IZVORNI ZNANSTVENI ČLANAK / *ORIGINAL SCIENTIFIC PAPER*

TYPOLOGY OF VIS ISLAND BASED ON INFLUENCE OF GEOLOGICAL, GEOMORPHOLOGICAL AND PEDOLOGICAL CHARACTERISTICS ON NATURAL AND CULTURAL LANDSCAPE

Tipologija otoka Visa temeljena na geološkim, geomorfološkim i pedološkim karakteristikama prirodnog i kulturnog krajobraza

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Summary

The basic assumption of this paper is that the relationship between geological basics, geomorphological and pedological characteristics, with structural features of the natural and cultural landscape can serve as a criterion to determine landscape typology with respect to sensitivity to natural processes and anthropogenic influences.

Karst natural and cultural landscape of Vis Island, continuously developed under the influence of traditional agriculture, transformed Vis Island into landscape of unique identity and relevance in the wider context of the Adriatic and the Mediterranean. Its characteristics are significant typological variations, authenticity and interdependence of natural and cultivated landscape structure, which makes significant difference respective to appearances of natural and human environment on other Adriatic islands.

In this paper character and scope of the impact of natural and social features of the landscape were assessed and sensitivity of areas to existing and potential adverse natural and anthropogenic influences was estimated. This is especially important due to the fact that in the future the island of Vis can expect significant transformation of natural and cultural landscape, as a result of synergic effect of recent natural and social processes. The last are represented through the stronger trend of abandonment of agricultural land, parallel with the spreading of tourism and related activity which leaves the consequences on the natural and cultural landscape.

Keywords: natural landscape, cultural landscape, Vis island, Adriatic, typology

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Sažetak

Temeljna pretpostavka ovog rada jest da odnos između geoloških, geomorfoloških i pedoloških značajki, zajedno sa strukturnim obilježjima prirodnoga i kulturnog krajolika može biti kriterij za određivanje tipologije krajobraza s obzirom na osjetljivost na prirodne procese i antropogeni utjecaj.

Krški prirodni i kulturni krajolik otoka Visa kontinuirano se razvijao pod utjecajem tradicionalne poljoprivrede, pri čemu je došlo do transformacije u krajobrazu jedinstvenog identiteta i značaja u širem kontekstu jadranskoga i sredozemnog područja. Njegove su karakteristike izražene tipološke varijacije, autentičnost i međuovisnost prirodne i kulturne strukture krajobraza, što ga u velikoj mjeri razlikuje od većine ostalih jadranskih otoka.

U ovom radu opisani su karakter i značenje utjecaja prirodnih i antropogenih faktora krajolika, procijenjena je osjetljivost područja na postojeće i potencijalne prirodne i antropogene utjecaje. To je posebice važno zbog činjenice da se u budućnosti može očekivati još snažnija transformacija krajobraza otoka Visa kao posljedica sinergijskih efekata recentnih prirodnih i antropogenih procesa. Antropogeni procesi uključuju napuštanje poljoprivrednog zemljišta, širenje turističkih sadržaja i s njima povezanih aktivnosti, što dovodi do negativnih utjecaja na prirodni i kulturni krajolik.

Ključne riječi: prirodni krajobraz, kulturni krajobraz, otok Vis, Jadran, tipologija.

INTRODUCTION / *Uvod*

Vis Island represents a landscape of unique identity. Consideration of variability of geomorphological, lithological, structural, pedological, climatological and vegetational features is relevant in the wider context of the Adriatic and the Mediterranean (Gams, 1987, Sauro, 1987). The island is being continuously developed under the influence of traditional agriculture. Therefore, settlements and agricultural landscapes represent basic elements of cultural landscape on the Vis Island. Agricultural landscapes cover the grasslands in which pasture takes place, gardens, fields, land with mixed crops, orchards, vineyards, forests, barren land, and dry stonewalls, a traditional fence of agricultural land, or as integral part of terraces.

