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Evaluation of landfill sites on Pašman Island and islanders' perceptions regarding waste management issues

Evaluacija odlagališta otpada na otoku Pašmanu i percepcija otočana o problemima gospodarenja otpadom

Islands and coastal regions are experiencing significant impact from sea-borne litter, and this issue also affects the Croatian islands, including Pašman Island. A comprehensive research approach has been adopted to assess the landfill sites on the island, which involves applying an integral list of indicators to existing landfills. Indicators have been connected to statistical data, and in the last phase of the research the perception of the islanders towards waste management was examined.

The research done in 2018 involved accessing 32 solid litter sites, including 10 located on the coastline and 22 inland, with particular attention given to the composition of the waste. Results revealed that plastic litter was more prevalent in coastal sites (55%) than in inland sites (20.9%). Although the local government reported no landfills on the island in February 2021, islanders disputed this claim and confirmed the presence of solid waste disposal sites. A qualitative research study conducted in January 2022 indicated that waste management has recently improved. The data collected from the fieldwork has informed a proposal for future waste management measures in isolated, inhabited coastal areas.

Key words: sea litter, indicators list, waste management, residents' perception, Pašman Island, Croatia

Otoci i obalne regije pod snažnim su utjecajem morskoga otpada koji stvara probleme i na hrvatskim otocima, uključujući otok Pašman. Stoga je provedeno opsežno istraživanje u okviru kojega su locirana odlagališta otpada diljem otoka te je primijenjen sveobuhvatni popis pokazatelja kojima su evaluirane pojedine lokacije. Pokazatelji su povezani i sa statističkim pokazateljima te se istražila i percepcija otočana o problemu gospodarenja otpadom, što je dio društveno-geografskoga pristupa proučavanju.

U 2018. godini istraživanjem su obuhvaćene 32 lokacije krupnoga otpada, od čega 10 lokacija na obali, a 22 u unutrašnjosti otoka te je posebna pozornost posvećena sastavu morskoga otpada. Rezultati istraživanja pokazali su da je plastični otpad najzastupljeniji na obalnim naslagama (55 %), dok je u unutrašnjosti otoka bio nešto manje zastupljen (20,9 %). Premda na otoku prema podatcima lokalne samouprave u veljači 2021. godine nije bilo divljih odlagališta, otočani su naveli da na otoku ipak postoje lokacije s divljim odlagalištima otpada. Rezultati kvalitativnoga istraživanja provedenog u siječnju 2022. godine upućuju na novije poboljšanje situacije glede gospodarenja otpadom. Podatci prikupljeni tijekom terenskoga istraživanja omogućili su i oblikovanje prijedloga budućih mjera u gospodarenju otpadom u izoliranim obalnim područjima.

Ključne riječi: morski otpad, popis pokazatelja, gospodarenje otpadom, percepcija otočana, otok Pašman, Hrvatska

Introduction

Solid waste management was one of the most important environmental issues within the European Commission's European Green Deal (2019). In the coastal regions, special attention has also been given to the seaborne litter which is affecting the ecosystems of all oceans and seas becoming one of the biggest global environmental threats (Beaumont et al., 2019; Serra-Goncalves et al., 2019). The 1970s saw the first reports of plastic pollution in the ocean but overall quantity present in the oceans is still unknown and it can only be estimated (Eriksen et al., 2014; Jambeck et al., 2015). A large portion of the litterin the seas ends up on the sea floor which is the world's least explored ecosystem (Chiba et al., 2018; Canals et al., 2021). The assessment of different litter types that can be found in the sea often requires specific approaches (Canals et al., 2021). While it is difficult to analyze the sea floor litter, especially in the deepest areas, it is much easier to access the sea litter that has been washed out to the shores. The recent studies which included the analyses of marine litter on the Mediterranean beaches showed that a large quantity of the litter originates from coastal activities and it is often linked to incorrect disposal on the mainland (Vlachogianni, 2019; Scotti et al., 2021). So, in order to better understand the problem of sea litter pollution of the oceans, a good starting point in environmental research is the analysis of litter in coastal deposits. After finding out where the litter comes from, how much of it is present in the sea or on the shore, and what the effects of human pressure on the marine and coastal environments are, we will be able to adopt appropriate preservation measures. According to some estimates, nearly 80% of the litter in the seas is generated by land-based activities (EC JRC, 2013).

An important issue in waste management is the perception of the local population toward it, because their collaboration in waste collection and management is partly based on understanding their views toward the importance of waste sorting and generally on waste disposal practices (Al-Khatib et al., 2015; De Gisi et al., 2017). In

Uvod

Gospodarenje krupnim otpadom jedno je od najvažnijih okolišnih pitanja unutar Europskoga zelenog plana Europske komisije (2019.). U obalnim je regijama posebna pozornost posvećena utjecaju morskoga otpada na ekosustave oceana i mora jer je morski otpad postao jedna od najvećih prijetnji okolišu (Beaumont i dr., 2019; Serra-Goncalves i dr., 2019). Još od 1970-ih datiraju prva izvješća o plastičnom otpadu u oceanima, no ukupna količina prisutna u svjetskim morima i oceanima je još uvijek nepoznata i jedino se može procijeniti (Eriksen i dr., 2014; Jambeck et al., 2015). Znatan dio otpada završava na morskom dnu koje spada u najslabije istražene ekosustave (Chiba i dr., 2018; Canals i dr., 2021), a procjena različitih vrsta toga otpada često zahtijeva specifične pristupe istraživanju (Canals i dr., 2021). Dok je teško analizirati otpad na dnu mora, posebice u njegovim najdubljim dijelovima, puno je lakše pristupiti morskom otpadu koji morski valovi izbacuju na obale. Novija istraživanja, koja su uključivala i analizu morskoga otpada na plažama Sredozemnoga mora, pokazala su da znatan dio otpada dolazi od obalnih aktivnosti i često stiže do obale zbog loše prakse odlaganja otpada na kopnu (Vlachogianni, 2019; Scotti i dr., 2021). Stoga, da bi se bolje razumio problem onečišćenja morskim otpadom, izvrsna je polazna točka za istraživanje okoliša analiza otpada deponiranog na obalama. Nakon što se utvrdi odakle je otpad došao, koliko je prisutan u morskom okolišu ili na obalama i koje su posljedice ljudskoga pritiska na morski i obalni okoliš, moći ćemo ih bolje sačuvati. Prema nekim procjenama gotovo 80 % otpada generiraju aktivnosti s kopna (EC JRC, 2013).

Važno je pitanje u gospodarenju otpadom percepcija lokalnoga stanovništva o toj temi s obzirom na to da je njihova suradnja u prikupljanju otpada i njegovu gospodarenju dijelom temeljena na razumijevanju njihovih pogleda na važnost odvajanja otpada i općenito na njihove prakse kod odlaganja otpada (Al-Khatib i dr., 2015; De Gisi i dr., 2017). U malim zatvorenim otočnim zajednicama koje imaju ograničene mogućnosti uobičajenoga (urbanog) gospodarenja otpadom

small, closed island communities with limited (urban) waste management systems it is crucial to educate the local population on waste sorting and recycling. A recent large-scale European public survey which focused completely on sea litter, showed that people are aware that it is a huge environmental problem today (as opposed to something that will be a problem "one day"). They also recognized that it does not negatively affect only coastal communities (Hartley, 2018). Even though people are aware of the waste problem, perceptions of marine environments are heterogeneous across various societal structures and they vary by country, region, and also by demographic variables such as age and gender (Jefferson et al., 2014; Potts et al., 2016). Another study performed among island fishing communities showed that even local communities in developing countries are fully aware of the environmental problems, including the presence of sea litter (Ferreira et al., 2021).

Island environments are particularly vulnerable to the impact of sea litter because they often depend on imported goods and they may lack proper waste management infrastructure (Ambrose et al., 2019). This is why the waste can end up being disposed of in the environment, including the surrounding sea. As global waste (particularly plastic) production continues to increase exponentially, it will further impact the natural beauty and biodiversity for which remote islands in particular have been recognized (Deschenes and Chertow, 2004; Lavers et al., 2013; 2017; Law et al., 2010; Eckelman et al., 2014).

After accession to the EU in 2013, a new law on the waste management in Croatia was adopted in order to meet EU standards and waste management goals. The recommendations of the European Green Deal (2019) highlighted as priorities within the Action Plan: 1) using resources more efficiently by moving towards a clean, circular economy, 2) restoring biodiversity, and 3) reducing pollution. However, the determined goals have not been achieved and the problem of sea litter accumulated along the shore has not been solved (Runko Luttenberger, 2020).

posebno je važno educirati lokalno stanovništvo o načinima odvajanja i recikliranja otpada. Novije istraživanje javnoga mnijenja provedeno na većem uzorku među europskom populacijom, koje je u potpunosti bilo usmjereno na morski otpad, pokazalo je da su ljudi svjesni da se radi o golemom problemu u okolišu koji je trenutno prisutan, a ne o nečemu što će iskusiti tek u budućnosti. Također su prepoznali da taj problem ne utječe negativno samo na obalne zajednice (Hartley, 2018). Premda su ljudi svjesni problema s otpadom, percepcije su morskoga okoliša heterogene unutar različitih društvenih struktura te variraju s obzirom na zemlju, regiju iz koje dolaze ispitanici, ali i s obzirom na demografske varijable poput dobi i spola (Jefferson i dr., 2014.; Potts i dr., 2016). Drugo istraživanje provedeno među otočnim ribarima pokazalo je da su i lokalne zajednice u zemljama u razvoju u potpunosti svjesne okolišnih problema, uključujući i onaj vezan uz prisutstvo morskoga otpada (Ferreira i dr., 2021).

Okoliš na otocima posebno je osjetljiv na utjecaj morskoga otpada jer otoci često ovise o uvoznoj robi te im nedostaje infrastruktura potrebna za gospodarenje otpadom (Ambrose i dr., 2019). Zbog toga otpad može završiti deponiran u okoliš, uključujući i onaj okolni, morski. Budući da globalna proizvodnja otpada (posebno plastike) eksponencijalno raste, u budućnosti će otpad itekako utjecati na izuzetne prirodne ljepote i bioraznolikost po kojima su nadaleko poznati posebno udaljeni otoci (Deschenes and Chertow, 2004; Lavers i dr., 2013; 2017; Law i dr., 2010; Eckelman i dr., 2014).

Nakon pridruživanja Europskoj uniji 2013. godine da bi se dosegli europski standardi i postigli ciljevi određeni glede gospodarenja otpadom, u Hrvatskoj je usvojen Zakon o gospodarenju otpadom. U preporukama Europskoga zelenog plana (2019) među prioritetima u Akcijskom planu posebno je istaknuto: 1) učinkovitije korištenje resursa prelaskom na čisto, kružno gospodarstvo, 2) obnova bioraznolikosti, 3) smanjenje onečišćenja i zagađenja. Međutim, utvrđeni ciljevi još uvijek nisu postignuti, a problem morskoga otpada akumuliranog na obalama još uvijek nije riješen (Runko Luttenberger, 2020).

According to global classifications Croatian islands are near islands that are well-connected with the mainland and inevitably influenced by it (Royle, 2020; Turner, 2020). Accordingly, they have been struggling with the problems of waste disposal and sea litter for a long time. Sea litter disposal in former Yugoslavia was one of the topics presented in 1973, at the 2nd International Congress of Marine Pollution and Marine Waste Disposal in San Remo (De Fraja Frangipane et al., 1975). To intensify the proactive approaches toward better environmental protection of islands along the Adriatic coast, proper guidelines for sustainable waste management are required, particularly in the absence of appropriate domestic and tourist attitudes toward marine ecosystems (National Research Council. 1995; Sustaining Large Marine Ecosystems, 2005; Benguela: Predicting a Large Marine Ecosystem, 2006; Ribic at al., 2010; Ecosystem Services, 2013).

Most of Croatian islands are demographically deprived areas, due to depopulation and aging, but they are also subject to extreme seasonal (summer) pressure from tourism. Mass tourism may have detrimental effects on the water supply, sensitive coastal landscapes, socio-cultural identity, and other factors (Gormsen, 1997; Ministry of Development and Reconstruction, 1997; Atik, 2010; Islands Act, 1999; 2006; 2018). Since the issue of sea litter disposal has been rather neglected, the analysis of onshore landfill sites has been set as the main aim: qualitative and quantitative investigation, and comparison to inland waste management best practices.

Incorporating public perceptions is an important part of the ecosystem approach because it influences further sustainable practices in waste management (CBD, 2014). Therefore the following objectives of the qualitative research were to: 1) discover what the attitude of local's was toward waste management and the willingness to actively be involved in this issue; 2) examine the perception of the locals towards changes in waste management over the last few decades; and 3) examine the perception of locals about the main problems island still faces related to waste disposal and their knowledge regarding illegal landfills and sea litter locations on/around the island.

Premda su temeljem svjetske klasifikacije hrvatski otoci tzv. bliži otoci (*near islands*), uz to i dobro povezani sa susjednim kopnom koje na njih ima značajan utjecaj (Royle, 2020; Turner, 2020), već se dugo bore s odlaganjem otpada i morskim otpadom. Jedna od tema prezentiranih još 1973. godine na 2. međunarodnom kongresu o morskom onečišćenju i morskom otpadu u San Remu bila je vezana uz problem morskoga otpada u bivšoj Jugoslaviji (De Fraja Frangipane i dr., 1975). Da bi se pojačao proaktivan pristup boljoj zaštiti okoliša na otocima duž jadranske obale, potrebne su odgovarajuće smjernice, posebice zbog odsutnosti odgovarajućega ponašanja domaćih i inozemnih turista prema morskim ekosustavima (National Research Council, 1995; Sustaining Large Marine Ecosystems, 2005; Benguela: Predicting a Large Marine Ecosystem, 2006; Ribic i dr., 2010; Ecosystem Services 2013).

Većina hrvatskih otoka spada u demografski ugrožena područja, i to zbog depopulacije i starenja. Uz to, otoci su i prostori u kojima je izražen ekstremni sezonalni pritisak koji je posljedica turizma. Masovni turizam može imati nepovoljan utjecaj na opskrbu vodom, na osjetljiv obalni krajolik, društveni i kulturni identitet i dr. (Gormsen, 1997; Ministry of Development and Reconstruction, 1997; Atik, 2010; Islands Act, 1999; 2006; 2018). Budući da je problem gomilanja morskoga otpada dosta zanemaren, analiza lokacija otpada jedan je od glavnih ciljeva istraživanja: kvalitativna i kvantitativna analiza i usporedba te vrste otpada s onim u unutrašnjosti otoka.

Uključivanje javne percepcije također je važan dio ekosustavnoga pristupa jer utječe na daljnje održive prakse u gospodarenju otpadom (CBD, 2014). Stoga su ciljevi kvalitativnoga istraživanja bili sljedeći: 1) utvrditi kakav je stav lokalnoga stanovništva prema gospodarenju otpadom i jesu li voljni aktivno se uključiti u tu problematiku; 2) istražiti percepciju lokalnoga stanovništva o promjenama u gospodarenju otpadom posljednjih desetljeća i 3) istražiti percepciju otočana o problemima vezanim za odlaganje otpada s kojima se otok još uvijek suočava i njihovo poznavanje lokacija divljih odlagališta i morskoga otpada na otoku.

The study area

Pašman Island is situated in Zadar County, in the central part of the Croatian Adriatic. It covers an area of 60.11 km² and has a 70.2 km long coastline (Duplančić Leder et al., 2004). It is divided into two municipalities (Fig. 1), Pašman and Tkon, and has 10 settlements mostly situated on the northeastern shores facing the mainland. Pašman Municipality is the larger of the two, situated on the northwestern part of the island and includes eight settlements, the largest is Ždrelac (397 inhabitants in 2021) (CBS, 2022). Tkon Municipality is situated in the southeastern part of the island and includes the largest settlement on the island, Tkon (662 inhabitants in 2021) (CBS, 2022). Pašman has a relatively low (permanent) population density; it has mostly rural settlements and no developed industry. Thus, most of the waste produced on the island comes from households.

