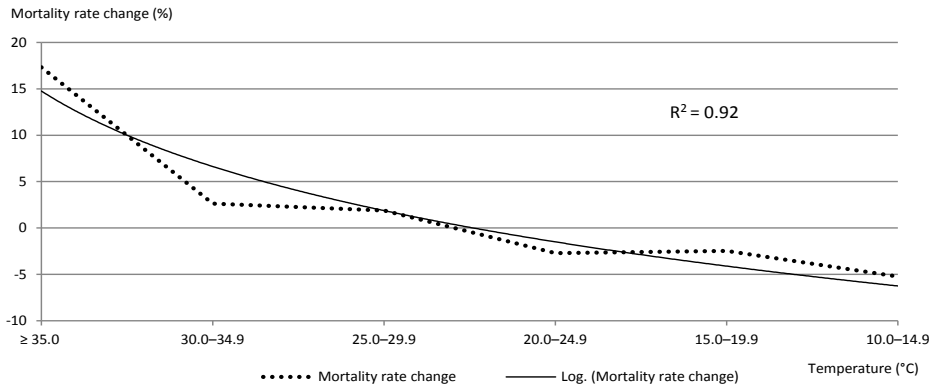
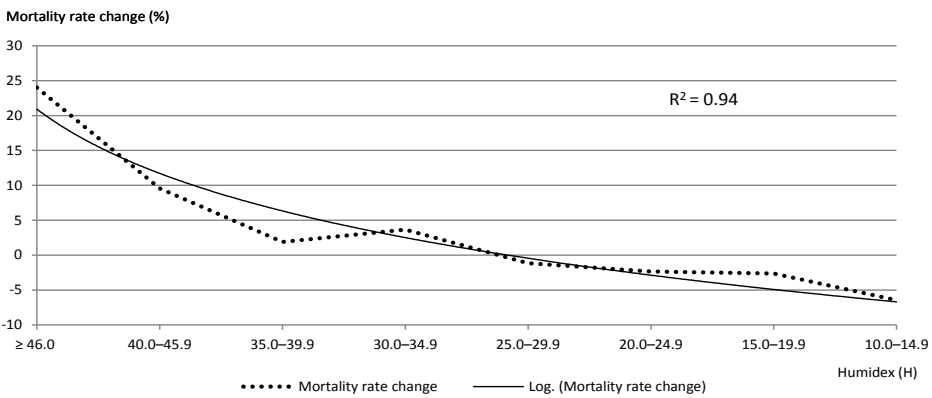


Figure 7: The maximum daily Humidex value, maximum daily temperature change and the change of the mortality rate (in % of the mean mortality) in Olomouc and surroundings in June 2013.
Slika 7: Maksimalne dnevne vrednosti indeksa Humidex, maksimalne dnevne spremembe temperature in spreminjanje mortalitete (v % od povprečne mortalitete) v Olomoucu in okolici junija 2013.



4 DISCUSSION

The biggest total amounts of time for which the threshold temperatures of 35.0°C, 30.0°C, and 25.0°C were exceeded occurred in the areas on the border of mid-rise, not very compact urban development and relatively open and well-insolated areas with the characteristics of zones LCZ 5 and LCZ 9 (LCZ D). This corresponds with the results of more recent studies on the heat island of a city, which imply that the highest daily temperatures are reached exactly in such types of environments (Houet, Pigeon, 2011; Stewart, Oke, Krayenhoff, 2014). High totals of time during which the temperature exceeded 35.0°C at the CHVA station (LCZ BD_w), which on average belongs to the colder stations, correspond with Stewart, Oke and Krayenhoff's (2014) founding that temperature in LCZ D may in some cases be even higher than the maximum temperature in LCZ 5 and LCZ 6. The smallest total amounts of time for which the threshold temperatures of 30.0 and 25.0°C were exceeded were found at the valley station DDHL (LCZ BA) near a forest and also at the station CMSE (LCT 2cc) in the city center. Such occurrence of cold fragments in the central parts of European cities when there is a positive energy balance has already been pointed out by Kłysik and Fortuniak (1999) through the example of Łódź (Poland).

Spatial differences between locations with high totals of intervals of temperatures above threshold values and locations with high totals of intervals of Humidex above threshold values were clearly demonstrable. Therefore, it turns out that not all the stations with the characteristics of LCZ 5 and 9 (D), typified by long intervals during which the threshold temperatures were exceeded, show long periods of time during which there was some discomfort (H30) or great discomfort (H40). It seems that a decrease in the relative humidity, together with increasing temperature, significantly reduces the resulting Humidex value unless there is a source of moisture in the neighborhood of the station (HOLI, CMSE, KOPE, and LETO). Analogously, and this is more serious, high maximum temperatures and high levels of water vapor pressure occur simultaneously at some locations (KRAK, KOJE).

It is clear that areas with low plants on moist soil may indicate a high maximum temperature, together with high water vapor pressure. This corresponds to the findings of Mayer and Höppe (1987), who justified the relatively lower values of water vapor pressure in an area of high vegetation by the fact that the vegetation in the period of maximum temperatures shows relatively low values of transpiration (closure of pores) and so does not contribute significantly to the value of water vapor pressure. As shown by the results presented here, the source of excessive water vapor pressure in the middle of the day and in the afternoon hours needs to be searched for in a wetland surface or in open water areas. At least in the middle of the day and during the afternoon hours of warm summer days, it is not possible to talk generally about the gradient of water vapor pressure between the urban and suburban landscape, as described, e.g., by Kuttler et al. (2007). Therefore, we can identify with the conclusions drawn by Fortuniak, Kłysik and Wibig (2006) that the gradients of water vapor pressure in the urban and suburban landscape are very difficult to define and the causes of their resulting spatial variability cannot be equated with the variability of the temperature field. Therefore, although there is criticism of Humidex (e.g.,

d'Ambrosio Alfano, Palella, Riccio, 2011), provided that air humidity affects thermal comfort, the Humidex assessment brings very valuable information about an important aspect of the spatial variability of heat stress in the urban and suburban landscape (i.e., at the **local level**).

Humidex values above H46 (dangerous) and temperatures above 35.0°C in Olomouc and its surroundings occurred relatively rarely, which corresponds to the results found for other Central European cities: Brno (Litschmann, Rožnovský, 2012; Dobrovolný et al., 2012) and Krakow (Bokwa, Limanówka, 2014). However, if they did occur, they were associated with a significant increase in mortality. The observed pattern of increased mortality together with maximum temperatures corresponds well with the detailed studies of the mortality rate caused by the heat carried out in the Czech Republic by Kyselý and Huth (2004a; 2004b) and Kyselý (2004). This finding is alarming if the predictions of greater frequency and extremity of high temperatures in Central Europe (IPPC, 2014b) are fulfilled.

Comparing the relative mortality and Humidex values with the relationship of the mortality rate and maximum temperature we found that, at the **regional level,** Humidex, in comparison with the maximum temperature, does not produce significantly more accurate information on the heat stress which warm weather causes to the population. This corresponds with the findings of Kyselý and Kříž (2003).

5 CONCLUSIONS

The longest intervals during which the threshold temperatures of 35.0°C, 30.0°C, and 25.0°C were exceeded occurred in locations on the border of mid-rise and not very compact urban development and relatively open well-insolated open spaces. On the contrary, the shortest intervals were found in compact mid-rise in the center of the city with dense development and outside developments near a forest.

There are significant spatial differences between the locations with long intervals of high temperatures and locations with long intervals of high Humidex values. Water vapor pressure significantly modifies the field of heat stress in the city and its surroundings. The spatial-temporal variability of water vapor pressure should therefore be subject to more detailed research.

High Humidex values are observed at stations that have high maximum temperatures and are also exposed to an excessive supply of moisture as a result of evaporation resulting from artificial irrigation, naturally waterlogged soil, or water surfaces.

Assuming that the air humidity has an influence on the thermal comfort of a person, the temperature-humidity indices represent important aspect of the further refinement of the study of heat stress in urban and suburban landscapes on the local level.

When studying the effect of heat stress on the population at the regional level in a temperate climate, Humidex does not bring significantly better results than simple temperature indicators.

Humidex values above H46 (dangerous) and temperatures above 35.0°C occurred only infrequently in the conditions of Central European cities; they are associated with a significant increase in the mortality rate.

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TOPLOTNI STRES V URBANEM IN SUBURBANEM OKOLJU TER NJEGOVA PROSTORSKA SPREMENLJIVOST NA PRIMERU SREDNJE VELIKEGA MESTA

Povzetek

Zmerne geografske širine so območja, kjer lahko predpostavljamo povečano smrtnost zaradi toplotnega stresa. Dejavniki, ki ga povzročajo, so dobro poznani, v desetinah znanstvenih člankov so predstavljeni tudi številni pokazatelji, s katerimi ga lahko kvantificiramo. Mnogo manj pozornosti je posvečeno preučevanju prostorske spremenljivosti toplotnega stresa, obenem pa nove ugotovitve o mestni klimi kažejo, da so razlike v temperaturnem polju v mestu večje, kot smo mislili doslej. Takšne

razmere kažejo na potrebo po podrobnejših preučitvah prostorske variabilnosti toplotnega stresa v mestih.