Appearance of natural landscapes of Vis Island is dominantly influenced by morphological diversity as a result of peculiarity of karst rock composition. This applies particularly to the dominant geomorphic karst and fluviokarst surface forms: poljes, dry valleys, uvalas, dolinas, karst plains, slopes and rocky shores, which are vulnerable to the recent process of modelling.

The purpose of this work is, among other things, to identify areas that are particularly exposed to these processes and to establish the methodology that can be applicable in other karst areas of similar characteristics in the country. Thus, better understanding of this complex problem would be achieved, with the goal of the more quality area management and what is more important, its preservation.

AREA OF RESEARCH / *Područje istraživanja*

Vis Island (Fig. 1) belongs to the middle group of the middle Dalmatian islands. With total area of 89.7 km^2 (max. length 17 km (from cape Barjaci to cape Kampanel) and max. width 8 km (Pritišćina – Oključna)) is the ninth largest island among the Croatian islands [3]. Coastal length of the island is 84.9 kilometres and the coefficient of indentation is 2.28, thus the island of Vis belongs to a group of less indented island. The island of Vis is so-called "Hvar orientated" (west-east), which deviates from the "Dalmatian direction". It is 45 km away from the mainland and it is the furthest and the largest offshore island. In the past (and even today) isolation of Vis Island influenced the socio-economic development of the island. As a result of isolation and demographic aging of the population the process of depopulation is intensifying, particularly pronounced in the 20th century. This process had multiple effects, and one of the distinctive changes is the change of natural and cultural landscape of the island [6].

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Figure 1. Topographical map of Vis Island
Slika 1. Topografska karta otoka Visa

MATERIALS AND METHODS / *Materijali i metode*

In this paper we used methods of analysis of topographic, satellite and thematic maps and aerophotogrametric data and spatial observation. By studying various cartographic bases we obtained spatial insight, so sites of interest for this study were further explored and photo documented. Were used them to show the types of natural and cultural landscape on Vis island. Overlapping of thematic maps and their mutual comparison (together with the documentation from the field) was used for determination of all the types of natural and cultural landscapes. They were determined by correlation of elements of natural basis and anthropogenic contents. All these methods gave an insight into the processes that influenced the formation, recent status and trends of development of the landscape of the island of Vis.

GEOLOGICAL, GEOMORPHOLOGICAL AND PEDOLOGICAL CHARACTERISTICS OF VIS ISLAND / *Geološke, geomorfološke i pedološke karakteristike otoka Visa*

Geological characteristics / *Geološke karakteristike*

Tectonically, Vis Island belongs to tectonic unit called "Middle Dalmatian Islands". This tectonic unit is part of the Adriatic carbonate microplate, for the most part extending beneath the Adriatic Sea. The anticline core is built of clastic sediments with gypsum and anhydrite in association with pyroclasts as well as spilites and diabases of upper Ladinian - upper Norian age, while the limbs are built of Cretaceous carbonates: limestones and dolomites (fig. 2). Regional compression created tectonic framework for geomorphological processes and development of karst forms. Quaternary sediments found in joint systems, local depressions and karst poljes are the youngest deposits on Vis Island [2]. Faults on Vis Island (often presented as fault zones few meters wide), are mainly sub-parallel to the longer axis of the island. Smaller faults, which are often provided transversely to the direction of the main fault, are of local importance because they dissected the entire island and pre-disposed formation of numerous uvalas, karst poljes, dry valleys, plateaus, hill slopes and trenches. In morphological depressions and on glacis slopes sediments were deposited and soils were developed.

