

Spatial Development Potential Considering Conservation Planning Criteria

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Summary

The paper focuses on the issues of possible differences in the decision considering spatial allocation of land use and its potential and optimized allocation that derives from suitability modeling. The researched area was Žumberak- Samoborsko gorje Nature Park, one of the youngest Croatian nature parks. As such, it should have a physical plan of the special features areas, in order to know its potential and limitations. There is no such plan yet, so protection measures and development is relinquished to cities and municipalities, within whose territory the Park is situated. One of the municipalities is Ozalj, and it is used in the paper as an example for the analysis of physical planning approach for Žumberak- Samoborsko gorje Nature Park. By the survey of Physical plan of Ozalj municipality, a random selection was used to choose one activity that was planned in the area and for that activity dual spatial analysis was created. It included spatial attractiveness and vulnerability analysis. The results of the analysis have shown whether, in addition to spatial attractiveness criteria, spatial vulnerability criteria was taken into consideration when deciding on the location for the winter sports center. The analysis has also shown whether the Physical plan was in favor of the municipality development or was the fact that it is a Nature Park, designed as the protected area of natural and cultural values, also considered relevant.

Key words

suitability, physical plan, activity, conservation

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Introduction

Since the beginning of human communities, places where people live have had a tendency towards development and improvement of living conditions. The same happens today and every new invention and technological intervention is used to adapt space for inhabitants and visitors. Often it results in permanent devastations of valuable natural areas. Therefore such areas are declared as conserved zones in which all activities are regulated by law. According to the Nature Conservation Act (OG, 2005) protected areas are categorized as followed; Strict Nature Reserve, National Park, Special Reserve, Nature Park, Regional Park, Nature Monument, Significant Landscape, Forest Park and Monuments of Park Architecture. Under the statutory provision of the Spatial Planning and Building Law (OG, 2007) all national and nature park areas and all areas defined by The Spatial Planning Strategy of the State or physical plan of the district must have a physical plan of the special features areas. A physical plan of the special features areas in compliance with the directions of the Spatial Planning Strategy and demands of the Spatial Planning Programme of the State, with respect to natural, landscape and cultural-historic values, and conditions of environmental and nature protection, is elaborating goals of physical planning in areas of special concern and defines its organization, protection, land use and conditions (OG, 2007).

This paper refers to the Žumberak – Samoborsko gorje Nature Park that belongs to almost half of the Ozalj municipality territory and within whose borders a winter sports center as a form of tourist activity is planned. From the physical plan of Ozalj municipality it is obvious that the goal is to “raise the level of tourism so it can compete with the continental tourism based on the natural environment: forests, lakes, waterways, architectural heritage, hunting areas” (Physical Plan of Ozalj Municipality,

2006). According to this provision it can be concluded that these exact areas are very important and vulnerable in the process of decisions making for the setting of a winter sports center. It is also said that “sports and recreation must as well be evaluated as new aspects of tourism with the inclusion of agriculture and tradition” (Physical Plan of Ozalj Municipality, 2006). In the Physical plan of Ozalj municipality the terms of land use, settlement and conservation are prescribed through goals of spatial development and planning. This paper examines the usage of conservation planning criteria while making the land use plan for the Physical Plan of Ozalj municipality, along with the reduction of choices for activity settlement that conservation criteria produce. The absence of Physical Plan of The Special Features Areas that would direct activity development, without impairing the quality of natural and cultural areas, is a huge problem in Croatia. Physical Plans of the Special Features Area are made for only three out of 11 nature parks, and for five out of eight national parks (State Institute for Nature Protection). This paper refers to the Žumberak – Samoborsko gorje Nature Park area that does not have a Physical Plan of the Special Features Areas, thus its development and conservation are regulated by physical plans of cities, municipalities and districts. The example of the Ozalj municipality and Žumberak- Samoborsko gorje Nature Park shows that municipalities, cities or districts development plans have no consideration for existing spatial qualities, whether of a cultural or natural character, although they are located throughout the areas of special concern. In the process of making spatial planning documents of cities, municipalities and districts, if the goal is sustainable development, the absence of an appropriate planning process with an evaluation phase, from which follows a better decision making on activity settlement, might present a problem. The goal of this paper is to establish the effect of conservation planning criteria on the potential of spatial development, and to