In order to determine the human impact on the waste production on the island, a set of features presented in three groups has been proposed. This should enable a more comprehensive understanding of the study area and socio-economic drivers that have influenced the environment, especially the waste management system and waste footprint. The features were selected according to their type (e.g. environmental, economic, social), duration (e.g. year, frequency), quantity (e.g. amount, total income), and data availability (Tab. 1). The data on tourism is also considered valuable for the waste management interpretation.

According to the 2021 Census, there are 2,884 people living on the island. The largest population level was recorded in 1948 (4310), and since then most of island settlements have been facing negative demographic processes such as deruralization, depopulation, emigration, and aging (CBS, 2021, 2022). In the second half of the 20th century, tourism started developing more intensively, and it stimulated the trend of building second homes and apartment buildings that are often used only during the summer season. In 2019, there were 31,192 tourist arrivals and 273,542 overnight stays recorded on the island, mostly during the summer season (CBS, 2019). Tourism increases pressure on the en-

Područje Istraživanja

Otok Pašman smješten je u Zadarskoj županiji, na središnjem dijelu hrvatskoga Jadrana. Ima površinu od 60,11 km², a duljina obalne linije mu je 70,2 km (Duplančić Leder i dr., 2004). Otok je podijeljen u dvije općine (sl. 1) – Pašman i Tkon te ima 10 naselja uglavnom smještenih na SI obali, okrenutih prema kopnu. Općina Pašman površinom je veća i nalazi se na SZ dijelu otoka te uključuje osam naselja među kojima je najveći Ždrelac (397 stanovnika 2021. godine) (DZS, 2022). Općina Tkon obuhvaća JI dio otoka i u njoj se nalazi i najveće otočno naselje Tkon (662 stanovnika 2021) (DZS, 2022). Otok Pašman ima razmjerno nisku gustoću naseljenosti (stalnoga stanovništva); ima pretežito ruralna naselja te nema razvijenu industriju. Stoga većina otpada proizvedenog na otoku dolazi iz otočnih kućanstava.

Da bi se utvrdio ljudski utjecaj na proizvodnju otpada na otoku, pokazatelji su prezentirani u tri predložene skupine. To je omogućilo opsežnije razumijevanje područja istraživanja i društveno-gospodarskih pokretača koji su utjecali na okoliš, posebice na sustav gospodarenja otpadom i ekološki otisak morskoga otpada. Pokazatelji su odabrani s obzirom na vrstu (npr. okolišni, gospodarski, društveni), vrijeme (npr. godina, frekvencija pojave), količinu (npr. količina , ukupan prihod) i dostupnost podataka (tab. 1). Podatci o turizmu također su smatrani vrijednima za interpretaciju problema gospodarenja otpadom.

Prema podatcima Popisa stanovništva 2021. godine na otoku su živjela 2884 stanovnika. Najveći je broj otočana zabilježen 1948. godine (4310), nakon čega se većina otočnih naselja suočava s negativnim demografskim procesima poput deruralizacije, depopulacije, emigracije i starenja (DZS, 2021). Turizam se značajnije počeo razvijati u drugoj polovini 20. stoljeća te je potaknuo trend gradnje kuća za odmor i rekreaciju koje su najčešće korištene samo u ljetno doba godine. U 2019. godini na otoku se bilježi 31.192 turistička dolaska koji su ostvarili 273.542 noćenja, pretežito za vrijeme ljetne sezone (DZS, 2019). Turizam povećava pritisak na okoliš i može ima-

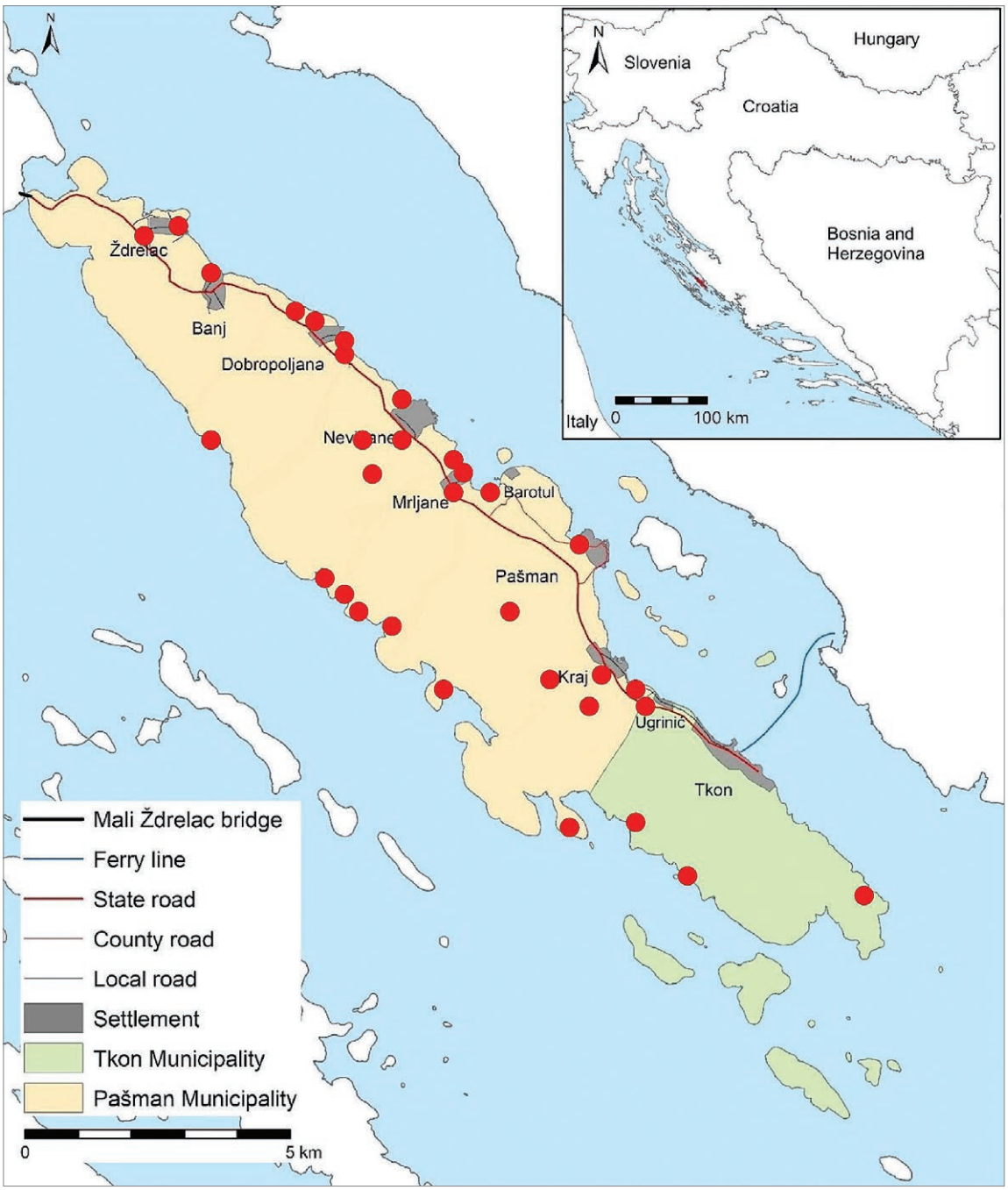

Fig. 1 Geographic position of the study area and landfill sites (marked in red)
Sl. 1. Geografski položaj istraživanoga područja i mjesta deponiranoga otpada (crvene točke)

Source: SGA (2016)
Izvor: DGU (2016)

vironment and can have a major impact on local infrastructure (Pirani and Arafat, 2014; Runko Luttenberger, 2020; Zovko et al., 2021). On northern Dalmatian islands, including Pašman, tourism has

ti velik utjecaj na lokalnu infrastrukturu (Pirani, Arafat, 2014; Runko Luttenberger, 2020; Zovko i dr., 2021). Na sjevernodalmatinskim otocima, uključujući Pašman, turizam je postao jedna od

Tab. 1 Selected features presenting the natural and socio-economic setting of Pašman Island
Tab. 1. Odabrani pokazatelji koji prikazuju prirodno i društveno-gospodarsko okruženje otoka Pašmana

	Općina Pašman / Pašman Municipality	**Općina Tkon** / Tkon Municipality
Okolišni / Environmental Area		
Area (in km²) / Površina (u km2)	48.3 km²	15.1 km²
Share of second homes and apartments rented to tourists in total dwellings (Census 2011) / Udio stanova za odmor i rekreaciju i stanova za najam turistima u ukupnom broju stanova (Popis 2011.)	55.1%	49.0%
Share of dwellings used as permanent habitations (Census 2011) / Udio stanova korištenih za stalno stanovanje (Popis 2011.)	41.9%	36.8%
Broj javnih akcija čišćenja otpada godišnje / Number of public cleaning campaigns/year	0	0
Broj ilegalnih odlagališta / Number of illegal landfills	0	0
Possibility of a municipal landfill / Mogućnost postojanja komunalnog odlagališta	Waste is transported to the mainland / Otpad se odvozi na kopno	Waste is transported to the mainland / Otpad se odvozi na kopno
Number of collections of bulk waste per year / Broj odvoza krupnog otpada godišnje	1	2
Frequency of municipal waste collection (during winter/summer per week) / Učestalost prikupljanja otpada (zimi/ljeti tjedno)	2/3	2/3
Hazardous waste management system / Gospodarenje opasnim otpadom	YES / DA	YES / DA
Separate collection of municipal waste (eco-islands) / Odvojeno prikupljanje komunalnog otpada (ekootoci)	YES / DA	YES / DA
Presence of waste collection centers / Postojanje centara za prikupljanje otpada	YES / DA	YES / DA
Economic / Gospodarski		
Total number of tourists (2019) / Ukupan broj turističkih dolazaka (2019.)	21,102	10,090
Intensity of total tourist traffic (tourist number/population number × 100) / Intenzitet ukupnoga turističkog prometa (broj dolazaka/broj stanovnika x 100)	910.7	1245.7
Index of tourism development (Institute of Tourism, 2019) / Indeks turističkog razvoja (Institut za turizam, 2019.)	25.4	16.9
Social* / Društveni		
Population (2021) / Broj stanovnika (2021.)	2,136	748
Population change (2011–2021) / Promjena broja stanovnika (2011. – 2021.)	+2.6%	-2.0%
Population density (inhabitant/km²) / Gustoća naseljenosti (broj stanovnika/km2)	44.2	49.5
Aging index (2011) Indeks starenja (2011.)	236.4	109.5
Share of elderly in total population (2011) / Udio starog stanovništva u ukupnom (2011.)	26.8%	18.1%

*Social features are mostly available only for 2011. Up to February 2022, the Croatian Statistical Bureau had released the new Census results only for several features: total population number and total dwellings.
*Društveni pokazatelji uglavnom su dostupni za 2011. godinu. Do veljače 2022. Državni zavod za statistiku objavio je samo nekoliko podataka s Popisa 2021. godine: ukupan broj stanovnika i ukupan broj stanova.

Sources: Data set on environmental features, Tkon Municipality, Pašman Municipality, Orlić d.o.o., Čistoća d.o.o.: Jan and Feb 2022, Personal Communication; Bronić et al., 2021; CBS, 2011a, 2011b, 2011c, 2022, 2021, 2019, 2012.
Izvori: Okolišni podatci: Općina Tkon, Općina Pašman, Orlić d.o.o., Čistoća d.o.o.: siječanj, veljača 2022., osobna komunikacija; Bronić i dr., 2021; DZS, 2011a, 2011b, 2011c, 2022., 2021., 2019., 2012.

become one of the most important economic activities, generating profit for the local community but also influencing the island landscape and causing environmental issues (Faričić, 2012). Waste generated from the tourism activities can much more easily be controlled and collected on the mainland than on the sea or the inaccessible shoreline. Therefore, the sea litter all over the shoreline can become a bigger environmental issue, as opposed to solid waste dumped into illegal disposal sites. Pašman is on an important nautical route and is an important fishing area, so sea traffic in Pašman Canal and southward to Kornati National Park is very intense, especially during the summer season. In addition to tourism, local people are mostly employed in various services. However, the economic structure of the population is similar to other mostly rural island settlements (CBS, 2012). The share of economically inactive people is over 50% in both island municipalities, which corresponds with processes of aging and emigration of the younger population (CBS, 2012). 2011 Census data shows that the share of islanders employed in primary activities, mostly fishery and agriculture, is relatively high (17.6%) but most of the employed persons work in tertiary and quaternary sector activities (63.9%) (CBS, 2011).

METHODOLOGY AND DATA

This study employed a combination of quantitative and qualitative research methods, including descriptive statistics, field surveys, field data analyses, and photo documentation (Fig. 2).

In the first phase of the research, statistical data on population, economy, environment, and waste collection from various sources, including the Croatian Bureau of Statistics, local government, and local utility services, were presented to provide an initial understanding of the socio-geographic features and their trends in relation to the environmental issues in the study area. The statistical data was also used to examine the current waste management system.

To investigate the waste issue on Pašman, we conducted a systematic in-situ observation via field surveys. We divided the island into two re-

najvažnijih gospodarskih djelatnosti koja generira zaradu lokalnoj zajednici, ali istovremeno utječe na otočni krajolik i dovodi do problema u okolišu (Faričić, 2012). Otpad koji nastaje od turističkih djelatnosti može se lakše kontrolirati i prikupljati na kopnu nego na moru ili na nepristupačnoj obali. Stoga, morski otpad duž cijele obale može postati veći okolišni problem nego čvrsti otpad deponiran na ilegalna odlagališta. Pašman se nalazi na važnoj nautičkoj ruti i ribolovnom području pa je pomorski promet u Pašmanskom kanalu i dalje prema NP Kornati vrlo intenzivan, posebice u vrijeme ljetne sezone. Osim u turizmu lokalno stanovništvo najviše se zapošljava u ostalim uslužnim djelatnostima te je gospodarska struktura stanovništva slična ostalim, pretežito ruralnim, otočnim naseljima (DZS, 2012). Udio je ekonomski neaktivna stanovništva preko 50 % u objema otočnim općinama, što je u skladu s procesima starenja stanovništva i emigracijom mlađe populacije (DZS, 2012). Prema podatcima Popisa 2011. godine, udio otočana zaposlenih u primarnim djelatnostima, uglavnom ribarstvu i poljoprivredi, bio je razmjerno visok (17,6 %), no većina zaposlenih osoba radila je u tercijarnim i kvartarnim djelatnostima (63,9 %) (DZS, 2011).

METODOLOGIJA I PODATCI

Za potrebe rada kombinirano je nekoliko metoda u okviru kvantitativnoga i kvalitativnoga istraživanja: deskriptivna statistika, terensko istraživanje, analiza podataka prikupljenih terenskim istraživanjem i fotodokumentacija (sl. 2).

U prvoj fazi istraživanja prikazani su statistički pokazatelji Državnog zavoda za statistiku, lokalne samouprave i komunalnih društava o stanovništvu, gospodarstvu, okolišu i prikupljanju otpada. Ti su podatci primarno omogućili razumijevanje društveno-gospodarskih obilježja prostora i trendova povezanih uz okolišne probleme istraživanoga područja. Statistički su pokazatelji također korišteni kao uvod u poznavanje trenutnoga sustava gospodarenja otpadom.

Da bi se istražio problem odlaganja otpada na otoku, provedeno je sveobuhvatno *in situ* terensko istraživanje gdje su analizirana odlagališta otpada.