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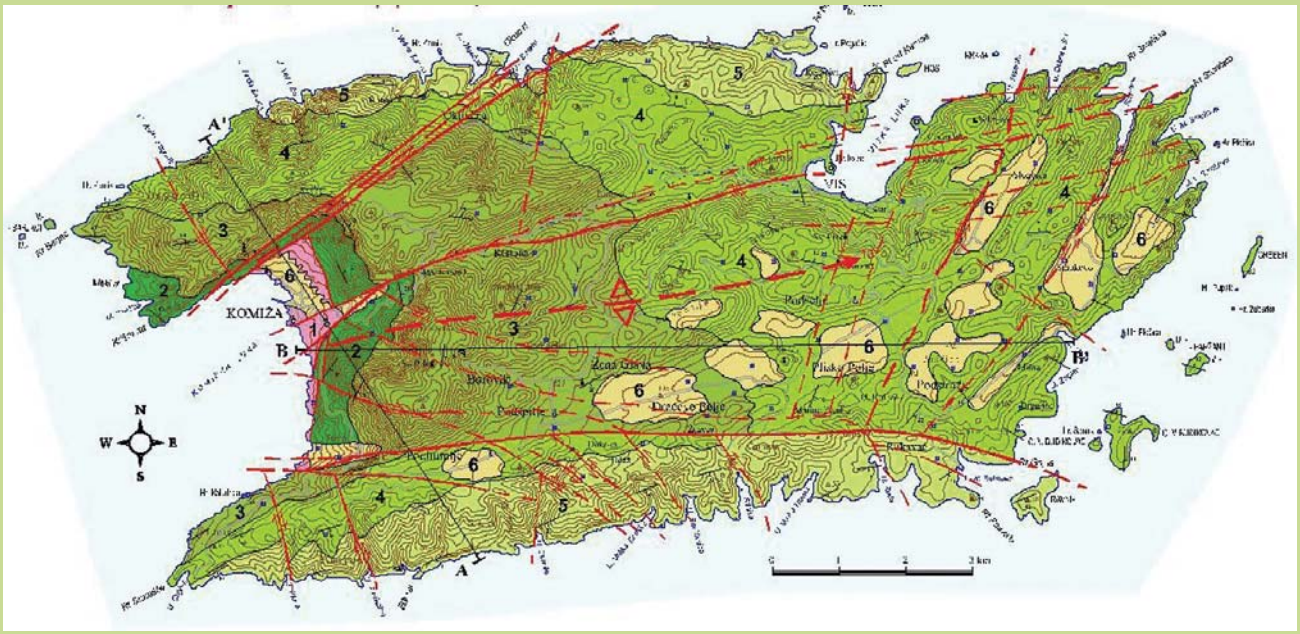

Figure 2. Geological map of Vis Island [7]. 1 - volcanogenic-sedimentary-evaporitic complex of Triassic age; 2 - lower Triassic dolomites; 3 – limestones of lower Cretaceous age; 4 – dolomites and limestones of Cenomanian age; 5 – limestones of Turonian-Coniacian age; 6 – Quaternary sediments

Slika 2. Geološka karta otoka Visa [7]. 1 – trijaski vulkanogeno-sedimentno-evaporitni kompleks; 2 – dolomiti donjeg trijasa; 3 – vapnenci donje krede; 4 – cenomanski dolomiti i vapnenci; 5 – vapnenci turon-koniaka; 6 – kvartarni sedimenti

GEOMORPHOLOGICAL CHARACTERISTICS / *Geomorfološke karakteristike*

Morphologically, three hill chains and two depressions containing several smaller karst poljes are well distinguished (fig. 3).

On the island 6 height classes ranking from 0 > 500 m were distinguished. On the eastern half of Vis Island the elevation does not exceed 300 m above sea level, while in the western part the elevation exceeds 500 metres. Higher hills are formed in the limestones; while in dolomites often negative forms (mostly in area of faults) of relief are located.

Ridges slopes (north and south) are dissected with trenches and dry valleys. Heights zonally increase from the coast to the interior where central ridge (extending from Komiža to Vis) highlights and shares the island on northern and southern part.

Slope inclinations largely reflect morphostructural terrain features. Four categories were distinguished. Considering that on the slopes inclined over 12° denudation processes become very strong, mass movement occurs. Processes of erosion (dispersion and collapse) become very intense.

Karst poljes were formed on tectonically predisposed areas (fault zones) by intense dissolution of carbonate rocks and accumulation of insoluble residuum. Geomorphological processes of erosion and dispersion ensure continuous deposition of materials in the karst poljes. Mentioned processes also affected the formation of dry valleys and coves. Dry valleys are the legacy of differential modelling during the cold and wet Pleistocene, and processes of flat surface corrosion played important role in their forming. Forms of dry valleys and uvalas also indicate fluvio-karst forming of relief on Vis Island during the geological history. Morphologically, dry valleys on Vis Island are of canyon type and are distributed along the coast and in the interior.