V študiji smo poskušali ovrednotiti prostorsko spremenljivost toplotnega stresa v srednje velikem mestu na primeru Olomouca in njegove okolice (Češka republika) ter ugotoviti, v kolikšni meri nam standardni podatki o temperaturah in indeks Humidex pojasnjujejo vrednosti toplotnega stresa na lokalnem nivoju. Uporabili smo podatke 14 merskih postaj iz metropolitanskega sistema postaj Olomouc (Metropolitan Station System Olomouc, MESSO), ki so razmeščene v različnih urbanih in suburbanih okoljih. Z analizo podatkov smo ugotavljali dolžino obdobij s preseženimi mejnimi temperaturami (25,0 °C, 30,0 °C in 35,0 °C) ter mejnimi vrednostmi indeksa Humidex (rahlo neugodno H30, zelo neugodno H40, nevarno H46) na posameznih lokacijah. Da bi pojasnili, v kolikšni meri oba pokazatelja uspešno pojasnjujeta toplotni stres na regionalnem nivoju, pa smo analizirali še razmerje med vsakim od obeh pokazateljev ter povečano mortaliteto.

Rezultati kažejo, da so se obdobja s preseženimi mejnimi vrednostmi temperatur pojavljala na merskih postajah med območji s srednje visokimi zgradbami (LCZ 5) in dobro osončenimi odprtimi javnimi površinami ali redko pozidanimi območji (LCZ 9/D). Območja z najkrajšimi obdobji preseženih mejnih vrednosti temperatur smo našli v bližini gozda (LCZ BA) in tudi v mestnem središču (LCZ 2cc). Prav tako se je izkazalo, da niso bila na vseh postajah z daljšimi obdobji preseženih mejnih vrednosti temperatur zabeležena tudi daljša obdobja s preseženima mejnima vrednostima indeksa Humidex H30 in H40.

Ugotovili smo, da so bile razlike v trendih mortalitete glede na temperature in indeks Humidex zanemarljive. Statistično značilno povečanje mortalitete se je pojavljalo v dnevih, ko je maksimalna dnevna vrednost indeksa Humidex dosegla 46 (nevarno) oziroma ko so najvišje dnevne temperature dosegle 35,0 °C.

Parcialni tlak vodne pare je pomembno vplival na razporeditev toplotnega stresa v mestu in okolici. Podatki o vlažnosti zraka nam torej dajejo pomembne informacije o prostorski spremenljivosti toplotnega stresa na lokalnem nivoju, pri preučevanju učinkov toplotnega stresa na prebivalstvo na regionalnem nivoju pa nam indeks Humidex ne daje nič boljših rezultatov kot podatki o temperaturah.

(V slovenski jezik prevedel Karel Natek)

PROF. DR. DARKO RADINJA (11. 1. 1927–9. 12. 2016)

Bogato geografsko življenjsko popotovanje je decembra 2016 sklenil spoštovani in cenjeni sodelavec našega Oddelka za geografijo Filozofske fakultete, prof. dr. Darko Radinja, redni in zaslužni profesor Univerze v Ljubljani.

Brez dvoma je bil prof. dr. Darko Radinja eden tistih univerzitetnih profesorjev, ki se je zaradi izjemnih pedagoških, znanstveno-raziskovalnih dosežkov in občečloveških vrlin neizbrisno zapisal med vodilne, inovativne ustvarjalce snovanja, širjenja in poglabljanja mnogoterih vsebinskih polj slovenske geografije. Za številne slovenske geografinje in geografe pa se je prof. Radinja osebnostno čvrsto zapisal tudi med najbolj odgovorne, tankočutne, a hkrati strokovno, znanstveno zahtevne učitelje in mentorje enciklopedičnega ter celostnega geografskega in interdisciplinarnega horizonta. Celotno njegovo geografsko utirjeno življenjsko pot kodno označuje naravnost pedantna skrb, prizadevanje za jasno in vsebinsko geografsko terminološko, pedagoško in znanstveno neoporečno sporočilno poslanstvo.

Prof. Radinja je jasno in premočrtno geografsko poslanstvo začel na takratni ljubljanski Prirodoslovno-matematični fakulteti, kjer je leta 1952 zaključil s hkratnim študijem C predmeta (fizika z meteorologijo), B predmeta (etnologija) in geografije kot A predmeta. Tudi sam izbor predmetov, torej tako naravoslovne kot družboslovno-humanistične usmeritve, nedvoumno kaže na njegov trdni namen, da se strokovno usposobi za široko, celovito in sistemsko razumevanje razmerja med človekom in naravo, geografskim okoljem, naravnih in družbenih silnic strukture in razvoja Zemljinega površja, sestavin geosfere. Za njegovo izjemno pedagoško osebnostno rast in s tem povezano kasnejše izvrstno prenašanje pedagoških vrlin na mlajše generacije geografinj in geografov je pomembno, da se je takoj po diplomi zaposlil kot gimnazijski profesor v Ljubljani. Leta 1959 pa se je zaposlil na takratnem Geografskem inštitutu Prirodoslovno-matematične fakultete, ki se je kasneje preoblikoval in nadgradil v Oddelek za geografijo Filozofske fakultete v Ljubljani. Leta 1960 je postal asistent in kasneje predavatelj za Matematično geografijo s kartografijo in Splošno fizično geografijo. Torej je bilo najprej v ospredju njegovega pedagoškega in znanstvenega geografskega poglabljanja splošnejše fizičnogeografsko polje, pa tudi problematika metodike geografskega pouka, torej t. i. šolske geografije. Prav navezanost in zgodnje prepoznavanje velikega pomena šolske geografije je bil razlog, da se je lotil izdajanja strokovnega geografskega glasila Geografski obzornik, ki ga je v obdobju 1953–1960 uspešno kot urednik urejal in strokovno dograjeval. V obdobju 1985–1996 pa je urejal Geografski vestnik,

osrednjo slovensko geografsko revijo. Doktoriral je leta 1965, že leta 1966 pa je bil izvoljen za docenta za fizično geografijo. Svoje znanje je dopolnil z enoletnim bivanjem (1967/1968) na moskovski in leningrajski univerzi, poglabljal se je v geomorfološke in hidrogeografske vsebine. Leta 1972 je postal izredni in leta 1983 redni profesor za fizično geografijo na Oddelku za geografijo FF v Ljubljani. Oddelku za geografijo FF je ostal zvest vse do svoje upokojitve leta 1996.

Prof. Radinja je slovensko geografijo ključno, s sebi lastno znanstveno prepričljivostjo, posebej zaznamoval na področju geografske teorije in terminologije, šolske geografije, geomorfologije, hidrogeografije in varstva geografskega okolja. V vseh naštetih, njegovih temeljnih vsebinskih poljih, je pustil lasten, v številnih konkretnih geografskih raziskovanjih metodološko in vsebinsko inovativni znanstveni pečat. Njegov znanstveni jezik je jasen, presoja virov kritična, ne pa kritizerska, metodologija sistemsko zasnovana, konkretni znanstveni rezultati in delovne hipoteze kvantitativno preverljivi.

Njegov znanstveno-raziskovalni in pedagoški opus je izjemno širok, saj je nastal v več desetletjih vztrajnega, ustvarjalnega prebiranja literature, terenskega in laboratorijskega dela, pisanja člankov, učbenikov, soočanja dobljenih rezultatov na številnih znanstvenih in strokovnih posvetih, na razburljivih in tehtnih okroglih mizah, kjer se je pogosto prof. Radinja izkazal kot besedno, terminološko in seveda vsebinsko briljanten, kritičen in samokritičen znanstvenik.

Praktično nemogoče je strokovno dovolj prepričljivo in korektno iz okoli 300 bibliografskih enot iz obdobja 1951–2005 izpostaviti ključne znanstvene dosežke prof. Radinje, na primer iz problematike fluvialne, kraške geomorfologije in procesov zakrasevanja, rečnih režimov, izdelave metodologije in raziskav slovenskih poplavnih pokrajin, priprave celotne metodologije in konkretnih raziskovanj vodnih obratov na slovenskih vodnih tokovih, njegovih pronicljivih in z geografskega vidika modelno inovativnih, pokrajinsko sistemskih raziskav degradacije naših rek, jezer in onesnaženih slovenskih pokrajin, kmetijskega obremenjevanja, snovanja in uspešnega razvijanja geografskega predmeta Varstva geografskega okolja, snovanja in vodenja fizičnogeografskega laboratorija itd.

A prof. Radinja ni bil le odličen znanstvenik in raziskovalec, bil je tudi pronicljiv teoretik na področju geografske metodike in didaktike. Brez kakršnega koli pretiravanja lahko v imenu številnih njegovih nekdanjih študentk in študentov, magistric in magistrov, doktorandk in doktorandov zapišemo naslednje: prof. Radinja se po sistematiki, jasnosti, argumentaciji, terminološki preciznosti in privlačnemu, niti malo dolgočasnemu slogu podajanja, brezprizivno uvršča v sam vrh univerzitetnih geografskih predavateljev. Njegova predavanja, na katera se je vsakokratno vestno in odgovorno pripravljal, so bila in so še vedno za vse nas enkratni didaktični vzor. Predavanja prof. Radinje so potekala praktično brez uporabe pisnega gradiva, njihov dobesedni zapis pa bi bil pravzaprav enak kakovostnemu poglavju iz univerzitetnega učbenika. Podobno velja za njegove razlage na terenu, kjer je s tehtnimi in jasnimi besedami obrazložil ne le sedanjo podobo obravnavanega geografskega območja, temveč tudi besedno pričaral pretekle naravne in antropogene pokrajinske procese, njihov vpliv na sedanjo podobo in strukturo geografskega območja, ki smo ga spoznavali, preučevali.