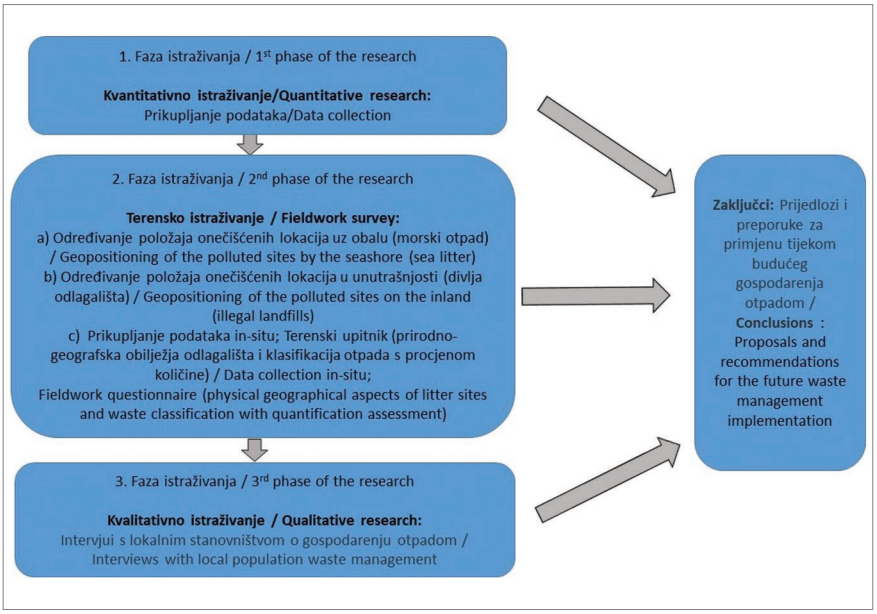

Fig. 2 Flowchart of the integral geographical approach to advanced waste management on Pašman

Sl. 2. Shematski prikaz integralnoga geografskog pristupa istraživanju gospodarenja otpadom na otoku Pašmanu

Source: According to the research process

Izvor: Prema rezultatima istraživanja

search areas based on the location of the waste source (waste washed ashore or waste dumped in-situ by people) and management: a) island shores and b) the island's interior. Via fieldwork, we identified 32 solid waste sites, with 10 located on the coast and 22 in the interior (Fig. 1). Our observations provided valuable insights into the differences between the coastal and inland parts of the island with regards to waste accumulation and management.

To assess the state of the environment surveyed and landscape characteristics or processes in progress, we created an original list of survey indicators. This list is recommended as a valuable tool for environmental research and monitoring, according to the example of the European Environmental Agency (EEA, 2005) which uses the DPSIR framework (driving forces-pressures-state-impact-responses) to identify crucial environmental problems. Our survey indicators were established based on the concept of natural settings-population-waste/location characteristics-measures (suggested). We prepared the survey indicators list in accordance with a previous study conducted on the Kornati archipelago (Špeh et al., 2021) which aimed to record the actual state/conditions of every landfill location accessible by sea kayak. By using these indicators, we can better understand the driving

Zbog razlike u izvoru onečišćenja (otpad koji su nanijeli valovi i otpad koji su dovezli te izravno odložili ljudi) i gospodarenja otpadom obalnoga i kopnenoga dijela otoka Pašmana odlučeno je da će se definirati dva područja istraživanja: a) obala otoka i b) unutrašnjost otoka. Opsežno terensko istraživanje omogućilo je detektiranje 32 lokacije na kojima se nalazio otpad. Deset lokacija nalazilo se na obali, a 22 u unutrašnjosti (sl. 1). Naše je opažanje omogućilo vrijedan uvid u razlike između obalnoga i unutrašnjega dijela otoka s obzirom na nakupljanje otpada i gospodarenje njime.

Da bi se kvalitativno procijenilo stanje istraživanoga okoliša, obilježja krajolika ili postojeće procese, unaprijed je pripremljen izvorni popis indikatora. Europska agencija za okoliš (EAO, 2005) to je preporučila kao jedan od najvažnijih alata za istraživanje i praćenje okoliša. Budući da EAO procjenjuje stanje okoliša da bi se prepoznali najvažniji problemi korištenjem DPSIR okvira (*driving forces-pressures-state-impact-responses*), za potrebe ovoga istraživanja utvrdili su se pokazatelji temeljem koncepta: prirodni čimbenici, stanovništvo, obilježje otpada, lokacija, predložene mjere. Upitnik s popisom indikatora pripremljen je u skladu s upitnikom korištenim u prethodnom istraživanju na području Kornata (Špeh i dr., 2021), čiji je cilj bio zabilježiti trenutno stanje/uvjete svih lokacija s otpadom do kojih se došlo morskim putem, kaja-

forces, pressures, state, impacts, and responses related to each location and gain insights into the broader environmental issues in the area.

Our survey indicators comprised both physical and socio-geographical aspects and included the following 13 elements: 1) geomorphological characteristics; 2) coast orientation; 3) openness of the bay/cove to the sea; 4) vegetation condition; 5) distance of waste from the sea; 6) waste distribution; 7) landscape exposure of the waste area; 8) amount of waste (in m^3); 9) origin of waste (information obtained from packaging); 10) type and percentage of waste type; 11) share of plastic waste (in%); 12) name of the area (bay/cove) on the island; and 13) coordinates (location) of waste. The value of indicator 10, the percentage of waste type, may exceed 100% since various waste types were present at the same location and presented data were aggregated for two main locations (ashore and inland).

We applied the same survey list to holistically observe the characteristics of solid waste accumulation in the two research areas: a) the coastline and b) the interior. The second phase of the research was conducted during the spring of 2018, and it was crucial to locate the main areas polluted with sea litter. As such, the coastal locations included in the survey had to be accessed using a small private vessel, as those areas were not accessible by road.

Comparable indicators were identified from surveys conducted on both coastal and inland sites, including the distance of litter from the sea, method of litter disposal, volume of litter (measured in m^3), proportion of plastic waste, types and distribution of litter, country of origin (identified via "made in" labels on packaging), and recommended sanitation measures. Malik et al. (2012) reported that improper disposal of solid waste on land, in open dumps or poorly-designed landfills, can lead to environmental impacts such as contamination of groundwater.

Qualitative research was conducted to gather information on the waste management practices and related environmental issues perceived by the islanders. Semi-structured and structured

kom. Koristeći se tim pokazateljima možemo bolje razumjeti pokretačke sile, pritiske, stanje, utjecaje i odgovore vezane uz svaku pojedinu lokaciju te dobiti uvid u šire okolišne probleme toga područja.

Popis indikatora uključio je prirodni i društveno-geografski aspekt kroz ukupno 13 elemenata: 1) geomorfološke značajke, 2) orijentacija obale, 3) otvorenost zaljeva/uvale prema moru, 4) stanje vegetacije, 5) udaljenost otpada od mora, 6) distribucija otpada, 7) izloženost krajolika području s otpadom, 8) količina otpada (u m^3), 9) podrijetlo otpada (informacije preuzete s pakiranja), 10) vrsta i udio vrste otpada, 11) udio plastičnog otpada (u %), 12) naziv područja (zaljev/uvala) na otoku i 13) koordinate lokacije s otpadom. Indikator broj 10 (udio vrste otpada) prelazi 100 % jer su različite vrste otpada bile prisutne na istoj lokaciji, a podatci su prezentirani zbirno za dvije glavne vrste lokacija (obala i unutrašnjost).

Isti se upitnik koristio za holističko promatranje načela nakupljanja krutoga otpada na Pašmanu u objema istraživanim zonama: a) obalna zona Pašmana i b) unutrašnjost otoka. Ta druga faza istraživanja provodila se u proljeće 2018. godine. Bilo je važno locirati glavna područja onečišćenja morskim otpadom pa se obalnim lokacijama uključenim u istraživanje moralo pristupiti malim privatnim plovilom. Obalne lokacije uglavnom nisu bile dostupne prometnicama ili drugim kopnenim putovima.

Sukladno obilježjima istraživanih lokacija, na obali i u unutrašnjosti, određeni su sljedeći usporedivi indikatori: 1) udaljenost otpada od mora, 2) oblik deponiranog otpada, 3) količina otpada (u m^3), 4) udio plastičnog otpada u ukupnom, 5) vrsta i udio otpada, 6) podrijetlo otpada (prema oznaci na pakiranju *izrađeno u*), 7) preporučene mjere sanacije. Prema Malik i dr. (2012), krupni otpad koji se deponira na otvorenim ili neispravno projektiranim odlagalištima može imati negativne učinke na okoliš i zbog procjednih voda koje se procjeđuju iz odlagališta i zagađuju podzemne vode.

Provedeno je i kvalitativno istraživanje kojim su se prikupile korisne informacije o percepciji lokalnoga stanovništva o gospodarenju otpadom i problemima u okolišu koji su posljedica lošega gos-

interviews were used to collect data, with a total of eleven interviews conducted with individuals from five settlements on the island. Due to the COVID-19 pandemic, interviews were conducted via phone and email rather than in person. Contacts for the interviews were collected from individuals met during earlier phases of the field research. The aim was to include participants of various age groups, genders, and residence status, including both permanent residents and second home owners. The latter group was important to include as less than 40% of island dwellings are permanently occupied, and it was assumed that occasional visitors with second homes on the island also play a significant role in waste production, based on their socio-economic and environmental characteristics.

In January 2022, semi-structured interviews were conducted with four respondents permanently living in Tkon Municipality and five respondents living in Pašman Municipality. The set of questions covered waste disposal practices before and after Croatian accession to the EU, locations of illegal landfills, waste collection, marine litter locations and its collection, and satisfaction with waste management on the island. One semi-structured interview was conducted with a respondent who spends half the year in Pašman Municipality and the other half on the mainland in Zadar, while a structured interview was conducted with a respondent who owns a property in Pašman Municipality and occasionally visits from Los Angeles, USA. All participants voluntarily agreed to take part in the research, and detailed notes taken during phone interviews were transcribed and analyzed. The respondent from the USA answered 16 questions via email. To ensure public engagement, the qualitative study did not involve representatives from local government or utility companies. However, official reports with relevant data on waste management and waste quantity provided by these entities were used in the research (Waste Management Plans, Tkon (2021) and Pašman (2021)).

podarenja. Korišteni su polustrukturirani i strukturirani intervjui da bi se podatci prikupili. Obavljeno je 11 intervjua sa stanovnicima pet otočnih naselja, a zbog pandemije virusa Covid 19 intervjui su se provodili telefonski i elektroničkom poštom, a ne osobno. Kontakti ispitanika prikupljeni su od ljudi koji su kontaktirani u prethodnoj fazi terenskoga istraživanja. Glavna je ideja bila uključiti različite profile ispitanika, one koji trajno žive na otoku, ali i vlasnike kuća za odmor i rekreaciju. Također su uključeni ispitanici različite dobi i spola. Uključivanje vlasnika kuća za odmor koji ne žive na otoku bilo je važno jer je manje od 40 % stanova na otoku korišteno za trajno stanovanje, a s obzirom na vrijednost društveno-gospodarskih i okolišnih pokazatelja pretpostavilo se da povremeni posjetitelji koji posjeduju stanove na otoku imaju važnu ulogu u proizvodnji otpada.

U siječnju 2022. godine provedena su četiri polustrukturirana intevjua sa stanovnicima koji stalno žive u općini Tkon i pet s otočanima koji žive u općini Pašman. Niz pitanja pokrio je teme vezane uz prakse odlaganja otpada, s posebnim osvrtom na vrijeme prije i poslije pristupa Hrvatske Europskoj uniji, lokacije divljih odlagališta, prikupljanje otpada, lokacije morskoga otpada i njegova prikupljanja i zadovoljstvo gospodarenjem otpadom na otoku. Jedan polustrukturirani intervju odrađen je s osobom koja polovicu godine živi u općini Pašman, a polovicu na kopnu u gradu Zadru, dok je jedan strukturirani intervju proveden s osobom koja posjeduje kuću na otoku, u općini Pašman, a živi u Los Angelesu te povremeno, jednom godišnje ili jednom u nekoliko godina, dolazi na otok. Svi su ispitanici pristali sudjelovati u istraživanju, a detaljne bilješke zapisane tijekom telefonskih razgovora kasnije su transkribirane i analizirane, dok je ispitanik iz SAD-a osobno popunio obrazac sa 16 pitanja i poslao ga elektroničkom poštom. S obzirom na postavljene ciljeve kvalitativnoga istraživanja gdje je bilo bitno dobiti percepciju javnosti nisu intevjuirani predstavnici lokalne vlasti ili komunalnih društava. Međutim, oni su na upit poslali službene informacije i izvješća s potrebnim podatcima o gospodarenju otpadom i količinom otpada koji su korišteni u istraživanju (Planovi upravljanja otpadom, Tkon, 2021. i Pašman 2021.).

RESULTS & DISCUSSION

Pašman Island waste management review

Most of the solid waste on the island consists of household waste. According to data provided by the local government (municipalities), there are no active illegal landfills on the island (Tkon Municipality, February 7, 2022; Pašman Municipality, February 21, 2022; Waste Management Plan of the Pašman Community, 2021; Waste Management Plan of the Tkon Community, 2021). However, in the Tkon area, specifically Triluke, authorities have observed a certain amount of solid waste covered with dirt and vegetation, which they plan to remediate, as there used to be an illegal landfill in that location until 2017. During fieldwork research and interviews with local residents, it was discovered that certain locations are occasionally used for waste disposal (e.g. building materials, furniture), but utility companies clean these areas. Our survey of inland landfills from 2018 found 22 waste locations. All waste collected on island is transported to the mainland. Each municipality has a recycling yard where islanders can dispose of metal, textiles, batteries, medications, and other items, with recyclable waste collected twice a month. However, the market for recyclables is inadequate, as disposal costs are significant, and there is no higher economic activity in terms of circular economy (Runko Runko Luttenberger, 2020). In other words, an infrastructure for waste management needs to be further developed (De Gisi et al., 2017; Ambrose et al., 2019).

Waste management is a crucial issue on the island and across Croatia. One of the key factors driving improvements in this area has been the introduction of new national waste management regulations. Since Croatia joined the EU in 2013, the *Act on Sustainable Waste Management* (NN 94/13, 73/17) has been in force. This legislation gives local governments the responsibility for deciding how waste should be

REZULTATI I RASPRAVA

Otok Pašman – pregled gospodarenja otpadom

Najveći dio otpada na otoku Pašmanu spada u komunalni otpad. Prema podatcima dobivenim u otočnim općinama na otoku nema aktivnih divljih odlagališta (Općina Tkon, 7. veljače 2022; Općina Pašman, 21. veljače 2022; Plan gospodarenja otpadom općine Pašman, 2021.; Plan gospodarenja otpadom općine Tkon, 2021.). Međutim, na području naselja Tkon, na lokaciji Triluke na kojoj je nekoć bilo divlje odlagalište sanirano 2017. godine, lokalne su vlasti uočile određenu količinu krupnoga otpada prekrivenog tlom i vegetacijom koji planiraju ukloniti. Za vrijeme terenskoga istraživanja provedenog 2018. bile su utvrđene lokacije na otoku na kojima ljudi povremeno odlažu otpad (npr. građevinski materijal, namještaj i dr.), no njih čiste komunalna društva. Ipak, prema iskustvima lokalnoga stanovništva, prikupljenih kroz intervjue, otpad se još uvijek povremeno odlaže u okoliš. Našim istraživanjem unutrašnjosti otoka zabilježene su 22 lokacije s otpadom. Inače, sav otpad prikupljen na otoku prevozi se na kopno. Svaka općina ima reciklažno dvorište kamo otočani odlažu metal, tekstil, baterije, ulje, lijekove i dr. Reciklabilni otpad prikuplja se dva puta mjesečno. S druge strane, tržište reciklabilnoga otpada nije odgovarajuće, troškovi odlaganja su visoki i nema veće gospodarske aktivnosti u vidu cirkularne ekonomije (Runko Runko Luttenberger, 2020). Drugim riječima, potrebno je razviti infrastrukturu potrebnu za gospodarenje otpadom (De Gisi i dr., 2017; Ambrose i dr., 2019).

Važan pokretač u gospodarenju otpadom, ne samo na otocima već u cijeloj Hrvatskoj, jest promjena nacionalne zakonske regulative o gospodarenju otpadom. Godine 2013. Hrvatska se pridružila EU-u te je iste godine na snagu stupio Zakon o održivom upravljanju otpadom (NN 94/13, 73/17). U Zakonu je definirano da lokalna vlast odlučuje o načinima prikupljanja otpada. Također je odgovorna za planiranje svih aktivnosti povezanih uz gospodarenje otpadom (petogodišnji plan) i jednom godišnje mora dostaviti izvješće o realizaciji plana. Obje općine na otoku Pašmanu to redovito provode sukladno zakonskim

collected and managing all related activities via a five-year plan, with an annual report on its implementation. Both Pašman and Tkon municipalities have been fulfilling their legal obligations by submitting regular reports. However, there are some significant differences in the amount of waste generated by these two municipalities. Despite having only three times the population of Tkon, Pašman produces 4.5 times more waste, partly due to the higher number of second homes and occasional visitors. While the total number of tourists in Pašman is twice that of Tkon, many of the second-home visitors are probably not included in official tourist statistics. It is therefore essential to take these factors into account when planning waste management strategies in these areas.