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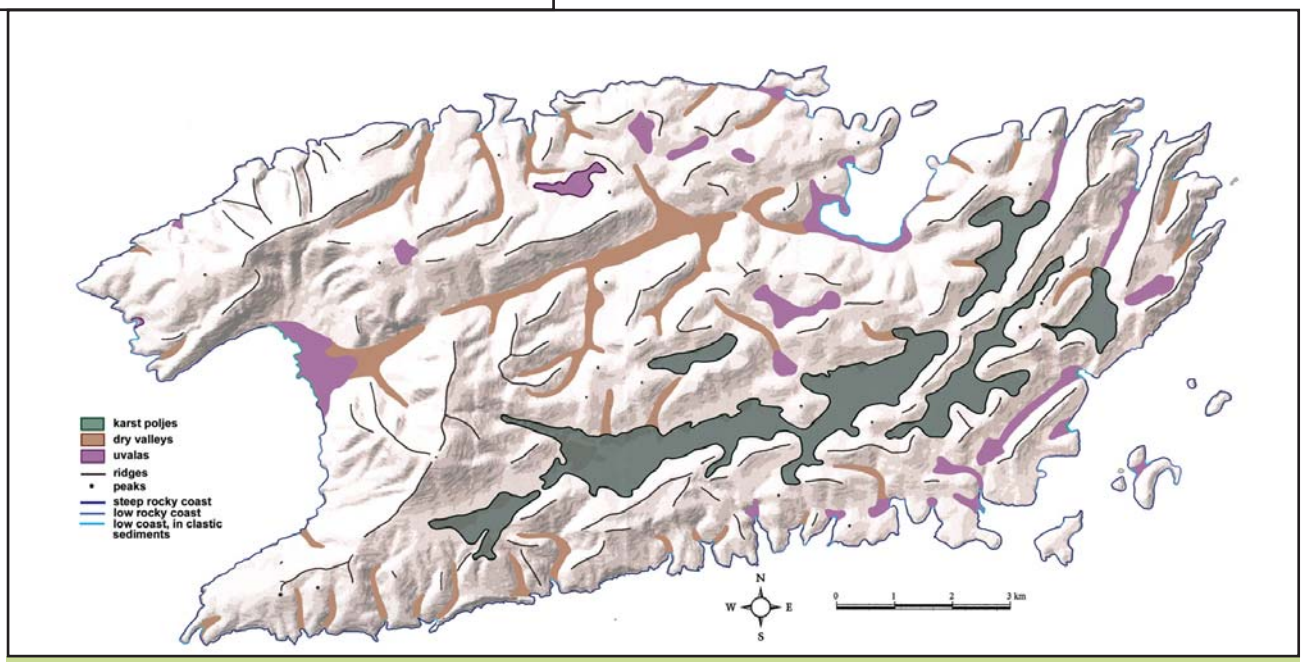

Figure 3. Geomorphological sketch of Vis Island
Slika 3. Geomorfološka skica otoka Visa

PEDOLOGICAL CHARACTERISTICS / *Pedološke karakteristike*

Lithology and rock structure, noticeable relief, particularities of hydrologic circumstances and climate-vegetation characteristics as well as human activity (anthropogenic soils) condition origin, development and features of the soils in a space. Zones of the fertile soils, although relatively small, have always been significantly important for development and resistance of human societies on Vis Island. These zones are limited to morphological depressions (karst poljes). There are 17 karst poljes (total area: 783,5 ha) mostly located on south-east of Vis island. Three soil types developed on carbonates occur in karst poljes: lithosol, terra rossa and anthropogenic soil as most common type (Fig. 4).

Soil in karst poljes has been used for agricultural production since ancient times; therefore most of settlements are located near, or at the edges of karst poljes. In the several last decades agricultural production has been slowed down or even abandoned.