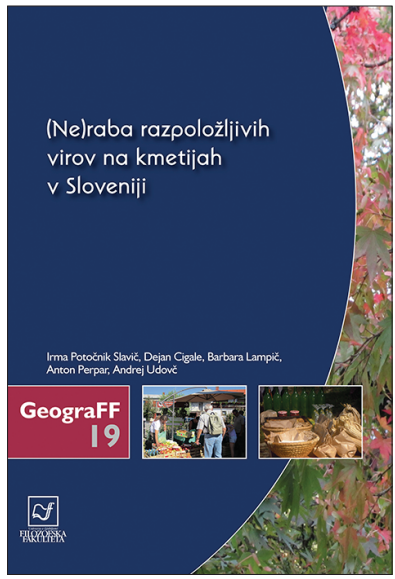
Prof. Radinja nikoli ni skoparil s časom za osebne razgovore, vedno si je vzel veliko časa, tako na primer za ustne izpite, ki so praviloma trajali vsaj kakšno uro, lahko pa tudi krepko več! Prav tako je bil potrpežljiv in poln koristnih nasvetov tudi na pogovorih glede kakovostnejše izdelave seminarskih, diplomskih, magistrskih del, doktorskih disertacij. Nobena posebnost ni bila, da je se je na primer konzultacija pri problematiki doktorske disertacije po štirih, petih urah v njegovi fakultetni sobi še živahno nadaljevala na hodniku oddelka, vse do izhoda s Filozofske fakultete. Kdo je imel pri zaključkih maratonskega, intelektualno izčrpajočega in iskrivega razgovora več svežine, kandidat ali mentor prof. Radinja, pa res ni potrebno navesti!

Z absolutno doslednim osebnim vztrajanjem na geografskem znanstvenem mišljenju, premišljanju in vedenju nas je prof. Radinja znanstveno in pedagoško moralno krepko zavezal k zahtevnemu argumentiranemu iskanju poti razumevanja geografske, pokrajinske stvarnosti. Morda je ključna sporočilna nota geografskega življenjskega poslanstva prof. Radinje prav v tem, v njegovi izrazito prepoznavni dvojni, znanstveno-učiteljsko geografski DNK vijačnici.

Žal prof. Radinje fizično ni več med nami, nenadoma se je od svojih najdražjih, od svoje geografske življenjske sopotnice, prof. Radinjeve, poslovil na njemu lasten način: v tihem, od sodobnega vrveža zavestno izbranem, odmaknjenem bohinjskem kotu Fužinskih planin, kjer je vse do dobesedno zadnjega trenutka opravljal tudi geografsko terensko poslanstvo. A v geografski dediščini bo ostal duhovno trajno zasidran preko njegovih zapisanih in izrečenih besed, ki bodo še naprej bistrile in plemenitile naše misli, zamisli in namene.

Dušan Plut

(NE)RABA RAZPOLOŽLJIVIH VIROV NA KMETIJAH V SLOVENIJI



Irma Potočnik Slavič, Dejan Cigale, Barbara Lampič, Anton Perpar, Andrej Udovč: (Ne)raba razpoložljivih virov na kmetijah v Sloveniji. Zbirka GeograFF 19. Znanstvena založba Filozofske fakultete in Oddelek za geografijo, 166 str. Ljubljana, 2016.

Na podlagi temeljite analize naravnih, kapitalskih in človeških virov podajajo avtorji celovit pogled na pomembne strukturne spremembe, ki so se zgodile v slovenskem kmetijstvu po osamosvojitvi in spremembi družbenega sistema, predvsem po vstopu Slovenije v EU. Nato izdelajo profil vitalne kmetije, ki se ukvarja z dopolnilno dejavnostjo. Profil temelji na kombinaciji devetih kazalcev (starost nosilca, starost prevzemnika, starostno-generacijska vitalnost gospodinjstva, končana formalna izobrazba nosilca, zgodovina kmetovanja, število gospodinjskih članov, vključenih v dopolnilne dejavnosti, dohodek, pridobljen izven kmetije, vzroki za ukvarjanje z dopolnilno dejavnostjo in prihodnji načrti za dopolnilno dejavnost na kmetiji), ugotovljenih s pomočjo anket in intervjujev z nosilci dopolnilne dejavnosti ter delavnic s kmetijskimi svetovalci.

Posebna pozornost je v monografiji namenjena turizmu na kmetiji kot pomembni in precej razširjeni dopolnilni dejavnosti na slovenskih kmetijah. Anketna raziskava med 440 prebivalci Slovenije je pokazala, da sta zanje pri izbiri določene turistične kmetije najpomembnejša dobra domača hrana in bivanje v mirnem, podeželskem okolju. Nadpovprečno ocenjeni so bili še bolj individualen odnos do gosta, nizka cena ter želja otrok, partnerja ali prijateljev. Avtorji so vrednotili potencial za razvoj dopolnilne dejavnosti turizem na kmetiji na primeru testnih kmetij s pomočjo metode DEXi, ki predstavlja ustrezno podlago za večkriterijsko odločanje in daje monografiji mednarodno primerljivost.

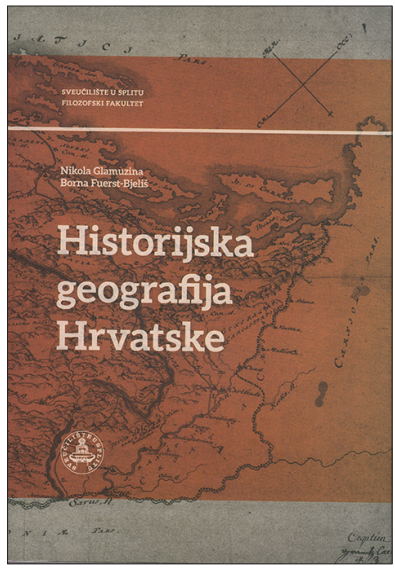
Monografijo zaključuje ugotovitev, da so ključni dejavniki, ki povzročajo razlike v razvitosti med slovenskimi občinami pretežno ekonomske (produktivnost, podjetnost, investiranje in struktura gospodarskih dejavnosti) in demografske narave (gibanje števila prebivalstva, izobrazbena struktura ter družbenogospodarsko stanje prebivalstva); kot pomembni dejavniki se izkažejo tudi odmaknjenost območja ter stanje okolja, brezposelnost, gospodarska moč kmetij ipd. Na podlagi teh dejavnikov so bile slovenske občine razvrščene v štiri skupine. Prva skupina občin izkazuje najnižjo gospodarsko in razvojno uspešnost, ki se nato povečuje do četrte skupine z najvišjo gospodarsko in razvojno uspešnostjo. Avtorji so dokazali, da ima pri razvojni uspešnosti slovenskih občin (ne)raba virov na kmetijah pomembno vlogo.

Monografija predstavlja izvirno interdisciplinarno znanstvenoraziskovalno delo na področju razvojnih potencialov kmetij in slovenskega podeželja. Hkrati so z interpretacijo rezultatov podkrepili lastna spoznanja in opažanja iz dolgoletnega znanstveno-raziskovalnega in terenskega dela. Avtorji izpostavljajo prostorsko dimenzijo kmetij oziroma njihovih virov: bralcu je tako vseskozi v pomoč bogato kartografsko in fotografsko gradivo.

Rezultati znanstvenoraziskovalnega dela, predstavljeni v monografiji, pomembno prispevajo k teoriji agrarne geografije, geografije turizma, geografije podeželja in regionalnega razvoja ter so uporabni v praksi pri snovanju dolgoročne politike razvoja slovenskega podeželja. Ugotovitve pričujoče študije so ustrezna strokovna podlaga pristojnim ministrstvom pri pripravi takšnih ukrepov za razvoj slovenskega podeželja, ki bodo krepili konkurenčnost slovenskega kmetijstva v EU in svetu ter hkrati ohranjali identiteto ter specifiko slovenske kulturne pokrajine. Prispevajo tudi pomembna spoznanja k teoriji regionalnega razvoja, ki utrjujejo znanstvena spoznanja slovenskih geografov že iz sedemdesetih let prejšnjega stoletja, o nujnosti udejanjanja enakomernega regionalnega razvoja Slovenije. Ohranjanje poseljenosti celotnega slovenskega podeželja in izjemnega naravnega okolja bo možno le s krepitvijo trajnostnega kmetijstva in ustreznim spodbujanjem podjetništva na podeželju v obliki inovativnih dopolnilnih dejavnosti na kmetiji.

Igor Jurinčič

HISTORIČNA GEOGRAFIJA HRVATSKE



Nikola Glamuzina, Borna Fuerst-Bjeliš: Historijska geografija Hrvatske. Sveučilište v Splitu, Filozofski fakultet, 312 str. Split, 2015

Historijska geografija Hrvatske je delo avtorjev Glamuzine in Fürst-Bjeliševe, ki sta ga pripravila kot učbenik za študij istoimenskega predmeta na splitski filozofski fakulteti. Predmet izvajajo na področju zgodovine, zato je koncepcija učbenika kakor tudi razumevanje njegove medpredmetne povezljivosti že v osnovi meddisciplinarno, torej med geografijo in zgodovino. Vsebinsko gledano pa je učbenik z zgodovinsko metodo prikazana geografska stvarnost v kronološko-tematskem ter podredno še regionalnem zaporedju. 312 strani besedila je razdeljeno na 12 poglavij, pregled literature ter sezname grafičnih prilog. Obravnavana obdobja so zaradi zgodovinskih vezi merodajna v več pogledih tudi za slovensko državno ozemlje.