The rate of waste separation in Tkon is higher than in Pašman, resulting in a larger annual amount of plastics, paper, and cardboard in the smaller municipality. Despite having similar demographic and economic features, there is a significant difference in waste separation between the two areas, as indicated in Table 2. This difference may be attributed to the fact that tourists and second-home visitors in Pašman are less likely to separate their waste. Table 1 shows that the aging index is high, particularly in Pašman, where almost 27% of the total population is elderly. Soukopova et al. (2017) found in a study conducted in the Czech Republic that senior

odredbama. Prema podatcima dobivenim od komunalnih društava Orlić d.o.o. i Čistoća d.o.o. (tab. 2), općina Pašman proizvodi 4,5 puta više otpada od općine Tkon. Ukupan broj stanovnika općine Pašman prema službenim je podatcima oko tri puta veći nego općine Tkon, dok je ukupan broj turističkih dolazaka dvostruko veći u općini Pašman nego u općini Tkon. Razlog tolikoj razlici u količini proizvedenoga otpada u tim dvjema općinama jest u broju posjetitelja kuća za odmor i rekreaciju. Prema podatcima o ukupnom broju povremeno korištenih stanova Pašman vjerojatno ima više posjetitelja koji nisu registrirani u turističkoj statistici. Stoga je ključne uzeti u obzir ove faktore prilikom primjene strategija upravljanja otpadom u ovim područjima.

Na području Tkona stanovnici više sortiraju otpad pa je ukupna godišnja količina plastičnoga otpada, papira i kartona veća u toj općini koja je po broju stanovnika manja. Analizom podataka društveno-gospodarskih pokazatelja utvrdilo se da demografska i gospodarska obilježja dviju analiziranih općina nisu bitno različita. Stoga se može pretpostaviti da su turisti i posjetitelji koji borave u kućama za odmor i rekreaciju, a koji su značajnije prisutni u Pašmanu, zapravo oni koji manje odvajaju otpad, a što se očitije odražava na razliku u odvajanju otpada u dvjema otočnim općinama (tab. 2). Pokazatelji društvenih obilježja (tab. 1) potvrđuju visok indeks starenja, posebno u općini Pašman gdje je udio staroga stanovništva u ukupnom gotovo 27 %. Soukopova i dr. (2017) u istraživanju provedenom u Češkoj zaključili

Tab. 2 Total annual waste collection from Tkon and Pašman municipalities according to the type of the waste in 2020
Tab. 2. Ukupna količina prikupljenoga otpada u općinama Tkon i Pašman prema vrsti u 2020. godini

	Pašman	**Tkon**
area (in km^2) / površina (u km2)	Total quantity of collected waste per year (t) / Ukupna količina prikupljenog otpada godišnje (t)	
municipal solid waste / miješani komunalni otpad	1,003.01	189.90
plastics / plastika	17.60	20.34
paper and cardboard / papir i karton	3.57	19.78
bulk waste / glomazni otpad	38.13	-
glass / staklo	4.66	4.08
Total / Ukupno	1,066.97	234.10

Source: Data on total annual waste collection in 2020, Utility companies for waste management (Orlić d.o.o. – data for Tkon Municipality; Čistoća d.o.o. – data for Pašman Municipality); January and February 2022, Personal Communication
Izvor: Podatci o ukupnom prikupljenom otpadu u 2020., komunalna društva za gospodarenje otpadom (Orlić d.o.o. – podatci za općinu Tkon; Čistoća d.o.o. – podatci za općinu Pašman); siječanj i veljača 2022., osobna komunikacija

citizens, particularly those who have retired, have the highest impact on communal waste production. However, waste production is influenced by several demographic variables such as consumer age, education, behaviors, and lifestyle (Jefferson et al., 2014; Potts et al., 2016).

Results of the qualitative research

The study found no significant difference in waste management practices and attitudes toward waste management between the two municipalities, and their responses are presented together. However, social features (Tab. 1) reveal that Pašman has an older population with a more than double the aging index of Tkon. Based on the data on total collected recyclable waste, it appears that younger people are more willing to sort waste. This observation was confirmed by some of the islanders interviewed (Tab. 3).

Since Croatia's accession to the EU in 2013, environmental laws have been adopted to regulate waste management practices. This study aimed to assess perceptions regarding waste separation and recycling among locals in the two municipalities. The results indicate that there has been an overall improvement in waste management attitudes among the islanders. Many have changed their habits and are now actively separating recyclable waste, recognizing its importance for their community. This positive trend is reflected in the increasing quantity of recyclable waste collected by local government and utility companies. However, the study also identified some challenges that need to be addressed. Certain types of waste, such as dangerous agricultural chemicals, bulky waste, and construction waste, are not being handled well and were observed in the environment during fieldwork. Younger people appear to be more disciplined in waste sorting and are more likely to participate in cleaning campaigns. Interviews with local stakeholders revealed that sea litter, particularly in the form of fishing gear, is a major problem on the island's shores. According to the study, 46.1% of sea litter comes from fishing activities (Fig. 7), highlighting the importance of the Pašman aquatory as a fishing area. In the

su da stariji stanovnici u određenoj dobi (uglavnom nakon odlaska u mirovinu) imaju najveći utjecaj na proizvodnju komunalnoga otpada. No, proizvodnja otpada ovisi o demografskim varijablama (Jefferson i dr., 2014; Potts i dr., 2016), primjerice dobi potrošača, obrazovanju, ponašanju i životnom stilu.

Rezultati kvalitativnoga istraživanja

Rezultati istraživanja pokazali su da nema značajnije razlike u gospodarenju otpadom i stavu lokalnoga stanovništva prema gospodarenju otpadom u dvjema općinama pa su stoga njihovi odgovori prikazani zajedno. Prema društvenim pokazateljima (tab. 1) Pašman ima starije stanovništvo i više nego dvostruko veći indeks starenja, pa bi se temeljem podataka o ukupnoj količini prikupljenoga reciklabilnog otpada moglo zaključiti da su mlađi stanovnici voljniji sortirati otpad. Neki od intervjuiranih ispitanika to su i potvrdili (tab. 3).

Netom nakon pristupanja Hrvatske Europskoj uniji 2013. godine usvojeni su zakoni o okolišu te su se regulirale prakse vezane uz gospodarenje otpadom. Istraživanjem je procijenjena percepcija lokalnoga stanovništva o odvajanju i recikliranju otpada u dvjema općinama. Rezultati pokazuju da se stav o gospodarenju otpadom u obje općine zadnjih godina popravio. Otočani percipiraju da je većina ljudi promijenila njihove navike, odvajaju otpad i smatraju da je to od velike važnosti za njihovu zajednicu. Podatci dobiveni od predstavnika lokalne vlasti i komunalnih društava potvrđuju da u novije vrijeme raste količina reciklabilnoga otpada iz kućanstava. No, još uvijek se s nekim vrstama otpada ne postupa na odgovarajući način, primjerice s opasnim otpadom (kemikalije korištene u poljoprivredi), glomaznim otpadom (namještaj) i građevinskim otpadom koji su primijećeni u okolišu i tijekom terenskoga istraživanja. Čini se da su mlađi ljudi discipliniraniji u odvajanju otpada i voljniji sudjelovati u dobrovoljnim akcijama čišćenja otpada. Prema mišljenju ispitanika najveći dio morskoga otpada dolazi od nautičara, uglavnom turista, i može se pronaći diljem obale otoka. Podatci dobiveni terenskim ispitivanjem pokazali su da 46,1 % morskoga otpada dolazi od ribarskih aktivnosti (sl. 7) što potvrđu-

Tab. 3 The results of the qualitative research
Tab 3. Rezultati kvalitativnoga istraživanja

Profile and number of participants / Profil i broj ispitanika:		
Number (N) / Broj (N):	11	
Age (average) / Dob (prosječna):	45	
Sex / Spol:	M / M=6; Ž / F=5	
Settlements / Naselja:	Dobropoljana, Ždrelac, Kraj, Tkon, Ugrinić	
Questions / Pitanja:	**Answers / Odgovori:**	**Results / Rezultati:**
Are participants satisfied with the frequency of the waste collection during the tourist season and out of the (tourism) season? / Jesu li ispitanici zadovoljni učestalošću prikupljanja otpada u turističkoj sezoni i izvan nje?	Yes, I am very satisfied with the organization. In the summer period when there is a lot of people on the island, the frequency of waste collection is increased. / Jesam, jako sam zadovoljan kako su organizirani. Ljeti se broj odvoza pojačava kad je puno ljudi na školju We have been saved since it came." (here they are referring to the new system of the waste management) / Spasili smo se otkad je to došlo I am satisfied but sometimes recyclable waste is not picked up according to the plan / Zadovoljan sam iako ponekad ne kupe smeće što se reciklira prema planu	Participants are generally very satisfied with the frequency of waste collection, especially with the collection of municipal solid waste. They said it is well organized in and out of the tourism season. However, one participant said that recyclable waste is not always picked up according to the plan / Ispitanici su općenito vrlo zadovoljni učestalošću prikupljanja i odvoza otpada, posebice prikupljanjem miješanoga komunalnog otpada. Kažu da je to dobro organizirano u sezoni i izvan nje. No, jedan ispitnaik naveo je da se reciklabilni otpad ne odvozi uvijek prema planu
Are there recycling yards in the settlements or in the municipality centers? Do participants use them? / Postoje li reciklažna dvorišta u naseljima ili u općinskim središtima? Koriste li ih? /	There is a recycling yard in Barotul, but I don't need it. I take care of it all at home / Ima tamo u Barotulu reciklažno dvorište, ali ne tribam ga. Sve ja to doma sredim There is a recycling yard in Pašman settlement where you can dispose of glass, textile, paper and there is a place for a bulk waste in Barotul. I often take the waste there / Postoji reciklažno dvorište u mjestu Pašmanu za staklo, tekstil, papir i postoji odlagalište krupnog otpada u Barotulu. Odnosim često smeće tamo	Participants are aware that there is a recycling yard in the settlements of Barotul and Tkon. Inhabitants said that they bring their waste to the recycling yard. Those who occasionally come to the island said that they know about the yard, but they do not need it, while people who permanently live there use it more often / Ispitanici su svjesni da se u naseljima Barotul i Tkon nalaze reciklažna dvorišta. Otočani koji žive na otoku kažu da nose otpad u reciklažna dvorišta. Oni koji povremeno dolaze na otok tvrde da znaju da postoje dvorišta, ali ih ne trebaju, dok ih stalni stanovnici češće koriste
Do they think that the situation in waste management has changed in the last decades? Do they see any improvement? / Je li se promijenilo stanje glede gospodarenja otpadom posljednjih desetljeća? Vide li kakvo poboljšanje?	It is much better. Earlier people were dumping waste everywhere; they were burning it all over the place. In the last 7–8 years the situation has improved. Since we entered the EU, it is much better / Puno je bolje. Ranije su ljudi svugdje bacali otpad, svugdi se i gorilo. Zadnjih 7, 8 godina je puno bolje. Otkad smo ušli u EU je puno bolje People thought it was useful to drop old ovens into the sea because they would become new spawning areas for fish. Now the municipality invested in education, so they don't do it anymore / Mislili su da je korisno odlagati stare špahere u more jer nastaju mjesta za mriještenje ribe. Sad je općina uložila u edukaciju pa to više ne rade	The respondents think that the situation has improved much compared to 10 or more years ago. They also mentioned that earlier all households used to burn their waste. Bulk waste was sometimes dumped into the sea (old washing machines, ovens, etc.) because they thought it would become a place where fish would spawn. / Ispitanici smatraju da se stanje popravilo u odnosu na vrijeme prije 10 godina i ranije. Također, spomenuli su da su nekoć sva kućanstva palila svoj komunalni otpad. Ponekad je otpad bio bačen i u more (stare perilice za pranje rublja, pećnice i sl.) jer su vjerovali da će taj otpad postati mjesto gdje se mrijeste ribe

continued Tab. 3 The results of the qualitative research
nastavak Tab 3. Rezultati kvalitativnoga istraživanja

Do respondents think that certain sorts of waste are not managed well? Which ones? / Postoji li neka vrsta otpada kojom se ne gospodari na odgovarajući način? Koja? /	Dangerous waste is not managed well, chemicals we used in agriculture. Me, for example, if I have some of those chemicals left, I don't know where to put them. I should take them back to town to the shop where I bought them. But I must have receipts. Who can keep the receipt for so long? / Nije dobro riješen opasni otrov, kemikalije koje koristimo u poljoprivredi. Ja, npr. ako mi ostane tih kemikalija, nemam di s njima. Morao bi ih odvesti natrag u grad u poljoljekarnu u kojoj sam ih kupio. A onda moram čuvati račun. Tko to može čuvati toliko? The biggest problem is construction waste. You cannot dispose of it anywhere so people dump it into the environment / Najveći problem je građevinski otpad. To nemaš di pa ljudi bacaju u prirodu.	Participants think that dangerous waste is not handled well, especially chemicals used in agriculture. Also, some mentioned that bulk waste should be managed better, especially old furniture. They are also aware that many people dispose of construction waste into the environment. / Ispitanici smatraju da se opasni otpad ne tretira na odgovarajući način, posebice kemikalije korištene u poljoprivredi. Također, neki su spomenuli da bi odvoz glomaznoga otpada, posebice staroga namještaja, trebao biti bolje organiziran. Svjesni su i toga da mnogi ljudi odlažu u okoliš građevinski otpad.
Are there any locations where there were illegal waste landfills in the settlement where they live or which they occasionally visit or somewhere else on the island? Are those landfills still active? / Postoje li u naselju u kojem žive ili koje povremeno posjećuju ili drugdje na otoku lokacije na kojima su bila divlja odlagališta otpada? Jesu li ta odlagališta još uvijek aktivna?	There were many illegal landfills on the island but now you can get a fine for dumping waste in that way / Bilo je puno odlagališta po otoku, ali sad postoje kazne za divlje odlaganje otpada There were locations within the settlement where people disposed of waste illegally but those locations have been remediated / Bilo je lokacija u naselju gdje se odlagalo na divlje, ali je to sanirano There are still illegal landfills but once there is a lot of waste, they collect it. Roma people take care of all the iron waste / Ima toga još, ali kad se nakupi onda se to i riješi. Romi riješe sve što ima željeza	All participants mentioned that there were many illegal landfills all over the island. But they have all been remediated. They also said that one could get a huge fine for illegal waste dumping, so people are generally not doing it anymore. Some claimed that maybe there are places where demolition and construction waste can be found. Several participants mentioned that there are also Roma people often coming with trucks to the island and they are collecting all the waste containing iron. / Svi ispitanici spomenuli su da je diljem otoka bilo mnogo divljih odlagališta, no ona su sanirana. Spomenuli su i da se može dobiti velika kazna za ilegalno odlaganje otpada pa da to uglavnom više ne rade. Pojedini su spomenuli da možda ima još uvijek mjesta gdje se može naći bačen građevinski otpad. Nekoliko je ispitanika spomenulo da Romi često dolaze na otok s kamionima i kupe sav otpad koji sadrži željezo.
What are the opinions of respondents regarding attitudes and awareness of the importance of waste separation and recycling among the local people? / Što misle o stavu lokalnoga stanovništva i njihovoj svjesnosti o važnosti odvajanja i recikliranja otpada?	The attitude toward recycling is developing, but not with everyone. Like in any other place it is individual. However, we are not drowning in waste because it is being collected. / Razvija se svijest o važnosti recikliranja, ali nije kod svih. Ka i svugdi drugdi to ti je individualno. Ali, nismo zatrpani smećem jer se sve odvozi. Older people still do not recycle and separate enough. If there is someone younger in the household they will help elders but if they are alone they don't feel like it. The problem is also people who are not from island but have houses here. They take the bulk waste along firefighting roads up to the hills and dispose of it by the side of the road. They don't know how things work here / Kod starijih još nije zaživilo recikliranje i odvajanje. Ako ima netko mlađi u kućanstvu onda će taj pomoći i to će raditi, ali ako su stari sami njima se to baš ne da. Problem su i furešti, oni koji imaju kuće tu. Oni krupni otpad voze tamo vatrogasnim putevima u brdo pa iskrenu negdi kraj puta. Oni ne znaju kako to kod nas funkcionira	Participants said that the attitude toward waste separation and recycling has been positively changed. However, two younger participants thought that the positive attitude and awareness of the importance of adequate waste management are more present among younger islanders than among older people who have different habits. Older participants did not think that way. They claimed that they are equally aware of this issue. Also, some think that people who don't live on the island (full time) are more responsible for disposing the waste into the environment because they do not know how the waste collection is organized. / Ispitanici tvrde da se pozitivno promijenio stav prema odvajanju i recikliranju otpada. No, dvoje mlađih ispitanika smatra da su pozitivan stav i svjesnost o važnosti odgovarajućega gospodarenja otpadom više prisutni kod mlađih otočana nego kod starijih koji imaju drugačije navike. Stariji ispitanici misle drugačije te kažu da su jednako svjesni toga problema. Također, pojedini smatraju da su ljudi koji ne žive na otoku odgovorniji za odlaganje otpada u okoliš jer ne znaju na koji je način organizirano prikupljanje otpada.