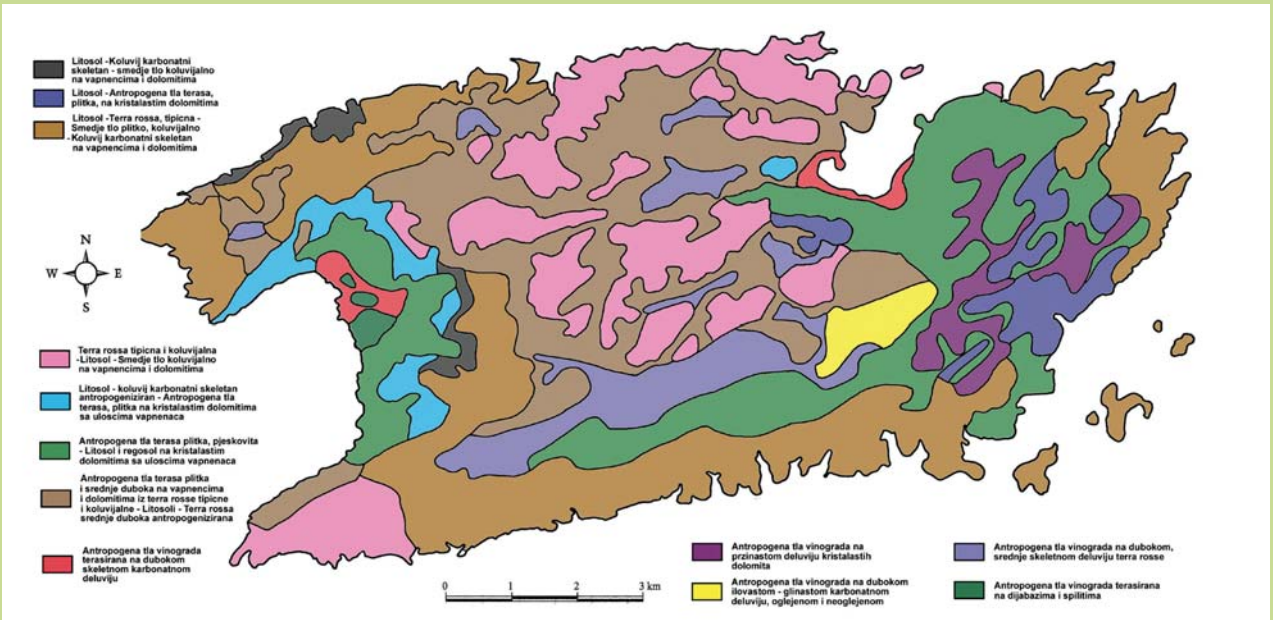

Figure 4. Pedologic map of Vis Island [5]
Slika 4. Pedološka karta otoka Visa [5]

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SOME CHARACTERISTICS OF CULTURAL LANDSCAPE OF THE VIS ISLAND / *Neke karakteristike kulturnog krajobraza otoka Visa*

Karst poljes represent the type of cultural landscape [1] that has the largest share of cultivated area (while the degraded areas on closer or more distant high ground generally have the function of pastures). Due to its importance in agriculture in the past, poljes were the driving force of island development, so most of the villages on the island of Vis are located at their ends (Fig. 5).

Because of intense agricultural production in the past, large areas on the island of Vis are covered with dry stonewalls. They are located on steep hill slopes in order to increase the area for agricultural production. Nowadays agricultural production is mostly abandoned and much of this type of landscape is overgrown. Determining the spatial distribution areas with stone walls that are covered with forests and degraded vegetation, can also identify areas where it is in the process of reforestation.