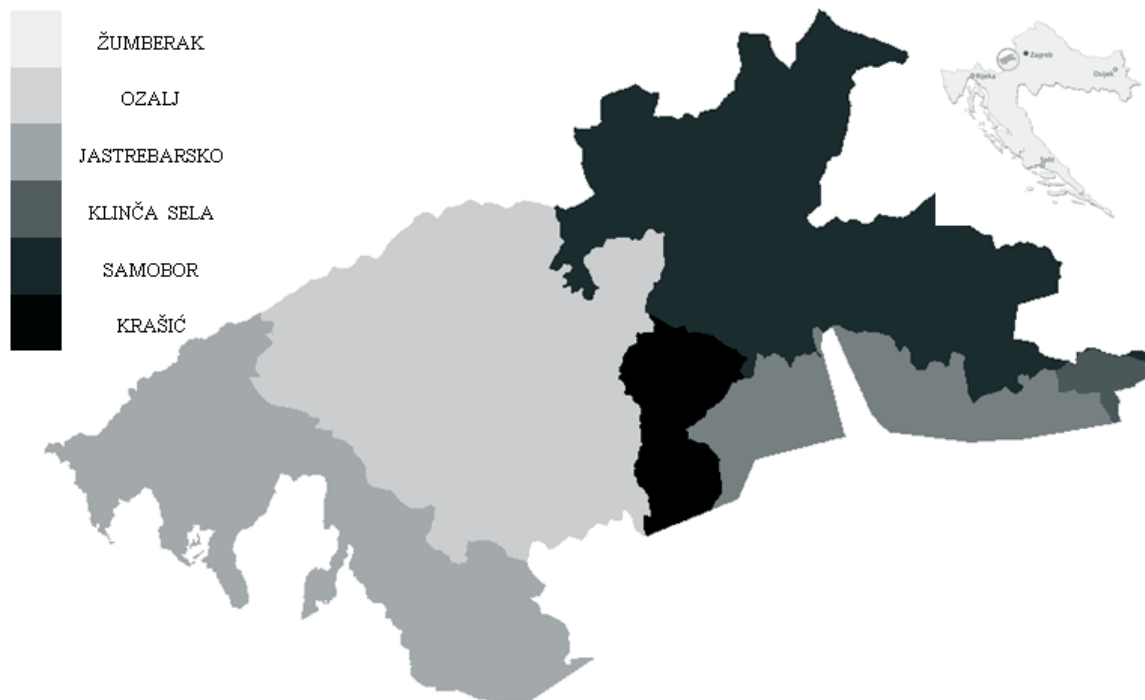


Figure 1. Territorial Municipality Zoning of the Žumberak – Samoborsko Gorje Nature Park

present how the lack of Physical Plan of The Special Features Areas can affect the spatial conservation and development as well as their correlation as a basis for sustainable development. The objective of a dual analysis was to determine if all necessary parameters were considered for development and protection of naturalness, the human environment and resource productivity during the making of physical plans for Ozalj municipality. The activity that was chosen for analysis is the winter sports center.

Material and methods

The area that was the subject of research in this paper territorially belongs to the Ozalj municipality, but it is also a part of the Žumberak – Samoborsko gorje Nature Park, one of the youngest nature parks in the Republic of Croatia. It was declared and legally protected on June 2 1999 and it extends to 33 300 hectares. The reason for declaring Žumberak – Samoborsko gorje as a nature park was the protection of natural and cultural values of the area. The area of Žumberak – Samoborsko gorje Nature Park abounds with many natural beauties as well as cultural monuments, medieval fortifications and examples of a traditional way of life. Within the area of Žumberak and the adjoining Samoborsko gorje the way of life is completely rural with no traces of urban settlements. Žumberak – Samoborsko gorje is territorially divided between the six municipalities;

Ozalj, Samobor, Žumberak, Krašić, Jastrebarsko and Klinča Sela (Figure 1).

Ozalj municipality area amounts 179.37 km²; the overlapping area with Žumberak- Samoborsko gorje Nature Park includes 76.58 km².

This overlapping can be observed in the context of the entire municipality, as well as the Nature Park's area. The part of municipality area that belongs to the Nature Park is 42.69%, while Ozalj municipality takes only 22.20% of the Nature Park area. It can be concluded that Ozalj municipality highly depends on the Nature Park, so a Physical Plan of The Special Features Areas of the Nature Park would have greatly influenced the city of Ozalj's development plans.

The current development of the Nature Park is directed at rural tourism and apart from the Eko village nearby Koretići settlement, there are many mountain lodges. Various forms of recreation such as hiking, walking, hunting and fishing are provided for visitors. Also, in the area around St. Gera there is a plan to develop winter tourism in a winter sports center, and that specific activity setting is researched in this paper.