continued Tab. 3 The results of the qualitative research
nastavak Tab 3. Rezultati kvalitativnoga istraživanja

What is their attitude toward recycling and waste separation? / Kakav je njihov stav o recikliranju i odvajanju otpada?	I do it because it has to be done. There is no other option / Činim to, to se mora jer nam nema druge It is important to separate waste. I always do it / Važno je odvajati smeće. Ja to uvik činim	All participants think that it is important to separate and recycle waste / Svi ispitanici smatraju da je važno odvajati i reciklirati otpad
Which sort of the waste still gets dumped into the island environment? / Koje se vrste otpada još uvijek odbacuju u otočni okoliš?	I'm always impressed by the quality of the environment in Žđrelac. Most waste appears to be tourist-generated litter or marine debris: wrappers, a lost flip-flop, a discarded drink bottle, a lost beach toy / Uvijek sam impresioniran kvalitetom okoliša u Žđrelcu. Čini se da najveći dio otpada dolazi od turista ili se radi o morskom otpadu: omoti, izgubljene natikače, ostavljene boce, izgubljene igračke za plažu People are still dumping some litter into the environment and mostly construction material / U prirodu se još baca sitni otpad i najviše građevinski People mostly dispose building material and furniture. And old household appliances / Najviše bacaju građevinski otpad i namještaj. To se najviše baca. I stare aparate	Opinions on what is still disposed of in the environment were different among participants who live on the island and among those who occasionally visit it but own the property there. Local people said that people still dump mostly furniture and construction waste into the environment. Participants who do not live permanently on the island think that the environment is extremely clean and all waste gets dumped in the right place / Mišljenja o tome koja je vrsta otpada još uvijek prisutna u okolišu različita su među ispitanicima koji žive na otoku i onima koji povremeno dolaze ili posjeduju nekretninu na otoku. Lokalno stanovništvo tvrdi da ljudi još uvijek u okoliš odlažu uglavnom namještaj i građevinski otpad. Ispitanici koji ne žive na otoku smatraju da je okoliš izrazito čist i da se sav otpad odlaže na pravo mjesto.
Have respondents noticed any sea waste on the island? Where are locations where the waste can be found, and who cleans such places? / Jesu li primijetili morski otpad na otoku? Gdje su lokacije na kojima se nalazi morski otpad i tko čisti takva mjesta?	There is a lot of it and there has always been. When I see it, I pick it up as much as I can. But it is always present, the southeastern wind brings it up and waves and then it all comes to the shore / Ima toga puno i toga je uvik bilo. Ja kad vidim, ja pokupim onako koliko mogu. Ali toga uvik ima, to jugo digne, valovi pa sve na kraj izbaci Local people do not dispose of waste into the sea. Those from sailing boats do it and then sea brings it up to the shore / Mještani ne bacaju u more. Nego oni s jedrilica. Oni svašta bace pa more to izbaci van.	All participants agree that there are various places where sea waste can be found but they said that most such places can be found on the southern shores of the island, far from settlements. Their perception is that tourist-sailors are the most responsible for that waste. They also said that in settlements beaches are clean because there is a person paid by the municipality who is responsible for collecting sea litter and trash from cans near the beaches. On the southern shores of the island, waste is not collected but they all agreed that it should be. / Svi se ispitanicu slažu s time da se morski otpad može pronaći na mnogim mjestima, no tvrde da su te lokacije uglavnom na južnim obalama otoka, daleko od naselja. Misle da su turisti nautičari najviše odgovorni za tu vrstu otpada. Također, tvrde da su u naslejima plaže čiste jer općina plaća osobu koja je odgovorna za prikupljanje otpada i pražnjenje kanti za otpad u blizini plaža. Na južnim obala otoka otpad se ne čisti, ali svi su se složili da bi to trebalo.
Are respondents aware of cleaning actions organized on the island? Who organizes them and are they willing to participate in those events? / Znaju li organiziraju li se akcije čišćenja otpada na otoku? Tko ih organizira i jesu li voljni u takvim akcijama sudjelovati?	Before the (tourism) season, in my settlement locals organize cleaning actions of the beaches and the dock. I have volunteered for such events / U mom mjestu, prije početka svake sezone mještani se skupe te očiste plaže i stajalište brodova. Sudjelovala sam u tim akcijama čišćenja	According to the statements of the participants, it can be concluded that only some settlements organize cleaning actions. It is done mostly before the tourist season. Most of the locals would voluntarily participate in those actions. Some of them have already done so / Prema tvrdnjama ispitanika, može se zaključiti da se samo u nekim naseljima organiziraju akcije čišćenja otpada i to uglavnom prije turističke sezone. Većina bi u tome sudjelovala, a neki od ispitanika već i jesu

Kornati archipelago, 25.0% of the same type of sea litter was recorded while household litter prevailed (32.1%) (Špeh et al., 2021). Similarly, at the Elafiti islands, household litter accounted for 33.2% of the impact, with biomass sea litter being the predominant type (48.9%) (Špeh and Lončarić, 2022).

Over the past decade, the municipalities have invested in educating locals about waste management, resulting in improved knowledge and attitude towards waste disposal. This positive change has been particularly noticeable since Croatia joined the EU. Islanders are generally aware of the few individuals who still dispose of waste illegally, but they report that such incidents are quickly addressed thanks to the well-organized utility companies and municipal government bodies. In the past, before comprehensive waste management became more prevalent, people had no other option but to burn or dump their household waste in the environment. Nowadays, they appreciate the benefits of having a better waste management system in place, and they feel like they have been "rescued" from a significant environmental problem.

Fieldwork survey analysis

Due to the lack of waste management practices such as the conversion of mixed waste into refuse-derived fuel (RDF) in Croatia, the collection and transportation of waste are inefficient and often involve long distances, resulting in non-compliance with proximity principles and missed opportunities for reuse (Runko Luttenberger, 2018). This has led to the creation of illegal landfills in the karst terrain, which poses a significant threat to vulnerable water ecosystems and the overall landscape. As an example, a survey conducted in the interior of Pašman revealed the existence of 22 waste sites, which could have a detrimental impact on the local living environment, tourism, and the quality of the sea, with the potential for expansion in the future.

The issue of sea (ocean) litter is a grave global concern that has been largely ignored. The coastal regions of the Adriatic Sea have also been affected by this problem due to improper waste manage-

je važnost pašmanskoga akvatorija kao važnoga ribolovnog područja. Na području Kornata bilo je zabilježeno 25,0 % morskoga otpada iste vrste, dok je tamo prevladavao otpad iz kućanstava (32,1 %) (Špeh i dr., 2021). Sličan udio (33,2 %) otpada iz kućanstava zabilježen je i na Elafitima gdje je u morskom otpadu prevladavala biomasa (48,9 %) (Špeh i Lončarić, 2022).

Posljednje desetljeće općine su uložile u edukaciju lokalnoga stanovništva, što je poboljšalo njihovo znanje i stav prema gospodarenju otpadom. Ta je pozitivna promjena posebice prijetna nakon pristupanja Hrvatske EU-u. Otočani su svjesni da ima i onih koji će svejedno odlagati otpad u okoliš, ali mišljenja su da se takva divlja odlagališta brzo očiste zahvaljujući dobro organiziranim komunalnim društvima i lokalnoj vlasti. Prije nekoliko desetljeća, kad se nije gospodarilo otpadom, stanovnici su morali sav otpad paliti ili ga odlagati u okoliš. Sad cijene dobrobit koju imaju zbog unaprjeđenja gospodarenja otpadom te se praktički osjećaju kao da su spašeni od otpada.

Rezultati terenskoga istraživanja

Budući da u Hrvatskoj nema prakse reprodukcije miješanoga otpada u novi oblik, primjerice proizvodnje goriva iz otpada, otpad se još uvijek nedovoljno prikuplja te prevozi na veće udaljenosti, što nije u skladu s načelom blizine i ne uzima u obzir potencijal ponovne upotrebe otpada (Runko Luttenberger, 2018). Kao posljedica toga na krškom terenu nalaze se divlja odlagališta koja ozbiljno ugrožavaju osjetljivi vodeni ekosustav i čitav krajolik. Istražujući otok Pašman, uočene su 22 lokacije s otpadom koje mogu u budućnosti utjecati na živa bića, turizam i kvalitetu mora.

Morski (oceanski) otpad globalni je problem koji je uvelike zanemaren. Obale Jadranskoga mora također su pod utjecajem toga problema zbog neodgovarajućega gospodarenja otpadom na kopnu i neprimjenjivanja odgovarajuće politike na rješavanje otpada koji dolazi s mora (nautički turizam sa širenjem marina, kruzerski

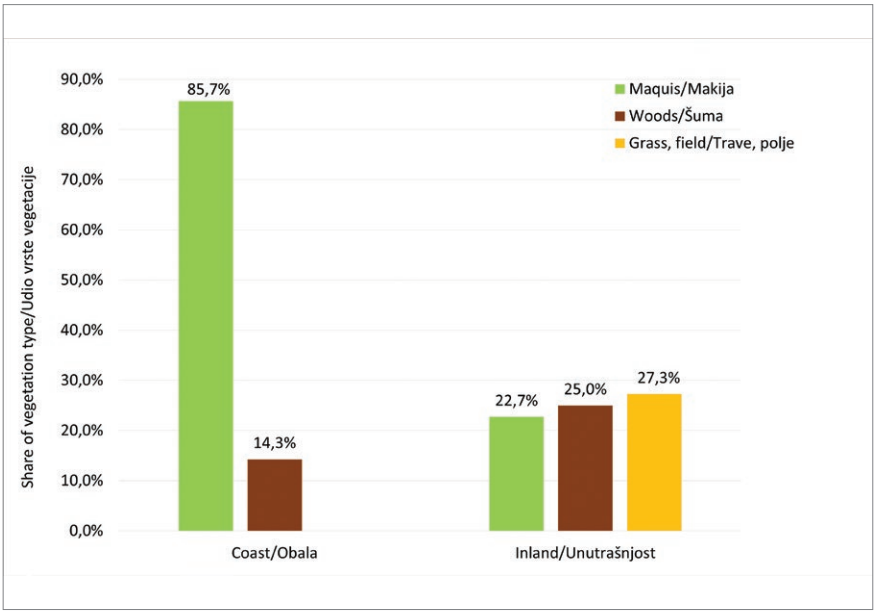

Fig. 3 Land cover categories at surveyed sites, coast and inland of Pašman Island

Sl. 3. Kategorije zemljišnoga pokrova na istraživanim lokacijama na obali i u unutrašnjosti otoka Pašmana

Source: According to research results

Izvor: Prema rezultatima istraživanja

ment practices on the mainland and the lack of appropriate policies to address the litter generated by activities such as boating tourism, expanding marinas, cruising, and fishing (Runko Luttenberger, 2020). A comprehensive analysis of fieldwork data has revealed the existence of ten distinct sea litter sites, further emphasizing the urgent need for concerted efforts to address this pressing issue.

Based on the lithological conditions, all the identified waste locations were found to be in the carbonate rock areas of the coastline, while only 9.1% of the inland areas with non-carbonate rock had waste sites. To assess the land cover indicators corresponding to the waste sites' exposure, vegetation coverage was analyzed. The coastal waste sites were predominantly covered by vegetation (70%), while the inland waste sites surveyed with vegetation (54.5%) exhibited more diverse land use patterns, with 27.3% of the sites covered by grass and fields, 25.0% by forests, and 22.7% by maquis (Fig. 3). In contrast, the land cover around the coastal waste sites was mainly maquis (85.7%), with the remaining 14.3% covered by woods (as shown in Fig. 3). The Kornati area, with less favorable environmental conditions, had 89.5% of locations without vegetation, and only 25% of the coast waste sites had land cover (38% maquis and 62% woods) on the Elafiti islands (Špeh and Lončarić, 2022).

turizam i ribarstvo) (Runko Luttenberger, 2020). Opsežnom analizom podataka prikupljenih na terenu utvrđeno je postojanje deset lokacija s morskim otpadom, čime se dodatno naglašava potreba za rješavanjem toga problema.

Što se tiče litoloških svojstava, sve lokacije s morskim otpadom nalaze se na području gdje prevladavaju karbonatne stijene uz obalu, dok na lokacijama u unutrašnjosti otoka 9,1 % stijena nije karbonatno. S obzirom na izloženost lokacija s otpadom (prirodno-geografski indikator) procijenjeni su pokazatelji zemljišnoga pokrova. Obalne lokacije pretežito su pokrivene vegetacijom (70 %). Lokacije u unutrašnjosti otoka na kojima je bila vegetacija (54,5 %) imale su raznolikiji način korištenja zemljiša: 27,3 % bilo je prekriveno s travom, 25,0 % bilo je pod višom šumom, a 22,7 % pod makijom. Obalne su se lokacije razlikovale te su najviše bile pod makijom (85,7 %) i šumom (14,3 %) (sl. 3). Zbog manje povoljnih obilježja okoliša na Kornatima je 89,5 % lokacija bilo bez vegetacije, dok je na Elafitima samo 25 % obalnih lokacija s morskim otpadom bilo prekriveno vegetacijom (38 % makija, 62 % viša šuma) (Špeh i Lončarić, 2022).

Socio-geographical settings of waste sites

To effectively address the socio-geographical characteristics of litter disposal sites in both inland and coastal areas, the following indicators have been established:

1. distance to the nearby residential area;
2. landscape exposure of the site (landfill);
3. landfill state;
4. accessibility of the landfill; and
5. assessment of the apparent impact on the quality of the geographic environment.

It is important to note before presenting the study results that the primary criterion used to distinguish ashore locations from inland locations, aside from their geographic position, was the dominant type of waste present in each location. Specifically, locations were categorized as coastal if the waste consisted primarily of litter that had washed up on the shore, whereas locations were categorized as inland if the waste primarily consisted of waste that had been dumped in-situ by people. The litter disposal sites were typically exposed and visible, with 83.3% of cases being found on the coast and 79.2% inland. However, due to vegetation or other reasons, some sites were not readily visible, with the remaining cases being covered in inland areas or hidden along the coast. The fieldwork estimation on landfills revealed that the disposal of waste had not ceased, with 40.9% of the inland sites (10.0% ashore) still being used regularly, and 27.3% (70.0% at the coast) being used occasionally. Other locations were not active at the time of research.

Of the surveyed coastal sites, 71.4% were reachable by the sea, 7.1% were to a macadam road, 14.3% were accessible by car, and the remainder required travel along a worse path. Inland disposal sites were primarily accessed by car on asphalt (54.2%) and macadam roads (37.5%), with the remaining sites being accessible via a better cart track.