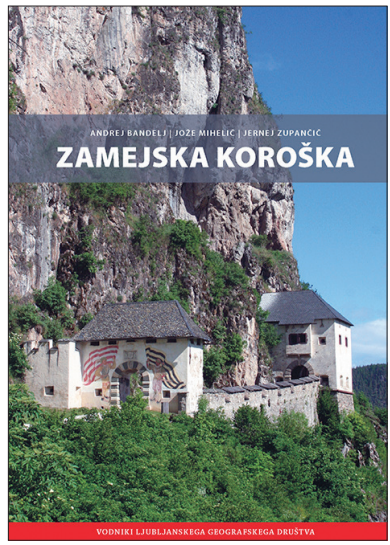
Interdisciplinarna raziskovalna disciplina posebej izpostavlja pomen časovne razsežnosti in njegovo vlogo v spremembah geografske stvarnosti. Čas je torej bistveni dejavnik, vendar ne sam po sebi, temveč zaradi kombinacije različnih družbenih in političnih vplivov, ki učinkujejo na vsakokratne družbene strukture, te pa oblikujejo kulturno pokrajino. V delu je le skromna pozornost odmerjena vplivu naravnih procesov; tako ostaja vtis, da je v metodološkem instrumentariju te discipline prisotna predvsem podmena antropogenih dejavnikov oblikovanja kulturne pokrajine ter seveda tudi družbe. Toliko bolj pa sta avtorja izpostavila gledanje in reakcije človeških družb v določenem časovnem obdobju in regionalnem kontekstu. Taka zgodovina je torej časovno opredeljena veda o okolju ter predvsem, kako človek (oziroma družba) percipira kategorijo okolja ne glede na to, v kolikšni meri je to lokalno ali regionalno rezultat naravnih ali pa na drugi strani človeških vplivov. Ker je pri interpretaciji človekovih ravnanj v preteklosti bistvenega pomena tudi poznavanje miselnosti preteklih družb, je disciplina tematsko široka in zelo zahtevna. Historična (zgodovinska) geografija ni zgodovina geografske vede, temveč geografska interpretacija zgodovinskih procesov. Pri tem predstavljajo državne tvorbe prvi (politični) okvir, na katerega se naslanja upravno-administrativna členitev in gospodarski sistem. Te strukture so na preučevanem primeru hrvaških teritorijev pustili najbolj markantne in obstojne sledi. V teh okvirih so se oblikovali sistemi poselitve in kultivacije zemljišč kot glavnih tvorcev pejsaža. Sledi razvoj različnih neagrarnih panog, upravno-administrativne razdelitve in socialne, kulturne in politične stratifikacije vsakokratnih družb. Interpretacija je

tematsko-kronološko zasnovana in uporablja vzročno-posledično logiko in argumentacijo virov podatkov, informacij in materialnih artefaktov.

Prebiranje tega dela razkrije bralcu drugačen, genetsko-interpretativno obogaten pogled na sosednjo državo. Na prvi pogled je manj izrazito stična kot Slovenija, a po drugi strani (predvsem v luči zgodovinskih procesov) je izrazito sestavljena. Če postavimo ta vedenja v vlogo sodobnega regionalnega razvoja ter razumevanja njenega geopolitičnega položaja, je omogočeno razumevanje Hrvaške skozi prizmo mozaične stvarnosti, ki so jo gradili beneški, mleški in dubrovniški državni sistemi, spreminjali vplivi turške osmanske države in politično-teritorialno v večji meri definirali ogrski in habsburški vplivi, nadgradili obe jugoslovanski državi ter dajejo sodobni družbeni in prostorski pečat čas po osamosvojitvi leta 1991. S tem grobim orisom pa se brskanje po prepletanju omenjenih vplivov, bodisi časovno vzporedno bodisi zaporedno, ter ugotavljanje človekovega prostorskega ravnanja v izbranih časovnih sekvencah šele resno začne. Zgodovinska geografija se tako manifestira kot široka interpretativna med-veda, pomožna veda tako geografije kot zgodovine, v smislu vednosti o (predvsem državnem) prostoru pa pravzaprav nadgradnja.

Jernej Zupančič

ZAMEJSKA KOROŠKA, VODNIKI LJUBLJANSKEGA GEOGRAFSKEGA DRUŠTVA



Andrej Bandelj, Jože Mihelič, Jernej Zupančič: Zamejska Koroška. Vodniki Ljubljanskega geografskega društva, ZRC SAZU, 213 str. Ljubljana, 2016

V letu 2016 smo se lahko razveselili nove publikacije Ljubljanskega geografskega društva (LGD). Gre za geografski vodnik po Zamejski Koroški, ki je nastal kot rezultat eno- in dvodnevnih ekskurzij po Sloveniji in zadnja leta že kar tradicionalno, predvsem po njeni neposredni, zamejski okolici. Z njimi LGD sistematično, drugo za drugim odkriva tančice našega narodnostnega ozemlja, ki nam je prostorsko tako blizu, kljub temu pa marsikdaj zelo oddaljeno, očem skrito in slabše poznano. Publikacija je plod dveh geografov (Andreja Bandlja in Jerneja Zupančiča) in profesorja športne vzgoje in naravovarstvenika Jožeta Miheliča. Vodnik na začetku krasi uvodnik urednika Draga Kladnika. V vodniku je na ustaljen način predstavljenih devet ekskurzij, ki so jih avtorji izpeljali med aprilom 2013 in septembrom 2015. Težišče predstavljenih ekskurzij je v severozahodnem delu slovenskega zamejskega ozemlja, ki se postavlja z izjemno bogato naravno, zanimivo zgodovinsko in pestro kulturno dediščino. Gre za ozemlje, ki smo ga Slovenci s plebiscitom 1920 (verjetno) dokončno izgubili in je od takrat naprej pod pritiskom ponemčevanja. Devet poglavij v vodniku vključuje: Ziljsko dolino, Beljak in okoliška jezera, Karavanke in Rož, Celovec in Gosposvetsko polje, Južna pobočja Svinške planine in Velikovško čezdravje, Podjuno, Labotsko dolino, Zgodovinske kraje severne Koroške in Pogorje Nockberge z biosfernim parkom.

Prva ekskurzija obravnava eno najdaljših alpskih dolin reke Zilje, ki poteka ob periadriatskem šivu, med Karnijskimi Alpami na jugu in Ziljskimi na severu. Med pomembnejšimi postajami lahko izpostavimo Dobrač s silovitim podorom, etnološki biser Bistrico na Zilji, športno zibelko Zahomec ter turističnega velikana Mokrine. Na celotnem območju lahko zasledimo slovenstvo, čeprav ponekod le še v krajevnih imenih. Močan pečat je pokrajini dala tudi prva svetovna vojna, saj jo je za vedno spremenila. Drugo ekskurzijo je prav tako vodil Andrej Bandelj. Obiskali so strateško pomembno prometno vozlišče Beljak ter njegovo okolico, polno ledeniških jezer, ki so temelj tamkajšnjega turizma. Tretjo ekskurzijo je pripravil Jernej Zupančič, s katero se je osredotočil na same Karavanke in Rož. Območje predstavlja eno od jeder poselitve Slovencev na avstrijskem Koroškem. Z ekskurzijo odkrivamo naravne vrednote (soteska Čepa), zgodovino (nekdanje rudarstvo v Železni Kapli), gospodarstvo in turizem (zdravilišča) pokrajine, kjer si slovenska narodna skupnost že vsaj stoletje in pol prizadeva ne le za miniaturno etnično preživetje, ampak

tudi prispeva pomemben delež v zakladnico slovenskega jezika in kulture. Naslednjih pet ekskurzij je ponovno pripravil Andrej Bandelj. V obratni smeri urinega kazalca se lahko popeljemo najprej v Celovec in na zgodovinsko pomembno Gosposvetsko polje. Območje ni veliko, zato se ekskurzija osredotoča na Celovec in njegovo vlogo, turistično pomembno bližnje Vrbsko jezero. Velik del je, razumljivo, posvečen zgodovinskemu pregledu od antike do danes. Peta ekskurzija nadaljuje pot od Celovca proti južnim pobočjem Svinške planine in se zaključi v Velikovcu. Tudi pri tej ekskurziji je močno v ospredju plebiscitna problematika ter pomen Drave kot mejne reke. Če le omenimo, da so Avstrijci »najbolj sončno vas Avstrije« (Djekše) razglasili za eno najprivlačnejših v vsej državi, je ekskurzija vredna ponovitve.