Ozalj municipality area (Figure 1) is evaluated, supported by Geographic Information Systems (GIS) package ProVal[®], using the dual analysis method, also called suitability analysis – with

attractiveness and vulnerability modeling for a winter sport activity settlement. Suitability analysis that determines if activities were settled correctly in certain locations considering vulnerability and attractiveness criteria was defined by McHarg (1969), and later by Hopkins (1977). Analysis of the landscape, or suitability analysis, is a process of determining the fitness of a specific landscape condition to support a well-defined activity or land use (Steiner, 1991). The basic premise of suitability analysis is that each aspect of the landscape has intrinsic characteristics that are in some degree either suitable or unsuitable for the activities being planned, and that these relationships can be revealed through detailed evaluation and assessment (Marsh, 1998). Its basic purpose is to determine the appropriateness of a given landscape for a particular use (Murphy, 2005). The intention of the process is to determine the optimum site location for activities while minimizing negative impacts on the environment (Figure 2).

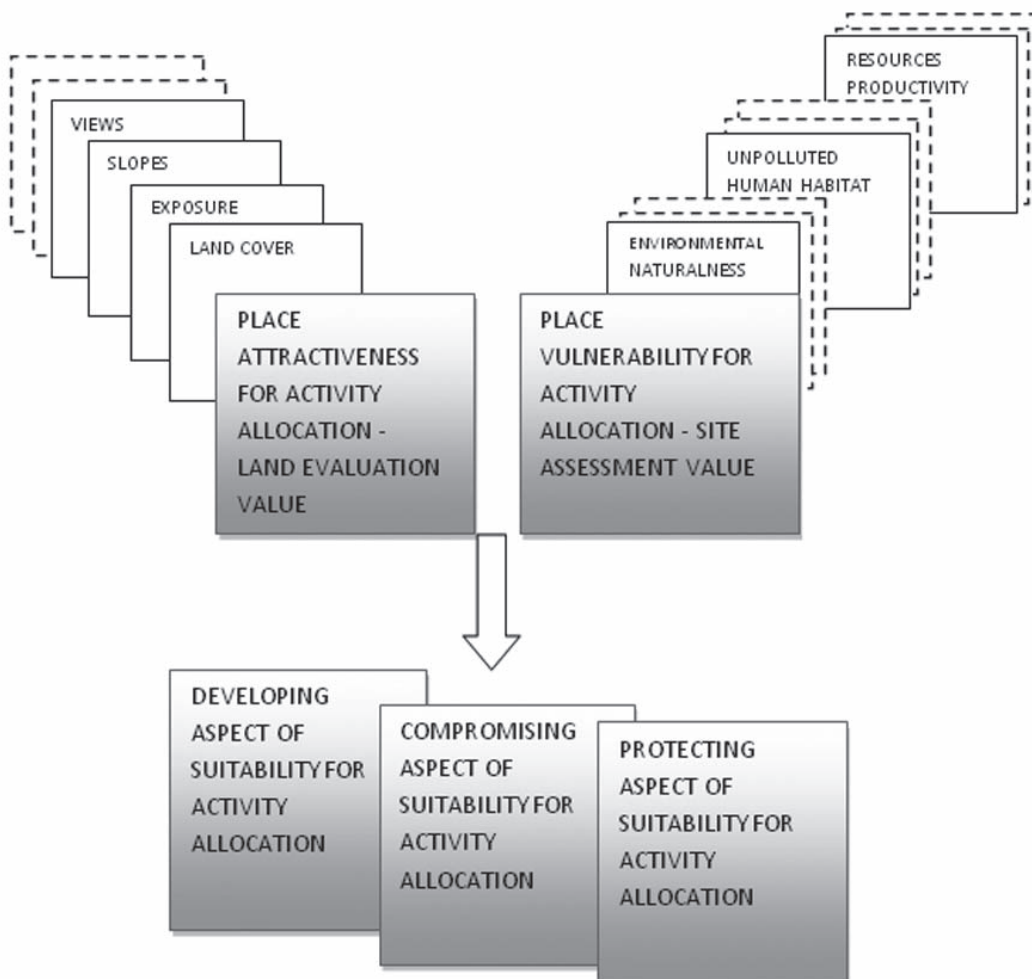


Figure 2. Process Scheme for Determining the Optimum Site Location for Activities

Table 1. Database

LAND COVER	STATE FORESTS
Rare populated areas	GEOMORPHOLOGIC FACILITIES
Industrial or business locations	Caves
Roads with related land	Barrows
Mines	FITOCENOLOGICAL DATABASE
Not irrigated agricultural areas	SURFACE WATERS
Vineyards	Brook
Pasturages	Ravines
Mosaic of different modes of agricultural land use	Rivers
Agricultural areas with significant content of natural vegetation	TERRITORIAL MUNICIPALITY
Deciduous forests	ZONING
Coniferous forests	Žumberak
Mixed forests	Krašić
Transitional areas of forest and bush	Klinča Sela
Marshlands	Samobor
Fluid waters	Ozalj
Stagnant waters	Jastrebarsko
SETTLEMENT POLYGONS	TRANSPORT INFRASTRUCTURE
PEDESTRIAN ZONES	State roads
MOUNTAIN LODGES	District roads
HIKING TRAILS	Local roads
BIKE TRAILS	Dirt roads
CLIMBING AND PARAGLIDE POLYGONS	Unclassified roads
Climbs	BIODIVERSITY
Take-off grounds	Forests
HUNTING AREAS	Lawns
SOILS	Humid lawns
	Overgrown lawns
	Wetland lawns
	Old beech forests
	DIGITAL ELEVATION MODEL