According to analysed data (Fig. 4), coastal waste sites were more prevalent in locations that were further away from residential areas. Specifically, for coastal sites located between 201–500 meters from the coast, the percentage of waste sites was 30.0%, which was higher than the percentage of inland waste sites in the same distance category (18.2%). Furthermore, the percentage of waste sites increased to 40.0% for the most distant category of "over 1,000

Društveno-geografsko okruženje lokacija s otpadom

Da bi se odredile društveno-goegrafske značajke obalnih i kopnenih lokacija s otpadom, utvrđeni su sljedeći pokazatelji:

1. udaljenost od najbližega naselja
2. izloženost krajolika lokacije (odlagališta)
3. stanje odlagališta
4. dostupnost odlagališta i
5. procjena očigledna utjecaja na kvalitetu geografskoga okoliša.

Prije predstavljanja rezultata potrebno je spomenuti da je osim geografskoga položaja glavni kriterij za izdvajanje obalnih lokacija i onih u unutrašnjosti bila prevladavajuća vrsta otpada na lokacijama. Tako su lokacije uz obalu na kojoj je otpad primarno činio onaj morski, donesen valovima, kategorizirane kao obalne, dok su lokacije na kojima su ljudi izravno donosili i odlagali otpad kategorizirane kao unutrašnje. Odlagališta otpada bila su uobičajeno izložena i vidljiva u 83,3 % slučajeva na obali i 79,2 % u unutrašnjosti otoka. U ostalim slučajevima bila su prekrivena vegetacijom (u unutrašnjosti) ili skrivena zbog drugih razloga na obalnom području. Terenskim je istraživanjem procijenjeno da su odlagališta još uvijek bila aktivna. Otpad se još uvijek redovito odlagao na 40,9 % lokacija u unutrašnjosti te 10 % na obali, odnosno povremeno se odlagao na 27,3 % lokacija u unutrašnjosti i 70,0 % na obali. Preostali dio lokacija na obali i u unutrašnjosti nije bio aktivan, tj. nije bilo novijih naslaga otpada.

Obalne lokacije bile su dostupne morskim putem (njih 71,4 %), 7,1 % ih je bilo dostupno makadamom, 14,3 % automobilom, a preostale su bile dostupne užim puteljcima. Odlagališta u unutrašnjosti otoka bila su dostupna automobilom asfaltiranim putem (54,2 %), makadamom (37,5 %), a preostale zemljanim putem.

Podatci pokazuju da je učestalija pojava otpada uz more na lokacijama koje su udaljenije od naselja (sl. 4). Čak 30 % lokacija uz more nalazilo se na udaljenosti 201–500 m od naselja, dok je u istoj kategoriji bilo 18,2 % lokacija u unutrašnjosti otoka. Najveći je broj obalnih lokacija, njih 40,0 %, bio u području najudaljenijem od naselja (preko 1001 m). Može se utvrditi da obalne lokacije s otpadom, a tako ni taj otpad, nisu povezane s naseljima, posebi-

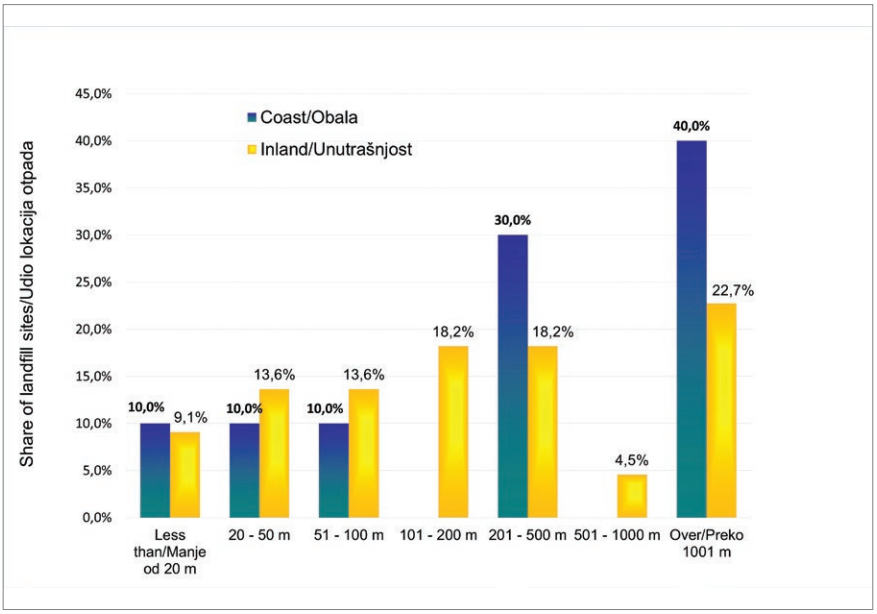

Fig. 4 Distance from landfill site to the nearby residential area

Sl. 4. Udaljenost od odlagališta do najbližega naselja

Source: According to research results

Izvor: Prema rezultatima istraživanja

meters" from a settlement area. These findings suggest that the Pašman coastal locations, where waste is disposed of, were not directly connected to a residential area. This is supported by the data on landfill accessibility, which showed that almost three-quarters of coastal disposal sites were only reachable by sea. Disposal locations were dispersed across each distance category, with the highest share (22.7%) located over 1,000 meters from an inhabited area (Fig. 4). Given that marine litter is a complex issue that results from a combination of human activities and natural factors such as winds and sea currents, an integrated approach to waste management in the Adriatic ecosystem, both on and off shore, is essential. This approach should aim to minimize waste disposal and implement policies that reduce the use of packaging, modify the materials used, and avoid single-use and disposable plastic materials. Such measures are crucial in addressing the issue of marine litter in the region (Runko Luttenberger, 2018; Vlachogianni, 2019; Scotti et al., 2021).

The study first assessed the characteristics of the disposal sites in terms of their impact on the geographic environment. Categorizing the apparent impact of the disposals, it was found that the sea was burdened mostly at the coast area (69.2%), whereas the inland areas were affected more in terms of their landscape. In addition, bad odors were present at 12.9% of inland disposal locations, resulting from

ce kad to potvrđuje i podatak o dostupnosti lokacija iz kojega proizlazi da su čak ¾ obalnih lokacija bile dostupne samo morskim putem. Lokacije s otpadom u unutrašnjosti otoka bile su raštrkane i unutar svake pojedine kategorije udaljenosti, s time da ih je najviše (22,7 %) bilo udaljeno od naselja 1001 m ili više (sl. 4). Budući da je problem morskoga otpada povezan s različitim ljudskim aktivnostima i prirodnim djelovanjem, primerice vjetrovima i morskim strujama, potreban je integrirani pristup proučavanju gospodarenja otpadom u jadranskom ekosustavu uz obalu i u unutrašnjosti. Otpad koji se odlaže treba minimalno smanjiti te primijeniti politike koje teže smanjenju pakiranja, promjeni korištenih materijala i na taj način izbjeći upotrebu jednokratne plastike i plastičnih materijala koji se odlažu (Runko Luttenberger, 2018; Vlachogianni, 2019; Scotti i dr., 2021).

U okviru istraživanja ponajprije su procijenjena vidljiva obilježja lokacija s obzirom na njhov utjecaj na geografski okoliš. Kategorizirajući mogući utjecaj odlagališta, utvrđeno je da je na obalnim lokacijama veće opterećenje u samome moru (69,2 %), dok je u unutrašnjosti najveći utjecaj odlagališta na izgled krajolika. Na 12,9 % odlagališta u unutrašnjosti otoka bio je prisutan smrad (npr. zbog spaljivanja otpada, gomilanja organskoga otpada). Na 7,7 % obalnih lokacija nije se mogao odrediti utjecaj na okoliš.

Fig. 5 After burning solid waste at an open dump, Skalice

Sl. 5. Otvoreno odlagalište gdje je spaljen otpad, Skalice

Source: N. Špeh

Izvor: N. Špeh

Fig. 6 Prevailing waste type in the interior was construction waste

Sl. 6. Prevladavajuća vrsta otpada u unutrašnjosti je građevinski otpad

Source: N. Špeh

Izvor: N. Špeh

waste burning and organic waste accumulation. It was not possible to determine the environmental impact in 7.7% of coast sites.

It was observed that there are is surface water on Pašman island, however, contamination of the underground water is possible by the run-off from the waste dump on Pašman Island. Also, there were issues with bad odors, pests, rodents, and wind-blown litter in and around the waste dump above the settlement of Kraj.

Na Pašmanu nema površinskih voda, no moguća je kontaminacija podzemnih voda procjeđivanjem vode iz odlagališta. Uz to je prisutan smrad, moguća je pojava štetnih organizama i širenje zaraze, pojava glodavaca, a dio otpada vjetrom se raznosi po okolišu, što je primijećeno na odlagalištu nedaleko od naselja Kraj.

Landfill analysis: from coast zone to inland

The study estimated that the total amount of waste in coastal disposal sites was approximately 9 m^3, while inland sites accounted for approximately 255 m^3 of waste. The average amount of waste per location was 0.9 m^3 for ashore sites and 11.6 m^3 for inland sites, in line with the total waste data. The distance of the waste from the sea provided a straightforward explanation. The majority of coastal locations (80%) were situated within 3 meters of the coastline. In contrast, the majority of inland waste dumps (68.2%) were located over 11 meters from the sea. The remaining coastal locations belonged to the category of 3–6 meters away from the sea. Inland waste locations were more dispersed, with 18.2% located within 3 meters of the sea, 4.5% within 3–6 meters, and 9.1% at distances of 7–10 meters from sea level.

Based on the results (Fig. 7), it was found that fishing gear and ship remains were the most common types of litter found in coastal areas (46.1%), followed by agricultural and bulky wood (42.5%) and household waste (30.6%). In contrast, construction waste was the most common type of waste found inland (73.6% of cases), followed by household waste (55.1%) (Fig. 5 and 6) (Fig. 7). Inert waste types, such as agricultural and bulky wood, were present in 36.7% of coastal and 22.8% of inland locations, while craft and industrial waste types accounted for 22.8% of inland locations and the lowest share of waste types were found in fishing waste, ship remains,

Analiza odlagališta: od obalne zone prema unutrašnjosti

Terenskim istraživanjem zabilježeno je 10 odlagališta s ukupno 9 m^3 otpada na obali i 22 odlagališta s ukupno 255 m^3 otpada u unutrašnjosti. Prosječna količina otpada po lokaciji iznosila je: 0,9 m^3 na obali i 11,6 m^3 u unutrašnjosti. Štoviše, pokazatelj udaljenosti upućuje na to da se većina otpada na obalnim odlagalištima (80 %) nalazila blizu obalne linije (na manje od 3 m udaljenosti), dok je većina (68,2 %) odlagališta u unutrašnjosti bila preko 11 m udaljena od mora. Preostale obalne lokacije bile su u kategoriji 3 – 6 m udaljenosti od obale mora. Lokacije u unutrašnjosti bile su dosta raspršene te ih je 18,2 % bilo smješteno unutar 3 m od obalne linije, 4,5 % 3 – 6 m, a 9,1% 7 – 10 m od obalne linije.

Analizom je utvrđeno (sl. 7) da su na obalnim lokacijama prevladavali ribarska oprema i ostatci brodova (46,1%), potom poljoprivredni otpad i drvo (42,5 %) te kućanski otpad (30,6 %). Za razliku od toga, najveći udio otpada u unutrašnjosti činili su građevinski otpad (73,6 %) i otpad iz kućanstava (55,1 %) (sl. 5 i 6) (sl. 7). Biomasa, inače inertna vrsta otpada (poljoprivredni otpad, drvo), ondje je činila 36,7 % otpada, 22,8 % bio je obrtnički i industrijski otpad, dok je najmanje bilo ribarskoga otpada, ostataka brodova i automobilskih guma. Nadalje, prosječni udio plastičnoga otpada bio je

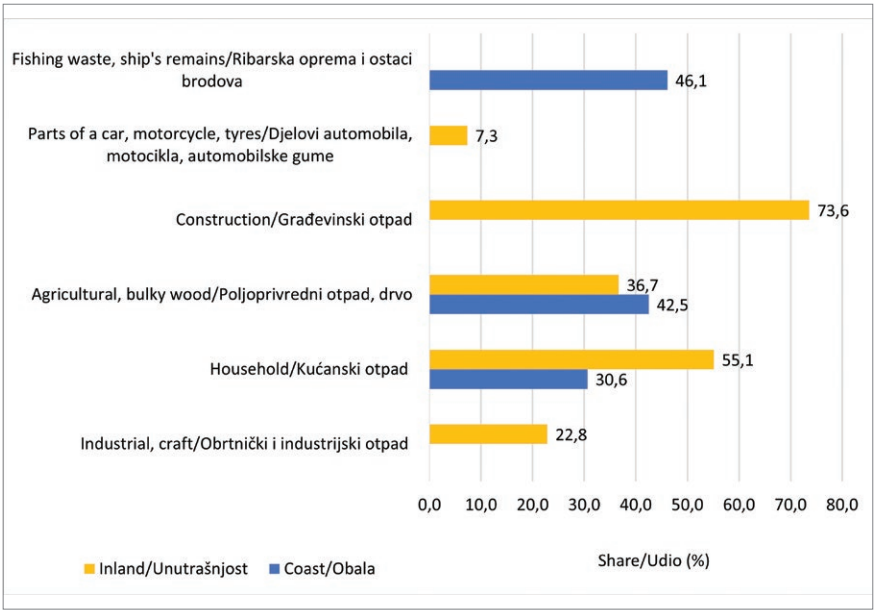

Fig. 7 Waste type at disposal locations, situated inland and in the coastal zone

Sl. 7. Vrsta otpada na istraživanim lokacijama smještenim u unutrašnjosti otoka i uz obalu

Source: According to research results

Izvor: Prema rezultatima istraživanja

and tires. Furthermore, the average share of plastic waste was higher in coastal locations (55.0%) compared to inland locations (20.9%) (Fig. 8). This finding is consistent with the results of other studies conducted on the Kornati (65.4%) and Elafiti (51.4%) archipelagos (Špeh and Lončarić, 2022). It is important to note that the marine environment has a growing resource potential that has yet to be fully recognized (Jambeck et al., 2015).

The indicator of waste origin, based on "made in" label on the packaging, was not identifiable in all cases. The study found that 70% of the sea litter in the researched locations was of Croatian origin, while inland waste was identified as Croatian, as it was located on

veći na obalnim lokacijama (55,0 %) nego onima u unutrašnjosti (20,9 %) (sl. 8). Slični rezultati zabilježeni su u Kornatskom arhipelagu (65,4 %) i na Elafitima (51,4 %) (Špeh i Lončarić, 2022). Potrebno je naglasiti da je morski okoliš sve veći potencijal s obzirom na resurse kojima raspolaže, a koji dosad nisu bili prepoznati (Jambeck i dr., 2015).