Podjuna je tisti del zamejske Koroške, ki je s Slovenijo najbolje povezan, saj od matične države ni ločen s težko prehodno naravnogeografsko oviro, kakršno na preostalem delu državne meje predstavljajo Karavanke. Podjuno je po mnenju avtorja vredno obiskati iz več razlogov. Gre namreč za območje velikih naravnih lepot, ki so posledica ledeniškega delovanja na vzhodnem robu Celovške kotline. Poleg tega je bila zaradi svoje lege in ugodnih naravnogeografskih razmer že zelo zgodaj poseljena, obenem ima območje tudi velik hidroenergetski potencial. Sedma ekskurzija nas popelje v svojevrstno in od ostalih delov Koroške precej drugačno Labotsko dolino. Dolina zaradi odprtosti predstavlja toplotni otok, zato bomo v njej našli vinograde in nasade špargljev. Nekateri ji pravijo »Koroški raj«, ki ga mnogi obiščejo kar s kolesi in si obenem lahko naberejo moči v številnih zdraviliščih. Zaradi večstoletne pripadnosti Salzburški nadškofiji in nadškofiji iz bavarskega Bamberga ima Labotska dolina velik zgodovinski pomen tudi za Slovenijo. Tudi osma ekskurzija je precej zgodovinsko naravnana, saj obišče pomembne kraje, kot so grad Ostrovica, Šentvid ob Glini, Breže, Krka in Straßburg, ki so bili v srednjem veku nosilci moči in razvoja te dežele. O njihovi nekdanji slavi priča predvsem bogata arhitekturna dediščina. Zadnja ekskurzija od ostalih nekoliko odstopa. Pogorje in biosferni park Nockberge leži precej onstran severnega roba slovenskega narodnostnega ozemlja. Obenem kopasti vrhovi bolj spominjajo na avstrijske pokrajine, kot pa tipične zašiljene »slovenske Alpe«. Kamninska podlaga je botrovala razvoju rudarstva, v naravi pa veliki pestrosti in bogastvu rastlinstva ter živalstva. Ekskurzijo je pripravil naravovarstvenik Jože Mihelič, ki po izobrazbi ni geograf, kar pa ne zmanjšuje pestrosti predstavljenih geografskih vsebin.

Vodnik nas ne razočara niti po privlačnosti izbranih ekskurzij niti po vsebinski plati, še manj po oblikovni in slikovni pestrosti. Publikacija je polna čudovitih avtorskih posnetkov, ki kar vabijo, da bi se bralec podal na potep po Zamejski Koroški. Tisti, ki vodnike redno prebirate (in tudi uporabljate), vsebinsko zasnovo poznate in tudi tokrat ni večjih odstopanj. »Novinci« boste mogoče pogrešali predvsem fizičnogeografske vsebine, pa vendar menim, da nihče ne bo kaj prida prikrajšan. Prej nasprotno: pričujoči vodnik je najbolj obsežen izmed vseh do sedaj izdanih slovenskih vodnikov.

LGD je eno redkih društev, ki s pomočjo mešanice strokovnih ter ljubiteljskih, predvsem pa prostovoljnih geografskih in negeografskih sodelavcev, pridno izdaja vodnike, ki dosegajo zavidljivo, na eni strani privlačno in poljudno raven ter na drugi strani primerno strokovno raven. Na tak način dokaj spretno krmarijo med dostopnostjo za širšo publiko

in specialno geografsko uporabnostjo. Z leti se je vodnikov nabralo že kar precej. Zamejska Slovenija je že… katera po vrsti? Težko reči, katera. Če štejemo le tiste, ki so nastale kot plod eno- in dvodnevnih ekskurzij po Sloveniji in njeni bližnji okolici, je to že deseta. Če štejemo vse, pa je to že kar legendarna 30. izdaja. To pomeni v povprečju več kot ena publikacija na leto, odkar je ne tako davnega leta 1991 izšel vodnik po Portugalski. Zaradi poznane problematike društev tako tujih, prvomajskih ekskurzij LGD ni več in posledično tudi vodnikov ne bo. Kritike »slovenskih« vodnikov tudi niso osamljene. Resda včasih malo upravičene, pogosto pa vseeno podane s premalo razumevanja za vloženi trud in delo, ki sta potrebna, da pridemo do takšne prijetne, na videz drobne in preproste knjižice.

S strahom se lahko upravičeno sprašujemo: »Koliko časa še?« Upam, da še dolgo. Prosim, še.

Blaž Repe

ZNANSTVENA KONFERENCA KARPATSKO-BALKANSKO-DINARSKE GEOMORFOLOŠKE KOMISIJE

Postojna, 13.–17. september 2016

V okviru delovanja Karpatsko-balkansko-dinarske geomorfološke komisije (okr. CBDGC) je septembra 2016 v Postojni potekala znanstvena konferenca, na kateri smo se zbrali geomorfologi in strokovnjaki sorodnih ved iz večine članic komisije. Ta že več kot pol stoletja na vsakih nekaj let pripravlja takšne konference z namenom izmenjavanja rezultatov znanstvenih raziskovanj in uporabe različnih raziskovalnih metod pri preučevanju reliefnih oblik in geomorfnih procesov, s poudarkom na ozemlju članic (Srednja in Jugovzhodna Evropa). Konferenco je pripravilo Geomorfološko društvo Slovenije v sodelovanju z Inštitutom za raziskovanje krasa ZRC SAZU, Geografskim inštitutom Antona Melika ZRC SAZU in Oddelka za geografijo Filozofske fakultete Univerze v Ljubljani. Na zasedanju se je zbralo 46 raziskovalcev, ki so predstavili 24 prispevkov v obliki referatov in 17 v obliki posterjev, prišli pa so iz Poljske, Češke, Slovaške, Madžarske, Romunije, Avstrije, Makedonije, ZDA in Slovenije.

Kot že na predhodni znanstveni konferenci CBDGC v Stari Lesni na Slovaškem junija 2013, so se tudi tokrat jasno pokazale velike spremembe v geomorfološkem preučevanju na območju članic komisije. Potrebnih je bilo kar nekaj let, da so geomorfologi v nekdanjih socialističnih državah povsem spremenili koncept geomorfološkega preučevanja ter se počasi in z velikimi napori vključili v glavni tok svetovnega geomorfološkega dogajanja. Ta pomemben proces je potekal sočasno z menjavo generacij, saj so zdaj v večini teh držav v ospredju raziskovalci in učitelji srednjih let, ki so že imeli možnost izpopolnjevanja v tujini, dostop do tuje literature in sodobne raziskovalne opreme in se bolj ali manj uspešno vključujejo v različne evropske in druge mednarodne projekte. V nekaterih državah tega območja poteka ta proces sicer počasneje, predvsem zaradi pomanjkanja finančnih sredstev, kar se je pokazalo tudi na odsotnosti raziskovalcev iz nekaterih držav, vključno z našo soseščino.

Predstavljeni prispevki so ponovno pokazali izjemno široko paleto raziskovalnih metod, s katerimi geomorfologi preučujejo sedanje in pretekle geomorfne procese ter najrazličnejše reliefne oblike, od periglacialnih procesov v Visokih Tatrah in recentne fluvialne dinamike velikih rek v Panonski nižini do modeliranja denudacijskih in fluvialnih procesov s pomočjo geografskih informacijskih sistemov, merilnih polj, lidarskih posnetkov itd. Pozornost vzbuja tudi velik poudarek na aplikaciji geomorfoloških preučevanj pri poseganju v prostor, bodisi v 'naravnem' ali urbanem okolju, ter na poskusih umeščanja rezultatov podrobnih meritev in preučevanj v širši kontekst geomorfnega dogajanja in spreminjanja okolja nasploh, kar je tudi eden od pomembnih trendov v sodobni geomorfologiji.

Že pred skoraj dvema desetletjema se je prvotna Karpatsko-balkanska geomorfološka komisija prav na pobudo Slovenije razširila še na območje Dinarskega gorstva, ki se od obeh drugih gorstev razlikuje po prevladi in posebnem, dinarskem tipu krasa.

Sodelovanje raziskovalcev s tega območja pri delu CBDGC je spodbudilo zanimanje za kras tudi v ostalih članicah, kjer preučevanje krasa ni tako zelo v ospredju, in to je bil tudi eden glavnih nagibov, da smo konferenco pripravili na slovenskem krasu. Udeležencem smo poskušali na različne načine predstaviti bistvene geomorfološke značilnosti Slovenije, z izrazitim poudarkom na krasu. Na začetku konference je akademik Andrej Kranjc spregovoril o razvoju in pomenu krasoslovja, kraški problematiki so bili posvečeni tudi trije od štirih vabljenih predavanj domačih raziskovalcev: Andreja Mihevca (*Kraška geomorfologija*), Nadje Zupan Hajna (*Kraški sedimenti: koristno orodje za rekonstrukcijo geomorfološkega razvoja (na primerih iz Slovenije)*, Matije Zorna (*Raziskovanje sedimentnih kaskad na stiku štirih evropskih pokrajin*) in Uroša Stepišnika (*Glacialna geomorfologija Dinarskega gorstva*). Tudi v ostalem delu konference so imeli domači strokovnjaki precej besede: izpostavil bi prispevke Mitje Prelovška (*Vloga koncentracije CO_2 in njenega spreminjanja pri geomorfnem razvoju krasa*), Uroša Stepišnika in sodelavcev (*Proglacialni kraški sistem: primer Blidinje*) ter Andreja Germovška in Mojce Zega (*Varovanje in vrednotenje geomorfološke dediščine v Sloveniji*).

Pomemben del konference je bilo tudi neposredno spoznavanje različnih tipov krasa na štirih ekskurzijah: *Morfologija in hidrologija kraških polj* (vodstvo: Andrej Mihevc), *Visoki dinarski kras* (Andrej Mihevc, Uroš Stepišnik, Matija Zorn), *Kras in kontaktni kras Krasa* (Andrej Mihevc) ter *Julijske Alpe* (Uroš Stepišnik, Matija Zorn).

Konferenca je potekala v prostorih Inštituta za raziskovanje krasa ZRC SAZU v Postojni, ravno pravšnje število udeležencev pa je omogočalo prijetno druženje ter živahno izmenjavo raziskovalnih in drugih izkušenj. Žal so finančne težave marsikomu preprečile udeležbo, a že nestrpno pričakujemo naslednjo konferenco CBDGC, ki jo nameravajo pripraviti naši kolegi iz Szegeda (Madžarska).