TYPOLOGY OF VIS ISLAND BASED ON COMBINED NATURAL AND CULTURAL LANDSCAPE ELEMENTS / *Tipologija otoka Visa s aspekta kombiniranog djelovanja prirodnih i kulturnih elemenata krajobraza*

On the island of Vis we separated three main types of integrated physical and cultural landscape, which are divided into subtypes (Fig. 6). Three general types of landscape are: karst poljes (Fig. 7 and 8), slope surfaces and the coast. Karst poljes, because of their anthropogenic evaluation are socio-geographic category and are fully integrated type of natural and cultural landscape. Additional criteria for distinguishing slope subtypes were: natural geographic criterion of the existence or absence of vegetation and socio-geographical criterion of the existence (Fig. 9 and 10) or absence of area under dry-stone walls. Coast types are distinguished in four subtypes: steep coasts in limestones (Fig. 11), low coasts in limestones, coasts in clastic sediments (Fig. 12) and urbanized coasts.

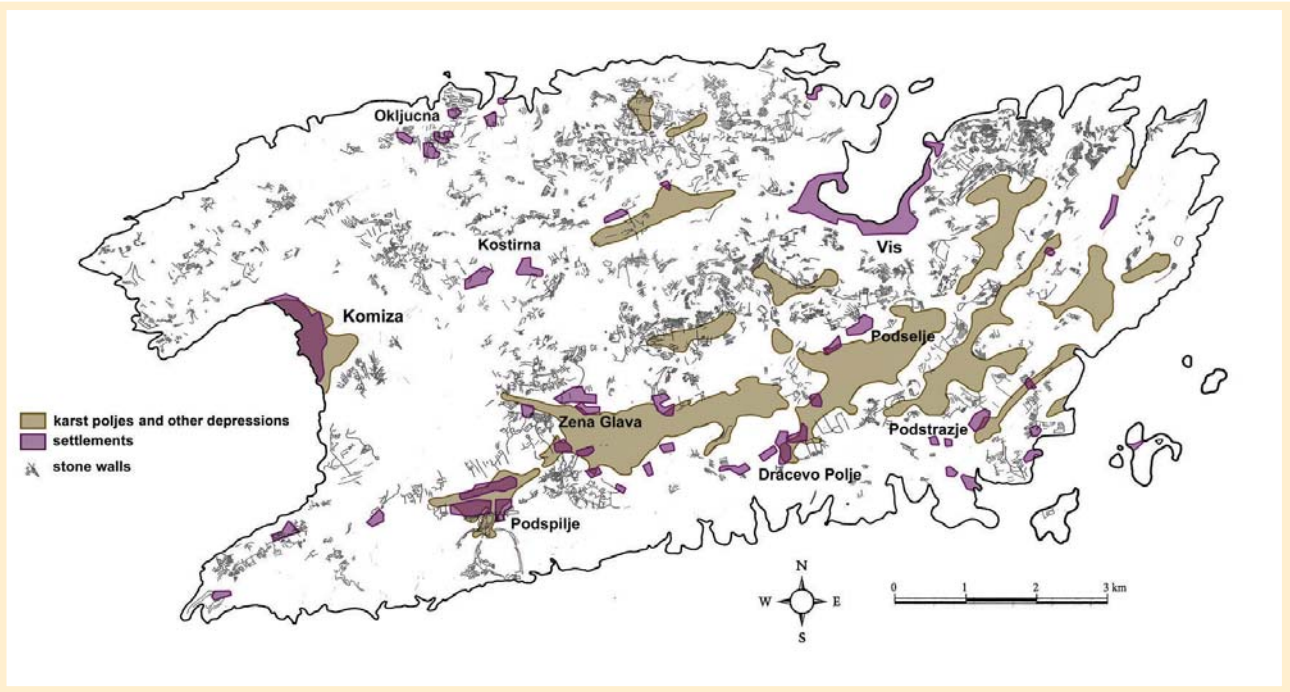

Figure 5. Cultural landscape features of the Vis Island
Slika 5. Elementi kulturnog krajobraza otoka Visa