S obzirom na pokazatelj o podrijetlu otpada, zemlji proizvodnje prema oznaci „izrađeno u", nije bilo u potpunosti moguće prepoznavanje podrijetla otpada. Otpad u unutrašnjosti otoka bio je prepoznat kao hrvatski jer je i smješten na privatnom zemljištu, dok je 70 % morskoga otpada na istraži-

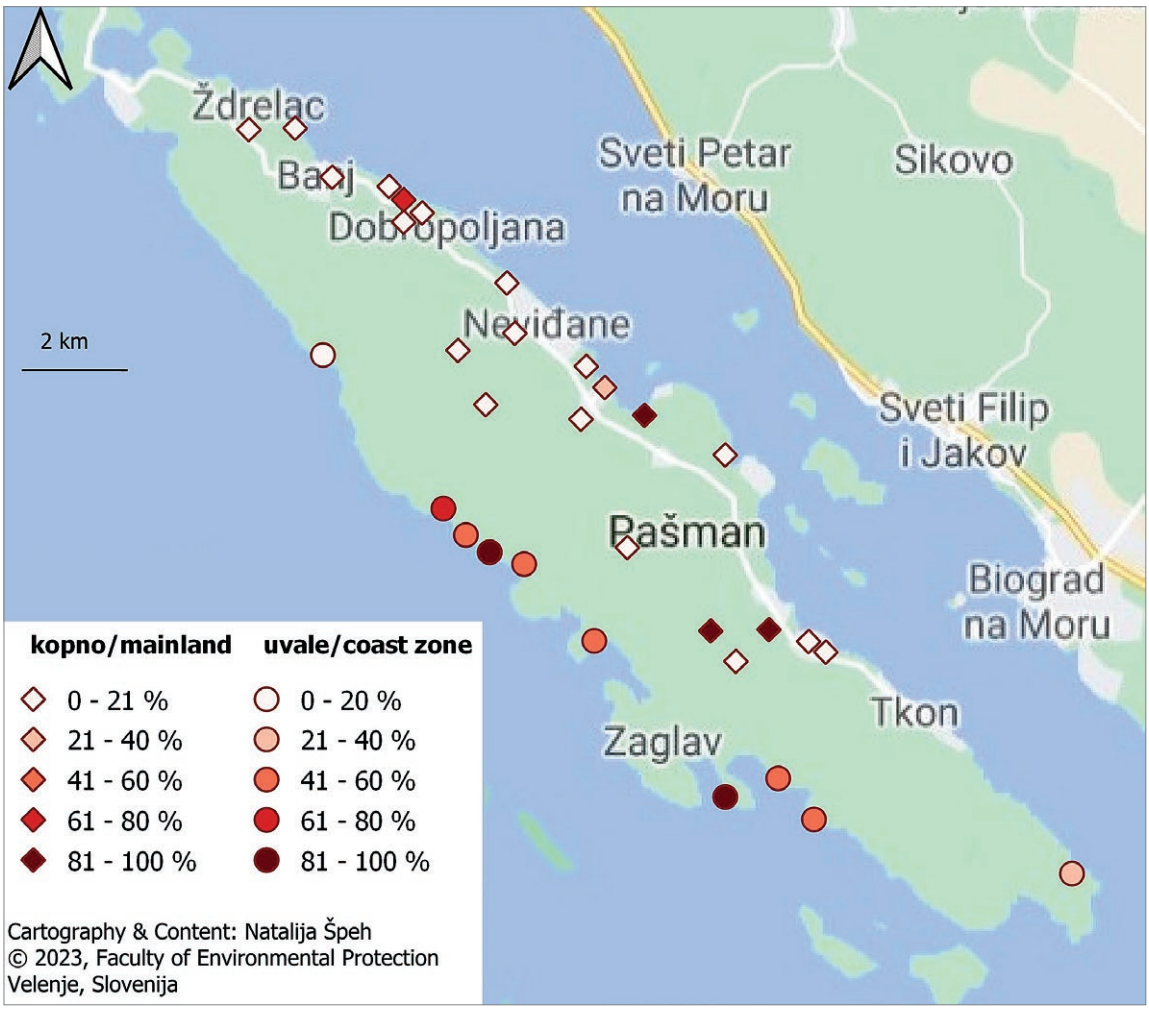

Fig. 8 Disposal sites and their plastic litter share, Pašman Island, 2018
Sl. 8. Lokacije divljih odlagališta i udio plastičnoga otpada na njima, 2018.

Source: According to the research results
Izvor: Prema rezultatima istraživanja

private land. However, a significant number of package pieces had unreadable labels, and some had been washed away. Identifying the origin of litter is an essential step in managing the impact of human activity on the sea environment (EC JRC, 2013). Therefore, the study recommends several sanitation measures. For coastal litter, the preferred solution was the re-disposal of litter to municipal landfills (90.9%), with safe wood-incineration as an alternative (9.1%) for biomass waste. For inland waste, the recommended measures included maximum potential disposal to municipal landfills (55.6%), burying and afforestation (40.7%), and wood-incineration (3.7%) as possible sanitation solutions. These recommendations aim to reduce the environmental impact of waste and promote sustainable waste management practices.

Based on the research data, it was determined that the coastal sites had an average of 0.9 m^3 of litter per location (totaling 9 m^3), while the inland sites had an average of 11.6 m^3 of litter per location (totaling 255 m^3). The waste sites on Pašman Island were also surveyed to obtain waste data, which were subsequently compared to the overall results (Tab. 4):

vanim lokacijama bilo izrađeno u Hrvatskoj. Nažalost, neka su se pakiranja isprala i naljepnice nisu bile čitke. Pokušaj detektiranja mjesta podrijetla otpada dobra je početna točka u rješavanju posljedica čovjekova utjecaja na okoliš (EC JRC, 2013). Temljem rezultata određene su i mjere sanacije. Za obalne lokacije predlaže se premještanje morskoga otpada na odlagalište (90,9 % otpada) i spaljivanje (9,1 % s obzirom na vrstu biomase). Što se tiče divljih odlagališta u unutrašnjosti, pretpostavka je da najviše otpada treba premjestiti na odlagalište (55,6 %), 40,7 % treba zatrpati i pošumiti, dok 3,7 % treba spaliti. Cilj je ovih mjera smanjenje utjecaja otpada na okoliš i promoviranje praksi održiva gospodarenja otpadom.

Rezultati istraživanja pokazuju da na obalnim lokacijama u prosjeku ima 0,9 m^3 otpada (ukupno 9 m^3), a na divljim odlagalištima u unutrašnjosti otoka 11,6 m^3 (ukupno 255 m^3). Ispitivanjem lokacija otpada na otoku Pašmanu došlo se do sljedećih rezultata koji se mogu usporediti s obzirom na položaj uz obalu ili u unutrašnjosti (tab. 4):

Tab. 4 The main characteristics of waste disposal on Pašman Island, survey 2018
Tab. 4. Glavna obilježja odlagališta otpada na otoku Pašmanu, istraživanje 2018.

indicator / **pokazatelj**	**inland (22 locations)** / **unutrašnjost (22 lokacije)**	**coastline (10 locations)** / **obala (10 lokacija)**
1) distance of waste from the sea / udaljenost otpada od obalne linije	68.2% were located over 11 m from the sea / 68,2 % lokacija bilo je preko 11 m udaljeno od obalne linije	80% were situated near the sea (less than 3 m distant) / 80 % bilo je smješteno uz obalnu liniju (na udaljenosti manjoj od 3 m)
2) waste disposal form / oblik odlagališta	90.4% in piles /90,4 % nagomilano	80.0% dispersed forms / 80,0 % raspršeno
3) amount of waste (in m^3) / količina otpada (u m^3)	255 m^3	9 m^3
4) average share of plastic / prosječni udio plastike u otpadu	20.9%	55.0%
5) prevailing waste type and share / vrsta i udio prevladavajućega otpada	construction waste (73.6% of cases) and household waste (55.1%) / građevinski otpad (73,6 % slučajeva) i kućanski otpad (55,1 %)	fishing litter (46.1%), biomass (42.5%) and household waste (30.6%) / ribarski otpad (46,1 %), biomasa (42,5 %) i kućanstva (30,6 %)

Source: Data on total annual waste collection in 2020, Utility companies for waste management (Orlić d.o.o. – data for Tkon Municipality; Čistoća d.o.o. – data for Pašman Municipality); January and February 2022, Personal Communication
Izvor: Podatci o ukupnom prikupljenom otpadu u 2020., komunalna društva za gospodarenje otpadom (Orlić d.o.o. – podatci za općinu Tkon; Čistoća d.o.o. – podatci za općinu Pašman); siječanj i veljača 2022., osobna komunikacija

The fourth indicator in Table 4 highlights a concerning issue with the economy's inefficiency in resource utilization, as the average plastic share was only 20.9% for inland locations, whereas coastal locations had an average of 55.0% of waste deposits with plastics present. This presents a clear opportunity for a circular economy, where waste is minimized and resources are maximized through recycling and reuse. To fully assess the potential for plastic recycling, further identification and analysis of the specific types of plastics found in the litter would be necessary.

CONCLUSION

The focus of this paper is to investigate the solid waste management of the island of Pašman, which was randomly selected to compare the waste locations found inland and the waste accumulated in the coastal zone. To understand the effectiveness and sustainability of waste management on the island, the CBS statistical data from 2012 and 2021 were analyzed in terms of their environmental, economic, and social features. This allowed us to determine and define the impact of human activities on waste production on the island, and various indicators were analyzed and presented in three groups. Despite having regulated waste management on the island, the survey conducted revealed ten waste disposal locations in the coastal area and 22 inland landfills, resulting in a density of 0.37 waste sites/km^2 of the island's surface.

Evaluation of the waste site data

The **physical geographical** settings and related properties of ashore and inland landfill areas were analyzed. Results showed that all coastal zone deposit sites were located on carbonate rock, while 9.1% of inland locations were situated on non-carbonate lithological basis. Vegetation cover also differed between ashore and inland sites. The majority of ashore locations (70%) were covered with vegetation, mainly of the maquis category (85.7% of disposal sites). In contrast, vegetation categories varied more evenly on

Četvrti pokazatelj u Tablici 4 naglašava postojanje zabrinjavajućega problema neučinkovita korištenja resursa jer je u unutrašnjosti otoka 20,9 % otpada prosječno otpadalo na plastični, dok su obalne lokacije u prosjeku imale 55,0 % plastičnoga otpada. Jasne su mogućnosti razvoja cirkularnoga gospodarenja otpadom, a da bi se odgovarajuće procijenio potencijal za recikliranje, potrebno je napraviti sljedeći korak, a to je prepoznavanje vrste plastike.

ZAKLJUČAK

Fokus istraživanja ovoga rada jest na gospodarenju krutim otpadom na otoku Pašmanu koji je nasumice odabran kao mjesto gdje su uspoređena divlja odlagališta u unutrašnjosti otoka i na obali. Istraživanje je obuhvatilo i analizu statističkih pokazatelja DZS-a (2011., 2021.) koji su razvrstani u tri skupine: okolišni, gospodarski i društveni, a koji su poslužili za utvrđivanje osnovne društveno-geografske podloge te učinkovitosti i održivosti trenutnoga gospodarenja otpadom. To je omogućilo utvrđivanje i definiranje ljudskoga utjecaja na proizvodnju otpada na otoku te su analizirane i predstavljene tri skupine različitih pokazatelja. Unatoč uređenom sustavu gospodarenja otpadom na otoku, uz korištenje sustavnoga popisa pokazatelja, detektirano je i analizirano 10 lokacija s morskim otpadom i 22 lokacije divljih odlagališta u unutrašnjosti otoka, čime je utvrđena ukupna gustoća zastupljenosti 0,37 lokacija s otpadom po km^2 površine otoka.

Evaluacija podataka o istraživanim odlagalištima

Kad je riječ o **prirodno-geografskim pokazateljima**, predstavljeni su paralelno podatci za obalne lokacije i one u unutrašnjosti otoka. Sve obale lokacije s otpadom nalaze se na karbonatnim stijenama, dok 9,1 % lokacija u unutrašnjosti nije na karbonatnoj litološkoj osnovi. Većina obalnih lokacija (70 %) prekrivena je vegetacijom, uglavnom makijom (85,7 %). Za razliku od toga, udio pojedine vrste vegetacije na lokacijama u unutrašnjosti bio je podjednak: u 22,7 % slučajeva tlo je prekri-

inland sites: 22.7% of locations were overgrown with maquis, 25.0% with woods, and 27.3% were used as grassland or fields. This indicator of vegetation cover corresponds to the litter site's visibility or exposure.

The selected indicators used to analyze the **socio-geographical** characteristics of the landfill locations on Pašman Island reveal that the waste sites are highly exposed, with 83.3% located on the coast and 79.2% inland. Fieldwork conducted on the landfills shows that waste disposal is ongoing, with 40.9% being dumped inland and 10.0% on the coastline. The fact that marine litter is present on land in areas that do not correspond to residential areas is particularly concerning, especially when considering that 71.4% of coast disposal sites are only reachable by sea. In contrast, access to inland litter sites is mostly by car. The distance between litter sites and nearby residential areas was also analyzed, and the results show that inland litter sites are more evenly spread across different distance categories. The highest share (22.7%) of inland litter cases was found to be over 1,000 m away from the nearest residential area. On the other hand, ashore locations show higher shares of more distant categories, with 40.0% of cases being over 1,000 m away and 30.0% in the second most distant category (501–1,000 m). The data suggests that inland litter disposal is more closely linked to settlement features and supports the NIMBY (not in my backyard) mentality.

Pašman Island waste management assessment

Pašman Island boasts favorable **environmental** features, with a low percentage of built-up areas (under 15%) and vast natural vegetation coverage, mainly maquis and scrub. These natural features have even spread to former agricultural lands. However, the number of second homes and apartments is relatively high (55.1% in Pašman Municipality and 49% in Tkon Municipality), indicating that the island's population fluctuates throughout the year, peaking during the summer tourist season. Consequently, waste production increases significantly during this period. The island's good traffic connection with the mainland has facilitated tourism development, leading to a surge in new apartment buildings. The frequency of waste collection is twice

veno makijom, 25,0 % šumom, a 27,3 % bile su lokacije s travom ili polja. Pokazatelj o zemljišnom pokrovu u skladu je s vidljivošću ili ekspozicijom odlagališta.

Odabrani pokazatelji **društveno-geografskih** obilježja na odlagalištima pokazali su da su istraživane lokacije dosta izložene: 83,3 % u obalnoj zoni i 79,2 % u unutrašnjosti otoka. Terenskim je istraživanjem na odlagalištima procijenjeno da su ona još uvijek dijelom aktivna; otpad se redovito bacao na 40,9 % odlagališta u unutrašnjosti te je stizao na 10,0 % odlagališta na obali. Posebno je zabrinjavajuće to što se morski otpad nalazi na mjestima dalje od naselja te je 71,4 % toga otpada dostupno samo morskim putem. Za razliku od toga, otpad u unutrašnjosti uglavnom je dostupan automobilom. Prema pokazatelju udaljenosti od najbližega naselja utvrđeno je da su lokacije u unutrašnjosti raspršenije unutar pojedinih kategorija. Najveći udio činile su one najudaljenije (22,7 %), u kategoriji preko 1001 m od naselja. Među obalnim lokacijama veći udio ih je bio u kategorijama udaljenijih lokacija: 40,0 % na udaljenosti preko 1001 m, a 30,0 % u kategoriji druge najudaljenije lokacije (501 – 1000 m). Lokacije divljih odlagališta u unutrašnjosti otoka u skladu su s tzv. NIMBY idejom (*not in my back yard* ili ne u mom dvorištu/susjedstvu).

Ocjena gospodarenja otpadom na otoku Pašmanu

Na otoku Pašmanu povoljni su **okolišni** čimbenici, mali je udio izgrađenoga zemljišta (ispod 15 %), a većina otoka prekrivena je prirodnim raslinjem, uglavnom makijom i šikarom koje se intenzivno šire i na nekadašnje poljoprivredne površine. No, udio stanova za odmor i rekreaciju u ukupnom broju stanova razmjerno je visok (55,1 % u općini Pašman i 49 % u općini Tkon) zbog čega broj stanovnika na otoku oscilira tijekom godine te dosiže maksimum za vrijeme ljetne turističke sezone. Stoga tada značajno raste i ukupna proizvodnja otpada. Prometna povezanost s kopnom razmjerno je dobra, što se pozitivno odrazilo na razvoj turizma i na povećanje interesa za kupnju novih stanova. Učestalost odvoza otpada

per week during the off-season and three times per week during the tourist season, enabling the collection of all waste produced. Additionally, all waste is transported to the mainland, minimizing the chances of new wild landfills. Furthermore, two collection centers cater to bulky waste and some hazardous waste. However, a notable challenge is the disposal of construction waste, which is often improperly disposed of in the environment.

In terms of **economic** features, Pašman Island's municipalities have a relatively low income per capita, with less than €1,000 per month. The island's economy mainly relies on seasonal tourism and basic services. The proportion of inactive people, mostly retirees, is also significant. During the summer season, tourist numbers on the island are ten times higher than the population, which puts pressure on the local infrastructure. Tkon experiences higher tourist traffic intensity and has a higher accommodation utilization rate compared to Pašman Municipality, which has a higher share of second homes but smaller accommodation utilization. Despite this, according to the Institute of Tourism, Pašman Municipality had a higher index of tourism development in 2019, the year before the Covid-19 pandemic, due to the total number of tourists, income, population, and the value of all tourist indicators.