Karel Natek

Udeleženci na ekskurziji na Cerkniškem polju (foto: M. Blatnik).

ŠOLA NA OBLAKU: POROČILO O PROJEKTU IN ZAKLJUČNI KONFERENCI

Člani Oddelka za geografijo od leta 2013 delujemo v okviru Evropskega projekta vseživljenjskega izobraževanja Šola na oblaku (*School on the Coud - SoC*, št. projekta 543221-LLP-1-2013-1-GR-KA3-KA3NW), ki se bo zaključil v letu 2017. V projektu se zavzemamo za uvajanje računalništva v oblaku in drugih sodobnih poti na vseh ravneh izobraževanja. Računalništvo v oblaku je namreč dodobra spremenilo naš celoten način življenja in dela. Z njegovo pomočjo imamo dostop do digitalnih podatkov (slike, glasba, besedila, prostorski podatki itd.) kjer koli in kadar koli, kjer imamo dostop do svetovnega spleta.

Projekt Šola na oblaku se osredotoča na možnosti, ki jih nudi stalna povezanost in dostopnost za različne oblike izobraževanja in usposabljanja. Računalništvo v oblaku prinaša v izobraževanje izjemno učinkovito ter najsodobnejšo programsko opremo in množico različnih računalniških virov. Pristopi računalništva v oblaku nam omogočajo začrtati nove dinamične načine izobraževanja in učenja, ki so v skladu z načini razmišljanja, deljenja informacij, učenja in sodelovanja znotraj in zunaj učilnice. Delovna orodja omogočajo sodelovanje in motivacijo dijakov in študentov ter tudi usposabljanje različnih družbenih skupin (npr. brezposelnih in vključenih v različna poklicna izobraževanja) za zaposlitev. S projektom smo raziskali, kako naj se izobraževanje na tak razvoj odzove, in sicer z zmanjševanjem obstoječih vrzeli med izobraževanjem in računalništvom v oblaku. Da bi dosegli ta cilj, je projekt Šola na oblaku ustvaril učno mrežo, sestavljeno iz 55 evropskih partnerjev v 18 evropskih državah. Partnerstvo zajema večino izobraževalnih interesnih skupin in vse sektorje izobraževanja. Pri projektu sodelujemo trije člani Oddelka za geografijo (Blaž Repe, Marko Krevs in Tatjana Resnik Planinc). Delo je potekalo v štirih i-delovnih skupinah: i-Vodja, i-Učitelj, i-Učenec in i-Prihodnost.

Prva delovna skupina i-Vodja (*i-Manager*) je preučevala vidike izobraževalnega vodenja, upravljanja in organizacijske spremembe v obdobju razvoja računalništva v oblaku. Cilj je bil opredeliti in izmenjati tehnološke, socialne, ekonomske, kulturne in druge izkušnje v različnih izobraževalnih kontekstih. Na podlagi pobude Evropske digitalne agende in Strategije Evropa 2020 je prva delovna skupina obravnavala različne vidike izobraževalnih organizacij, izdelovala smernice za podporo tistim, ki že izvajajo oziroma razmišljajo o razvoju na podlagi računalništva v oblaku. Ustvarjanje »Zemljevida tehnologij v oblaku« omogoča vsem, ki sodelujejo pri vodenju razvoja računalništva v oblaku, da upoštevajo različne parametre za prenos dobrih praks v svoje okolje.

Druga delovna skupina i-Učitelj (*i-Teacher*) je preučevala vpliv računalništva v oblaku na vloge učiteljev in mentorjev v izobraževanju; ugotavljala je, kako lahko nove tehnologije in aplikacije v oblaku uporabimo, da izobraževanju prinesemo dodano vrednost; obravnavala je težave učenja in poučevanja, povezane z računalništvom v oblaku; prepoznavala je na eni strani ključne ovire in na drugi strani vse potrebne kompetence

učiteljev. Zanimala jih je vloga učitelja kot inovatorja. Delovna skupina je pregledala vse pomembne pristope k učenju in poučevanju ter podala praktične in bistvene smernice za učitelje in učitelje učiteljev. Med rezultate delovne skupine sodijo: predstavitve vpliva poučevanja in izobraževanja učiteljev, ki temelji na računalništvu v oblaku in vodi k ugotavljanju potreb po usposabljanju učiteljev; spletni katalog priporočenih platform, aplikacij in orodij, ki temeljijo na računalništvu v oblaku; letak z napotki za učitelje in mentorje o poučevanju v oblaku; oblikovanje interaktivne učne delavnice o uporabi računalništva v oblaku za i-Učitelje in i-Mentorje, ki so nosilci aktivnosti in rezultatov same delovne skupine.

Tretja delovna skupina i-Učenec (*i-Learner*) je v formalne in neformalne učne situacije povezovala učitelje, mentorje in različne izobraževalne inštitucije (šole, visoke šole in izobraževanje odraslih) z učenjem v oblaku. Delovna skupina je skušala opredeliti posamezniku prilagojeno učenje in nato usmeriti pozornost na tisto, kar tovrstno učenje na podlagi računalništva v oblaku naredi uspešno. Seznam meril, izdelan na podlagi izvedene raziskave, so uporabili kot okvir za oceno izbranih praktičnih primerov. Izdelali so tudi priročnik, ki pomaga pri ustvarjanju dobro prilagojenega učenja v oblaku. Glavni rezultati te skupine so: vodnik, ki temelji na pregledu najsodobnejše literature z izsledki raziskovalnih in inovativnih projektov; zbirka študij primerov dobrih praks posamezniku prilagojenega učenja, ki učiteljem omogočajo dostop do teh primerov; priročnik za učitelje, koordinatorje in mentorje, ki si ga lahko prenesejo in natisnejo; delavnica za prenos ugotovitev in rezultatov te delovne skupine.

Zadnja, četrta delovna skupina i-Prihodnost (*i-Future*), je obravnavala tematike, kot so: vloga, procesi in vpliv odprtih (izobraževalnih) virov v oblaku, razpoložljivost brezplačnih in drugih informacij ob uporabi računalništva v oblaku, nove generacije orodij za uporabo računalništva v oblaku, sporazumevanje in objavljanje v oblaku ter posledične težave (npr. etika in pravice intelektualne lastnine). Te težave se nanašajo tako na organizacije (izobraževalna združenja in združenja učiteljev, nevladne organizacije, založniške organizacije, muzeji, knjižnice, ministrstva) kot tudi na raziskovalce, učitelje, mentorje, upravnike šol, oblikovalce politik in politike. Izsledki delovne skupine so: poročilo o scenarijih za prihodnost, ki so nastali na konferenci projektnih partnerjev; sporočila za javnost o moči, možnostih in šibkostih računalništva v oblaku. Vsi dosedanji izdelki in ugotovitve, katalog spletnih orodij, aplikacij in platform za potrebe učiteljev ipd. so dostopni na spletni strani projekta.

Zaključna konferenca projekta (*School on the Cloud: a roadmap to a new teaching and learning paradigm*) je bila izvedena 18. novembra 2016 v Bruslju. Le delno je bila namenjena predstavljanju rezultatov in različnih dejavnosti v okviru projekta. Glavni namen je bil ozaveščanje širše strokovne javnosti in politike o že obstoječi »vseprisotnosti« računalništva v oblaku ter možnostih njegove učinkovite uporabe v izobraževanju danes in v prihodnje. Prireditev je potekala v flamskem parlamentu. Dodatno težo sta konferenci dala dva zunanja ključna govorca, Sugata Mitra (več o njem na primer Hole in the Wall, 2016; School in the Cloud, 2016; Sugata Mitra, 2016) in Ewan McIntosh (NoTosh, 2016), ki vsak na svojski, a vrhunski način zaznamujeta današnji napredek na področju izobraževanja, podprtega z računalništvom v oblaku.

V pretežnem delu konference so se odvijale delavnice, na katerih so se udeleženci najprej seznanili z dosežki štirih delovnih skupin v okviru projekta, nato pa s primeri inovativnih orodij, pristopov ter dobrih praks izobraževalne uporabe računalništva v oblaku. V skladu z značajem projekta in konference je bilo večkrat uporabljenih tudi nekaj spletnih orodij za glasovanje ali bolj kompleksno spletno podprto sodelovanje med udeleženci. Omenjena orodja so bila že preizkušena tudi v nekaterih šolah in so brezplačno dostopna na spletu. Morda bo kateremu od bralcev zanimiv *Mentimeter* (https://www.menti.com), namenjen spletno (»oblačno«) podprtemu glasovanju ali zbiranju idej s pomočjo naprav, ki omogočajo dostop do spleta, ali *Dotstorming* (https://dotstorming.com) in *Trello* (https://trello.com), namenjena spletno podprti uporabi metod skupinske razprave oziroma možganskega viharja.