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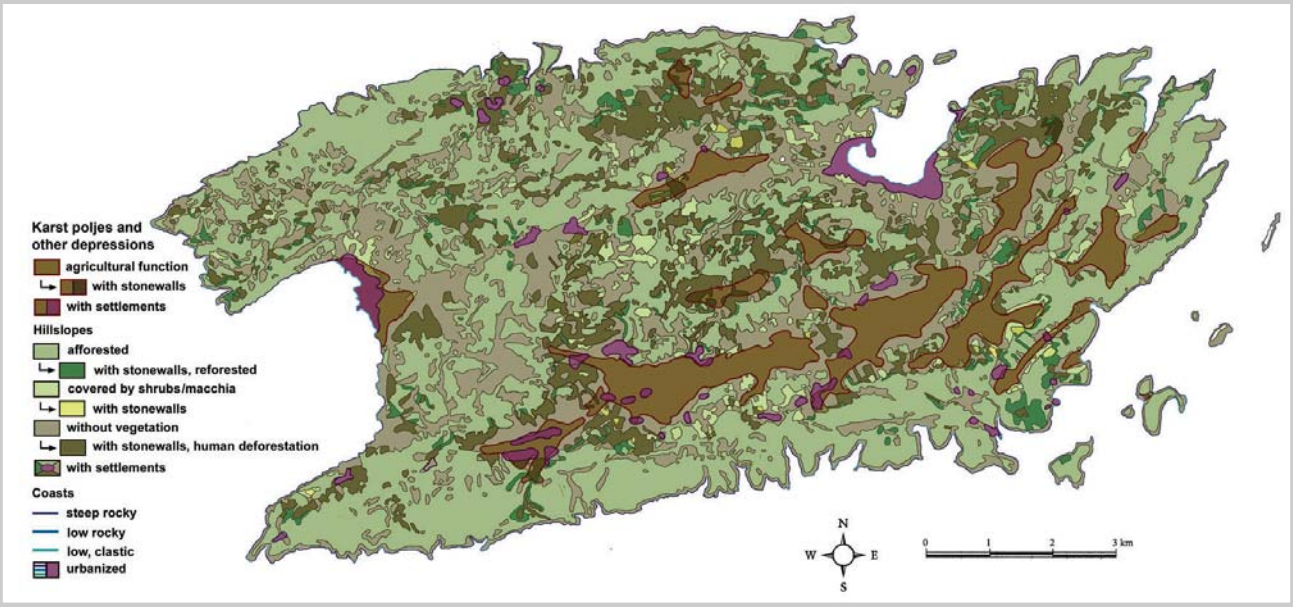

Figure 6. Types of integrated physical and cultural landscape of Vis Island
Slika 6. Tipovi integriranog prirodnog i kulturnog krajolika otoka Visa

Figure 7. Karst polje
Slika 7. Krško polje

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Figure 8. The edge of karst polje with settlement
Slika 8. Rub krškog polja s naseljem

Figure 9. Slope with terraces in agricultural function
Slika 9. Padina s terasama u poljoprivrednoj funkciji

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Figure 10. Slope with abandoned terraces, reforestation
Slika 10. Padina s napuštenim terasama, reforestacija

Figure 11. Steep coast in limestones
Slika 11. Strma obala u vapnencima

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Figure 12. Coast in clastic sediments
Slika 12. Obala u klastičnim sedimentima

CONCLUSION / *Zaključak*

Spatial changes, whether due to neglect or conversion of agricultural land into construction land, represent a threat because of the potential loss of traditional agricultural landscape, which is in this area an important element of spatial structure and spatial factor identity. To preserve this landscape it is necessary to determine the degree of sensitivity of certain areas to natural and anthropogenic destructive influences. It is possible to conduct a detailed analysis of interdependence of the natural elements (geology, geomorphology, soil, vegetation, climate, etc.) and cultural landscape (villages, fields and dry stonewalls), where it is necessary to establish a hierarchy of degree of impact strength on the changes in space, individually and as a whole.

For this purpose, in this paper synthetic typology of natural and cultural landscape was conducted, in which some of these elements were brought into interrelation. In further research, it would be useful to carry out evaluation of landscape types in terms of natural and destructive anthropogenic influences. In that way, predictions for providing basic and appropriate protection measures would be created. These measurements would be adjusted to the specific characteristics of certain types of natural and cultural landscape.

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