According to the **social** features of Pašman Island, it has a relatively low population density, and most of the settlements in both municipalities are facing negative demographic trends. The depopulation issue is particularly severe in Tkon Municipality, and there is a high aging index, especially in Pašman Municipality. Economically inactive population makes up over 50% of the total population in both territorial units, which has hindered overall economic development. However, according to the most recent Census data in 2021, the population in Pašman municipality has slightly increased. However, some people have registered their residency on the island but do not live there permanently, which is a problem because they avoid paying taxes for a second home and pay lower prices for ferry boat tickets. This has created an unfair situation that hinders the island's economic growth and development.

jest dvaput tjedno izvan sezone i tri puta tjedno za vrijeme turističke sezone, što omogućuje odvoz svega komunalnog otpada. Sav otpad prevozi se na kopno pa su razmjerno male šanse za stvaranje novih divljih odlagališta. Čak i glomazni otpad i neke vrste opasnoga otpada prikupljaju se u dvama reciklažnim dvorištima na otoku. Jedini je veći problem građevinski otpad koji se često nepropisno odlaže u okoliš.

Gospodarski pokazatelji upućuju na to da obje općine imaju razmjerno malen prihod po stanovniku (manje od 1000 EUR/mjesečno). Otočno gospodarstvo oslanja se mahom na sezonski turizam i osnovne uslužne djelatnosti. Na otoku je zabilježen značajan udio neaktivnoga stanovništva, uglavnom umirovljenika. Broj turističkih dolazaka bio je deset puta veći od broja stanovnika što dovodi do snažna pritiska turista na lokalnu infrastrukturu u ljetnom dijelu godine. Intenzitet turističkoga prometa bio je veći u općini Tkon koja je imala i veći stupanj korištenosti stanova. S druge strane, općina Pašman imala je veći udio stanova za odmor i rekreaciju u ukupnom broju stanova, no manji stupanj korištenja stanova. Unatoč tomu, zbog ukupnoga broja turističkih dolazaka, prihoda i vrijednosti turističkih pokazatelja, prema Institutu za turizam, općina Pašman imala je viši indeks turističkoga razvoja od općine Tkon u 2019. godini, netom prije pandemije virusa Covid-19.

Društveni pokazatelji upućuju na rijetku gustoću naseljenosti otoka i na negativne demografske procese koji su prisutni u većini naselja obiju općina. Najveći su problem depopulacija (posebice u općini Tkon) i vrlo visok indeks starenja (posebice u općini Pašman). U objema teritorijalnim jedinicama zabilježen je visok udio neaktivnoga stanovništva (preko 50 %), što se odražava na gospodarski razvoj. Prema podatcima s Popisa stanovništva 2021. godine, ukupan broj stanovnika općine Pašman blago je porastao, no na to utječe i broj administrativno doseljenih, tj. osoba koje ondje imaju prebivalište, ali nisu stalni stanovnici otoka. To čine radi izbjegavanja plaćanja poreza na kuću za odmor te radi ostvarivanja manje cijene pomorskoga prijevoza. Ovo je stvorilo nepravednu situaciju koja sprečava ekonomski rast i razvoj otoka.

The findings of the qualitative research suggest that the waste management practices on Pašman Island have significantly improved in the past decade. The younger generation appears to be more committed to waste separation and recycling, and they actively participate in cleaning campaigns that are occasionally organized on the island. In addition, the local community has made significant efforts in waste management, such as cleaning up old illegal landfills and educating the residents about proper waste disposal. As a result, all interviewees emphasized the importance of taking care of the environment and sorting out waste. Although some residents still dispose of bulky or construction waste improperly, such cases are less frequent than in the past. In the earlier years, before organized waste collection was introduced, residents used to burn waste in their yards or dump it in the woods or sea. They even believed that old appliances like washing machines or stoves would create artificial reefs that would attract fish. Nowadays, islanders feel relieved that they are no longer so plagued by waste-related problems. However, marine litter remains a challenge, with fishing (46.1%) and nautical tourism (30.6% of household litter) being the main sources of sea litter. Furthermore, the southern, uninhabited shores of the island are more vulnerable to sea litter.

Rezultati kvalitativnoga istraživanja pokazuju da je lokalno stanovništvo u posljednjem desetljeću unaprijedilo svoje navike vezane uz gospodarenje otpadom, odvajanje i recikliranje otpada. Mlađi stanovnici čine se disciplinirani-jim u odvajanju otpada i više žele sudjelovati u kampanjama čišćenja otpada koje se katkad organiziraju na otoku. Također, lokalna je samouprava dosta uložila u čišćenje starih divljih odlagališta i u edukaciju otočana. Stoga su svi ispitanici spomenuli da je vrlo važno voditi brigu o okolišu i sortirati otpad. Svjesni su toga da još uvijek ima ljudi koji bacaju otpad u okoliš, uglavnom građevinski i glomazni otpad, no to se događa rjeđe nego prije. Desetljećima prije, dok nije bio organiziran odvoz otpada, komunalni su otpad palili u svojim dvorištima, a glozani otpad odlagali u okoliš ili bacali u more. Čak su bili uvjereni da je bacanje u more stare perilice za rublje ili pećnice dobra ideja jer će postati mrijestilišta za ribe. Danas se otočani osjećaju kao da su spašeni od otpada. Veći je problem morski otpad koji uglavnom dolazi od ribarenja (46,1 %) i nautičkoga turizma (30,6 % komunalnoga otpada), a kojem je izloženija južna nenaseljena obala otoka.

Proposals and recommendations

The study revealed that the majority of waste found on the island was of Croatian origin, as indicated by the "made in" label on the packaging. In particular, the waste found inland was entirely of Croatian origin. In response to these findings, sanitation measures were recommended, and potential participants were identified to help address the issue.

The use of indicators was deemed a suitable approach for analyzing and quantifying waste pollution in isolated island areas. The selected indicators were chosen based on the study's focus and included both physical and social geographical aspects. Results showed that for interior locations, construction waste was the predominant type of waste, whereas sea litter consisted mainly of plastics, fishing gear remnants, and boat debris.

Prijedlozi i preporuke

Istraživanje je pokazalo da je većina otpada na otoku hrvatskoga podrijetla s obzirom na oznaku „proizvedeno u", posebice u unutrašnjosti otoka gdje se to odnosi na sav otpad. S obzirom na rezultate preporučene su mjere sanacije i izdvojeni mogući sudionici da bi se riješio problem odlaganja otpada.

Korištenje pokazatelja činilo se odgovarajućim pristupom za analizu i kvantifikaciju onečišćenja otpadom na izoliranim otočnim područjima. Odabrani pokazatelji izdvojeni su s obzirom na usmjerenost istraživanja te su uključili prirodna i društveno-geografska obilježja. Rezultati su pokazali da je na lokacijama u unutrašnjosti najviše zastupljen građevinski otpad, dok je među morskim otpadom najviše bilo plastike, ribarskoga otpada i otpada s brodova.

The qualitative research was conducted by utilizing statistical data to identify the availability possibilities. The features were then interpreted to propose future waste management implementation on Pašman Island. The findings of the study highlighted the importance of considering the question of whether to conserve or develop the island. Additionally, it was noted that the summer season lifestyle, including food habits and living standards, may impact the island's future. Overall, the qualitative research provided valuable insights to inform decision-making for sustainable waste management and future development on the island.

The waste survey conducted in the coastal zone of Pašman Island provides valuable quantitative data on the accumulation of sea litter in the north Dalmatian waters. As the first systematic research of an Adriatic island, the survey's results have implications beyond the island itself, offering insights into waste management in isolated coastal residential areas. Based on the findings, strategic goals for waste management evaluation are proposed, targeting both tourists and the local population (see Table 5). Given the island's geographic characteristics and its reliance on its natural environment, it is crucial to implement sanitation measures to prevent further degradation caused by illegal waste disposal. To achieve long-term effectiveness, an integrated approach involving residents, authorities, and visitors is needed to strengthen Pašman Island's waste management practices.

In order to enhance the effectiveness of waste management on Pašman Island, it is essential to raise awareness among both residents and visitors about the vulnerability of the marine ecosystem and the importance of regular monitoring of illegal waste disposal. Addressing the main regional challenges, such as the lack of appropriate legislation, insufficient funding and services, and the need for cost-efficient municipal services, is crucial. Moreover, special attention should be paid to remote, aging, and depopulated rural areas, which are particularly susceptible to non-indigenous and invasive anthropogenic influences, such as plastic waste. One promising solution could be to transform waste into a resource and integrate it into the regional green economy, thus creating economic

Tijekom kvalitativnoga istraživanja koristili su se statistički podatci da bi se utvrdile dostupne mogućnosti. Nakon interpretacije svih pokazatelja bilo je moguće oblikovanje određenih prijedloga koji će se u budućnosti moći primijeniti u gospodarenju otpadom na Pašmanu. Prepoznato je i pitanje budućega očuvanja i razvoja otoka na što može dodatno utjecati sezonski stil života (primjerice navike u prehrani i životni standard). Sve u svemu, kvalitativno istraživanje omogućilo je vrijedan uvid u probleme o kojima se mogu obavijestiti i oni koji odlučuju o održivom gospodarenju otpadom i budućem razvoju otoka.

Istraživanje otpada provedeno na obali otoka Pašmana daje vrijedne kvantitativne pokazatelje o gomilanju morskoga otpada na akvatoriju Sjeverne Dalmacije. Budući da je ovo prvo ovakvo sustavno istraživanje jednoga otoka na Jadranskom moru, rezultati imaju implikaciju i dalje od samoga Pašmana jer pružaju uvid u gospodarenje otpadom na izoliranim obalnim naseljenim prostorima. Temeljem rezultata predloženi su strateški ciljevi za procjenu gospodarenja otpadom koji su usmjereni na posjetitelje i na lokalno stanovništvo (tab. 5). S obzirom na prethodno spomenute geografske aspekte (s naglaskom na okoliš) predložene su mjere sanacije da bi se zaustavila trenutna degradacija otoka divljim odlagalištima te spriječila buduća. Da bi se postigao dugoročni efekt, integrirani pristup uključuje lokalno stanovništvo, vlasti i posjetitelje otoka, što je potrebno da bi se ojačale prakse gospodarenja otpadom na otoku Pašmanu.

Da bi gospodarenje otpadom na Pašmanu bilo učinkovitije, obvezno je povećati svijest stalnih i povremenih stanovnika o osjetljivosti neobnovljivih dobara i usluga morskoga ekosustava te započeti s redovitim praćenjem otpada na divljim odlagalištima. Potrebno je upozoriti i na glavne regionalne izazove poput rješavanja nedostatka propisa, omogućavanje dovoljno sredstava i usluga za zajednicu i organizacija općinskih usluga na način da budu isplative. Pokazalo se da na udaljena, ostarjela i depopulirana ruralna područja mogu utjecati neautohtoni i invazivni antropogeni izvori (npr. (plastični) optad). Jedno od mogućih rješenja moglo bi biti da ga se iskoristi i uključi u integralno regionalno zeleno gospodarstvo čime bi

Tab. 5 Proposal of the strategic goals and the future measures for the waste management on Pašman Island
Tab. 5. Prijedlog strateških ciljeva i budućih mjera za gospodarenje otpadom na otoku Pašmanu

Target population group/institution / Ciljana skupina populacije/institucije	Strategic goals / Strateški ciljevi	Measures (Sustainable Communities, 2003) / Mjere (Održive zajednice, 2003)
Locals, Guests/ Tourists / Lokalno stanovništvo, posjetitelji/turisti	Control personal Carbon budget (thinking and acting Zero waste) / Kontrola osobnog proračuna ugljika (promišljanje i reagiranje za nula otpada ili *zero waste*)	1. Respect the concept of the separate waste collection (so-called eco-islands): separate landfills for (non) hazardous and inert wastes. 2. Reduce the amount of biodegradable municipal waste sent to landfills. 3. Payment of the Municipal waste service. 4. Near recycling is compulsory. / 1. Usvajanje koncepta odvojenoga prikupljanja otpada (tvz. ekootoci): odvojiti odlagališta za (ne)opasni i inertni otpad. 2. Smanjenje količine biorazgradivoga komunalnog otpada koji se odvozi na odlagališta. 3. Plaćanje općinske usluge odvoza otpada. 4. Obavezno recikliranje u blizini.
Municipal authorities / Općinske vlasti	Provide an efficient system for the permanent and temporary inhabitants of Pašman Island (Harmonize the waste generation, storage, collection, transport, processing, and disposal of solid waste, in accord the best principles of public health, economics, landscape conservation and aesthetics with other environmental features) / Omogućiti učinkovit sustav za stalne i povremene stanovnike Pašmana (uskladiti proizvodnju otpada, pohranu, prikupljanje, prijevoz, obradu i odlaganje krutoga otpada i uskladiti najbolje principe za javno zdravstvo, gospodarstvo, očuvanje i izgled krajolika s ostalim obilježjima okoliša)	1. Empower the regulation for regional waste management according to EU waste disposal laws. 2. Control and monitoring of the closure of the irregular sites. 3. Enact restrictions on land-filling liquid wastes, infectious clinical waste, and certain types of hazardous waste (e.g. highly flammable waste). 4. Consider opening legal, controlled disposal of old tyres and cars. / 1. Osnaživanje regulacije za gospodarenje otpadom na regionalnoj razini prema zakonima EU-a o gospodarenju otpadom. 2. Kontrola i praćenje zatvaranja divljih odlagališta 3. Donošenje propisa o ograničenju odlaganja tekućega otpada, infektivnoga medicinskog otpada i određenih vrsta opasnoga otpada (npr. visoko zapaljivog). 4. Uzimanje u obzir mogućnosti otvaranja legalnoga, kontroliranog odlagališta za automobilske gume i stare automobile.

opportunities and contributing to environmental sustainability.

While Pašman Island currently has a well-organized waste collection service, there is a need to consider additional waste management arrangements as tourism development grows. Despite the presence of illegal landfills, the island's natural landscape still offers high environmental aesthetics that must be protected and preserved.

The research aimed to conduct an environmental impact assessment of Pašman Island's delicate coast and inland ecosystems and identify areas for improvement in waste management activities. The island's high season period, when tourism is at its peak, causes significant environmental, social, and economic pressures. Despite having waste management regulations in place, they do not adequately scale with the rising population in summer period, increasing municipal waste generation, and tourism

se otvorile gospodarske mogućnosti i pridonijelo održivosti okoliša.

Premda Pašman trenutno ima dobro organizirano prikupljanje otpada, postoji potreba da se razmisli o dodatnim mjerama zbog budućega razvoja turizma. Unatoč dokazu o postojanju ljudskoga utjecaja na divljim odlagalištima otpada otok još uvijek pruža čisti prirodni krajolik s visokom estetikom okoliša koji vrijedi zaštititi i očuvati.

Istraživanjem se nastojao procijeniti utjecaj na okoliš otoka Pašmana, na njegov osjetljivi ekosustav obale i unutrašnjosti te utvrditi područja u kojima se mogu popraviti aktivnosti vezane uz gospodarenje otpadom. Turistička aktivnost na otoku, u srcu sezone, značajan je okolišni, društveni i gospodarski pritisak. Unatoč postojanju regulacija o gospodarenju otpadom one nisu u skladu s povećanjem stanovnika u ljetnom dijelu godine, povećanjem komunalnoga otpada i turističkoga

income. It is imperative to address this issue to ensure the protection and preservation of the island's environment while supporting its economy. Our future plan includes revisiting the landfill areas to assess whether they have been fully remediated or are still active.

prihoda. Naglasak je na isticanju toga problema da bi se omogućila zaštita i očuvanje otočnoga okoliša uz istodobno podržavanje gospodarstva. Planiramo u budućnosti opet posjetiti odlagališta i procijeniti jesu li u potpunosti sanirana ili su još uvijek aktivna.

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