Na konferenci so bile izpostavljene tri okoliščine, ki so vsaka na svoj način prispevale k uspešnosti izvedbe projekta. Za kakovost izvedbe projekta, uporabnost ter vplivnost njegovih rezultatov je bilo izrednega pomena sodelovanje raziskovalcev in učiteljev (z najrazličnejših strokovnih področij), učencev, »neizobraževalnih« ustanov, ki so povezane z izobraževanjem (iz Slovenije na primer NUK in Geodetski inštitut Slovenije), »upravljavcev« v izobraževanju (na primer ravnateljev šol, strokovnjakov in odločevalcev z ministrstev za izobraževanje) ter strokovnjakov s področja računalništva v oblaku. Drugo posebnost v primerjavi s podobnimi projekti predstavlja ustanova, ki je vodila projektno delo velike mednarodne mreže tako zelo raznovrstnih ustanov in organizacij. Te funkcije ni opravljala katera od sodelujočih visokošolskih organizacij ali izobraževalnih podjetij, temveč zasebna šola Doukas School iz Aten, ki že udejanja marsikatero zamisel iz projekta. Tretjo pomembno okoliščino je predstavljalo predhodno delovanje velike geografske mreže s področja izobraževalne uporabe informacijsko-komunikacijske tehnologije (člani mreže *digitalearth.eu*, v tesni zvezi z EUROGEO, tj. Evropsko zvezo geografov; v obeh smo dejavni tudi člani Oddelka za geografijo Filozofske fakultete Univerze v Ljubljani), ki je zasnovala ta projekt ter prispevala velik del partnerjev za njegovo izvedbo.

Številne vznemirljive poglede na prihodnost izobraževanja, ki so bili podani na konferenci, morda najbolje na kratko povzamemo takole. Računalništvo v oblaku omogoča oblike izobraževanja, ki doslej niso obstajale oziroma niso bile mogoče. Mitra se na podlagi lastnih raziskav celo sprašuje, ali lahko »samo-organizirano učno okolje« (SOLE, ang. *self-organized learning environment*), ki je ena izmed oblik izobraževanja, nadomesti šolo, kakršno poznamo danes. Skupina, ki se je v projektu usmerila v scenarije prihodnosti izobraževanja (v tej skupini je deloval tudi drugi avtor tega zapisa), predvideva vse večjo usmeritev v posamezniku prilagojeno učenje (ang. *personalized learning*), ki ob temeljiti podpori računalništva v oblaku spreminja paradigmo šolskega izobraževanja (Koutsopoulos, Kotsanis, 2014; Koutsopoulos, Sotiriou, 2015). Težko je bilo spregledati optimistično sporočilo konference, da računalništvo v oblaku prinaša izredno pomembno podporo in okoliščino za modernizacijo vseh ravni izobraževanja in obljubo, da bo projektna mreža v obstoječi ali nekoliko spremenjeni zasedbi nadaljevala s svojim raziskovalnim, didaktičnim in ozaveščevalnim poslanstvom.

Vsi dosedanji izdelki in ugotovitve so na voljo na sledečem spletnem naslovu: http://www.schoolonthecloud.net/outputs.

Zanimiv je tudi katalog spletnih orodij, aplikacij in platform za potrebe učiteljev: http://www.schoolonthecloud.net/outputs02.

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Blaž Repe in Marko Krevs

TRAJNOSTNI RAZVOJ OB REKI VIPAVI

Spomladi 2015 so predstavniki Alumni kluba geografov Univerze v Ljubljani, Komisije za hidrogeografijo Zveze geografov Slovenije in Občine Miren predstavili »Strokovne zasnove ureditve vodnega in obvodnega prostora ob reki Vipavi na območju občine Miren-Kostanjevica«. Dokument, ki je nastal na podlagi dveh delavnic z domačini ter terenskega druženja geografov, išče nove razvojne priložnosti ob vse bolj čisti Vipavi in nove možnosti za čezmejno sodelovanje. Predlog za nov pristop k razvoju območja je kmalu postal »vsevipavska« zgodba: trajnostni prostorski razvoj se ne načrtuje več izključno na območju posamezne občine, ampak v celotnem porečju Vipave, kar je poseben primer v Sloveniji.

Med strateškimi predlogi je bilo zapisano: »Razvojna prizadevanja za izrabo potencialov je potrebno razširiti z vključevanjem študentov različnih strok«. Geografi smo različne vidike trajnostnega prostorskega razvoja ob reki Vipavi vključili v redno pedagoško delo pri seminarjih in vajah tako na prvi kot drugi stopnji študija geografije v okviru predmetov Regionalni razvoj in regionalna politika, Metode in tehnike v regionalnem planiranju, Ekonomska geografija, Geoinformacijska podpora odločanju, Geoinformacijski modeli in scenariji, Razvojna neskladja na podeželju, Endogeni razvoj podeželja in Pokrajinska ekologija. Pri tem delu je sodelovalo 80 študentov ter 7 učiteljev. Končni rezultat procesa, ki je potekal v študijskem letu 2015/2016, je 12 različnih raziskovalnih nalog, veliko samostojnega dela, zbiranja virov in literature, obiskov na terenu in pogovorov z domačini, a se kljub mozaičnosti med seboj povezujejo v prizadevanjih za trajnostni prostorski razvoj ob reki Vipavi.

V sodelovanju z domačini so tako študentje poskušali odgovoriti na številna praktična vprašanja, povezana s trajnostnim prostorskim razvojem ob Vipavi. Kako izboljšali poplavno varnost? Katera območja ob reki Vipavi so primerna za razvoj rekreacije na vodi in ob vodi? Kje naj se trasirajo nove kolesarske poti? Kako vključiti zgodovinsko dediščino v razvoj novih turističnih produktov? Kako povezati lokalne proizvajalce in ponudnike različnih storitev? Kakšen pogled na razvoj ob reki Vipavi imajo domačini? Zanimalo nas je torej, kako upravljati s prostorom in upoštevati geografske prednosti in omejitve te slovenske pokrajine, pri čemer je v razvojnih pobudah vselej prisotna komponenta trajnostnega razvoja.

Pomemben del spoznavanja prostora in njegovega potenciala je bilo razumevanje pogleda domačinov na prihodnji razvoj ob reki Vipavi. S pomočjo odgovorov 161 anket se je izkazalo, da domačini kot največjo težavo v prostoru prepoznajo poplavljanje reke

Vipave, za razvoj območja pa kot pomembno prepoznajo trajnostno prometno infrastrukturo, kot so pešpoti in kolesarske steze ter izboljšanje javnega potniškega prometa.

Tako so študentje želeli prispevati k reševanju poplavne ogroženosti Mirna. Na podlagi izbranih kriterijev so preučili možnost za izgradnjo prekopa oziroma podzemnega kanala, ki bi del poplavnega toka reke Vipave preusmeril skozi Miren in tako zmanjšal škodo, ki jo v naselju povzročajo poplave. Kot najustreznejša rezultata analize so ovrednotili dve možnosti poteka kanala, severno in južno pot. Severna pot je krajša, a se obenem nekoliko bolj približa stavbam (do štiri metre), južna pot pa je občutno daljša, vendar je od obstoječih zgradb oddaljena vsaj deset metrov.

Glede dostopnosti in urejenosti reke Vipave v občini Miren Kostanjevica že nekaj časa velja, da reka z izgradnjo čistilnih naprav v celotnem porečju pridobiva na športnem, rekreacijskem in turističnem pomenu. Študenti so se v eni od raziskovalnih nalog lotili analize reke Vipave in njenega obrečnega pasu z vidika dostopnosti in urejenosti ter podali svoj pogled na potenciale in izzive za razvoj turistične in športnorekreacijske infrastrukture ob reki Vipavi.

Ključni rezultat je tematska karta, na kateri so prikazani naslednji elementi: dostopnost do struge, preoblikovanost struge, cestna dostopnost ter infrastruktura ob sami reki Vipavi. Poleg teh elementov pa so na karti označili še območja, katera so se jim po opravljeni analizi zdela najbolj primerna za razvoj turizma in športno-rekreativnih dejavnosti.

V modeliranju erozije prsti so študentje ugotovili, da večina površin občine ni ogrožena predvsem zaradi obširnih uravnanih delov površja, relativno majhnih naklonov in gozdnatosti. Z zmerno intenziteto se sooča 15 % površine občine; z močno, zelo močno ali ekstremno močno erozijo pa le 2,6 % površine občine. Moč erozije se občutno poveča ob odstranitvi rastlinske odeje, pri zbitosti prsti ali globokem oranju. Med manj ogrožene dele spada celotni ravninski del občine, z izjemo sadovnjakov, vinogradov in travnikov na Biljenskih gričih in na prehodu na kraško planoto.

Kot izziv na področju turistične infrastrukture so si študentje izbrali umeščanje kolesarskih poti s turistično namembnostjo. Na podlagi geoinformacijske podpore odločanju in večkriterijskega vrednotenja s pomočjo relevantnih kriterijev so poskušali ovrednotiti primernost območja Vipavske doline in njenega zaledja za umeščanje tras kolesarskih poti s turistično namembnostjo ter določiti najustreznejše trase, primerne za prostorsko umestitev novih kolesarskih poti. Osnovni cilj je bil zagotoviti trase kolesarskih poti, ki bi bile ustrezne z vidika prometne varnosti, katere bi v čim večji meri potekale po obstoječi, z motornim prometom manj obremenjeni cestni infrastrukturi, primerni za kolesarjenje. Le-te bi se čim bolj približale vodnim površinam oziroma turistično zanimivim lokacijam ter obstoječi gostinski in prenočitveni turistični ponudbi območja, hkrati pa naj bi bile trase načrtovane tudi z upoštevanjem varstvenih vidikov (zlasti varstva kakovostnih kmetijskih zemljišč ter varstva varovanih in zavarovanih območij narave in kulturne dediščine). Zasnovali so pet kolesarskih tras, ki glede na uporabljeno metodologijo in kriterije potekajo po najbolj optimalnih lokacijah za umeščanje kolesarskih poti, in sicer od Mirna do Vipave, od Mirna do Štanjela, od Štanjela do Vipave, od Mirna do Ajševice ter od Ajševice do Potoč.

Po večkratnih obiskih občine Miren-Kostanjevica, natančnem opazovanju, raziskovanju ter pogovoru s številnimi domačini, so študenti zaznali določene težave, s katerimi

se tamkajšnji prebivalci soočajo. Kot bistven problem občine Miren-Kostanjevica lahko izpostavimo njeno nepovezanost, kar se odraža na dveh ravneh. Občina se deli po naravnogeografskih značilnostih na dolinski flišni in vzpeti kraški del, med katerima močno primanjkuje sodelovanja. Na drugi strani ni povezanosti tudi med podjetniki, saj jih večina deluje individualno. Že sama občina ima obrobno geografsko lego. Kot obroben lahko označimo predvsem kraški del, ki ima precej slabe povezave z dolino in širšo okolico. Sooča se z odseljevanjem mladih, njegovi prebivalci pa se večkrat počutijo »odrezani od sveta«. Problematiko so prepoznali tudi v nerabi bogatih potencialov, kot so lokacija, okoljske danosti, reka, obmejnost in turizem, ki bi občini lahko predstavljali dodano vrednost.

Najpomembnejši potencial so prepoznali v povezovanju in sodelovanju znotraj lokalne skupnosti. Ugotovili so, da bi sodelovanje lahko potekalo na več ravneh (med podjetniki, kmetovalci, lokalnimi prebivalci, ustanovami) in med različnimi generacijami (vrtčevski otroci, šolarji, starostniki, delovno aktivno prebivalstvo), glede na obmejno lego občine pa tudi na meddržavni ravni. V okviru tega povezovanja obstaja tudi potencial za razvoj alternativnih oblik podjetništva – na primer za vzpostavitev podjetja, ki ga vodi lokalna skupnost. Pomemben potencial so prepoznali tudi v rabi drugih lokalnih virov: bližine reke, privlačnega naravnega okolja, razgibanega reliefa, zgodovine, bogate naravne in kulturne dediščine, dolge tradicije sadjarstva in vinogradništva ter kulinarike.

Nadalje so študenti predlagali, da znotraj podjetja, ki ga upravlja lokalna skupnost, ustanovijo lokalno blagovno znamko RIMiren, ki bi povezala lokalno ponudbo, znanje in ideje prebivalcev občine in zaledja ter hkrati dala rimski dediščini novo komponento. Z novo znamko RIMiren želijo v ospredje postaviti tematsko gostinsko ponudbo, ki bo vključevala predvsem izdelke lokalnih ponudnikov. Ta ponudba bi prišla do izraza v dveh dogodkih, ki bi se lahko odvijala v občini. Prvi bi potekal v spomladanskem času in bi bil vezan na otvoritev sezone ribolova v začetku aprila (glavna tema ribe). Konec novembra bi na vrsto prišel drugi del rimskih dni, ki bi tematsko temeljil na vinu.

Raziskovanje razvojnih možnosti in endogenih potencialov občine Miren-Kostanjevica je pokazalo vso paleto možnosti trajnostnega razvoja, a nakazalo tudi pomanjkljivosti, ki so krive, da del teh potencialov ni bil izkoriščen že prej. Z vključevanjem študentov v konkretne projekte na lokalni ravni pa smo na Oddelku za geografijo Filozofske fakultete Univerze v Ljubljani nadaljevali s prizadevanji povezovanja študijskih dejavnosti s prakso, ki jih poskušamo vpeljati v kar največji možni meri in tako dati geografiji aplikativno vrednost, kar mladim geografom bistveno poveča konkurenčnost na trgu delovne sile.

Matej Ogrin

NAVODILA AVTORJEM ZA PRIPRAVO PRISPEVKOV V ZNANSTVENI REVIJI DELA

1. Znanstvena revija DELA je periodična publikacija Oddelka za geografijo Filozofske fakultete Univerze v Ljubljani. Izhajajo od leta 1985. Namenjena so predstavitvi znanstvenih in strokovnih dosežkov z vseh področij geografije in sorodnih strok. Od leta 2000 izhajajo dvakrat letno v tiskani in elektronski obliki (http://revije.ff.uni-lj.si/Dela). Revija je uvrščena v mednarodne baze (Scopus, CGP – Current Geographical Publications, GEOBASE, Central and Eastern European Academic Source, GeoRef, Russian Academy of Sciences Bibliographies, TOC Premier, International Bibliography of the Social Sciences, DOAJ, ERIH PLUS) in ima mednarodni uredniški odbor.
2. V prvem delu so objavljeni znanstveni (1.01 in 1.02 po kategorizaciji COBISS) in strokovni članki (1.04). V drugem delu se objavljajo informativni prispevki v rubriki POROČILA, in sicer biografski prispevki (obletnice, nekrologi), predstavitve geografskih monografij in revij, pomembnejše geografske prireditve in drugi dogodki idr.
3. Znanstveni in strokovni članki so lahko objavljeni v treh jezikovnih različicah: dvojezično slovensko-angleško, samo v slovenskem jeziku, samo v angleškem jeziku. Prispevki morajo imeti naslednje sestavine:
   - naslov članka;
   - ime in priimek avtorja/avtorjev;
   - avtorjev akademski naziv (npr. dr., mag., prof. geog. in zgod.);
   - avtorjev poštni naslov (npr. Oddelek za geografijo Filozofske fakultete Univerze v Ljubljani, Aškerčeva cesta 2, SI-1000 Ljubljana);
   - avtorjev elektronski naslov;
   - izvleček (skupaj s presledki do 500 znakov);
   - ključne besede (do 8 besed);
   - besedilo članka (skupaj s presledki do 30.000 znakov; v primeru daljših prispevkov naj se avtor predhodno posvetuje z urednikom);
   - v primeru enojezičnih člankov tudi povzetek/summary v drugem jeziku (skupaj s presledki od 5000 do 8000 znakov) ter prevod izvlečka in ključnih besed v drugi jezik;
   - ime prevajalca.
4. Članek naj ima naslove poglavij in naslove podpoglavij, označene z arabskimi številkami v obliki desetiške klasifikacije (npr. 1 Uvod, 2 Metode, 3 Rezultati in razprava, 4 Sklep, Literatura in viri ipd.). Razdelitev članka na poglavja je obvezna, podpoglavja naj avtor uporabi le izjemoma.
5. Avtorji naj prispevke pošljejo v digitalni obliki v formatih *.doc ali *.docx. Digitalni zapis besedila naj bo povsem enostaven, brez slogov in drugega zapletenega oblikovanja, brez deljenja besed, podčrtavanja in podobnega. Avtorji naj označijo le krepki in ležeči tisk. Besedilo naj bo v celoti izpisano z malimi tiskanimi črkami

(velja tudi za naslove in podnaslove, razen velikih začetnic), brez nepotrebnih krajšav, okrajšav in kratic.

6. Zemljevidi in druge grafične priloge morajo upoštevati format revije. Če so celostranske, morajo biti velikosti 125 x 170 mm, če so manjše, pa jih omejuje njihova širina – največja dovoljena širina je 125 mm. Črke pri besedilu ne smejo biti manjše od 6 pt. Vse grafične priloge morajo biti oddane kot samostojne datoteke (ne v datoteki z besedilom!), in sicer v rastrskem formatu (npr. *.tiff ali *.jpg) z ločljivostjo najmanj 300 pik na palec (dpi). Grafikoni morajo biti izdelani s programom *Excel* ali sorodnim programom (avtorji jih oddajo skupaj s podatki v izvorni datoteki, npr. Excelovi preglednici). Če avtorji ne morejo oddati prispevkov in grafičnih prilog v navedenih oblikah, naj se predhodno posvetujejo z urednikom. Za grafične priloge, za katere avtorji nimajo avtorskih pravic, morajo priložiti fotokopijo dovoljenja za objavo, ki so ga pridobili od lastnika avtorskih pravic.
7. Avtorji so dolžni upoštevati način citiranja v članku ter oblikovanje seznama virov in literature, preglednic in ostalega grafičnega gradiva, kot je to navedeno v podrobnejših navodilih za pripravo člankov na povezavi http://revije.ff.uni-lj.si/Dela/about/submissions#authorGuidelines. Za dela, ki jih je avtor uporabil v elektronski obliki, naj poleg bibliografskih podatkov navede še elektronski naslov, na katerem je delo dostopno bralcem, in datum citiranja. Za znanstvene članke s številko DOI avtorji navedejo samo DOI številko.
8. Znanstveni in strokovni članki bodo recenzirani. Recenzentski postopek je praviloma anonimen, opravita ga dva kompetentna recenzenta, in sicer člani uredniškega odbora ali ustrezni strokovnjaki zunaj uredniškega odbora. Recenzenta prejmeta članek brez navedbe avtorja članka, avtor članka pa prejme recenzentove pripombe brez navedbe recenzentovega imena. Če recenziji ne zahtevata popravka ali dopolnitve članka, se avtorju članka recenzij ne pošlje. Uredniški odbor lahko na predlog recenzentov zavrne objavo prispevka.
9. Avtorji, ki želijo, da se njihov članek objavi v reviji, se strinjajo z naslednjimi pogoji:
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