During the systematic solving of spatial problems occurring in appearance of development and protection demands, modeling or models forming is very important. The model in this case represents reality, in other words, simplified and generalized spatial characteristics (Marušič, 1979). The models assignment simulates a spatial situation that comes after a pre-determined vision of spatial development and protection. The first group of models provides an image of a planned activities layout that extracts the best spatial characteristics from criteria that provides complete and unobstructed development to some activity. Another group of models is the one that determines spatial vulnerability. With analysis of the current state of space it acquires locations that possess some vulnerable and valuable areas that need to be protected by some criteria. That analysis also simulates possible consequences of the planning decisions in a given area. Models, whether they are attractiveness or vulnerability models represent very reduced and general structures. Various spatial characteristics are presented in the form of a matrix in such a way as to provide ratings of some levels of spatial appearance. The assessment comprises of a value scale of five points (1-5), in attractiveness the model is defined as (1) unattractive, (2) somewhat attractive, (3) medium attractive, (4) very attractive and (5) the most attractive. In vulnerability the model is

Table 2. Metadata for researched area

Coordinate system: GK6	Georeference:
Transverse_Mercator	Min x= 5.518910
False_Easting: 6500000.000000	Max x= 5.556113
False_northing: 0.000000	Min y= 5.055755
Central_Meridian: 18.000000	Max y= 5.078969
Scale_Factor: 0.999900	
Latitude_of_Origin: 0.000000	

defined as (1) invulnerable – no negative impact, (2) a little vulnerable – negative impact is inherent but negligible, (3) medium vulnerable – negative impact exists but is acceptable, (4) very vulnerable – negative impact is high and (5) the most vulnerable – negative impact is inadmissible.

Used database (Table 1) in this paper consists of digitized and georeferenced theme maps obtained by a digital interpretation of the Žumberak – Samoborsko gorje Nature Park area (Table 2) whereas homogeneous spatial unit for analyses was 10 m x 10 m.

Physical planning for activity settlement is coordinated with obtained maps of values and the average estimate of vulnerability and attractiveness is being calculated for a specific location.

The average estimate is obtained by summing up all homogeneous unit values (1 - 5), and dividing that number with the sum of homogeneous units in the researched area. Suitability valuation procedure based on a two-dimensional matrix, also called Reduction Matrix System (RMS), was used for the purpose of combining the two factors (Marušič, 1979). After overlapping the attractiveness and vulnerability valuation maps of the Ozalj municipality area, in accordance with overlapping matrix (Tables 3, 4, 5), the valuation maps of suitability aspects (developing, compromising and protecting) were obtained. As shown (Tables 3, 4, 5), the valuation procedure is direct and explicit and takes into account mutual dependence or independence of vulnerability and attractiveness factors considering suitability aspects. For every suitability aspect an average estimate is calculated for the whole area and also for the new activity location envisaged by The Physical Plan of the Ozalj municipality. The obtained average estimates of all suitability aspects of the location were put in relation to vulnerability average estimates. To show such a relationship the most widely used approach is clustering the results into indices (Herman et al. 2007). It is a method used to simplify the search for measurable factors and their conversion into efficacy indicators. The indices, as relative numbers of dynamics, are used for monitoring the dynamics of the group occurrence. The differentiation index, used here, is a framework indicator of the efficacy of activities settlement and it is obtained as a difference of median values of suitability aspects and median value of location vulnerability. Differentiation index was calculated using the equations:

$$i_D = \overline{SA} - \overline{VL}$$

$$\overline{SA} = \frac{\sum xi}{n}$$

$$\overline{VL} = \frac{\sum yi}{n}$$

Table 3. Matrix of developing aspect of suitability

		Attractiveness					
		0	1	2	3	4	5
Vulnerability	0	0	0	0	0	0	0
	1	0	2	3	4	5	5
	2	0	1	3	4	5	5
	3	0	1	2	3	4	5
	4	0	1	1	3	4	5
	5	0	1	1	2	3	4

Table 4. Matrix of compromised aspect of suitability

		Attractiveness					
		0	1	2	3	4	5
Vulnerability	0	0	0	0	0	0	0
	1	0	1	2	4	5	5
	2	0	1	2	3	4	4
	3	0	1	1	2	3	4
	4	0	1	1	2	3	3
	5	0	1	1	2	2	2

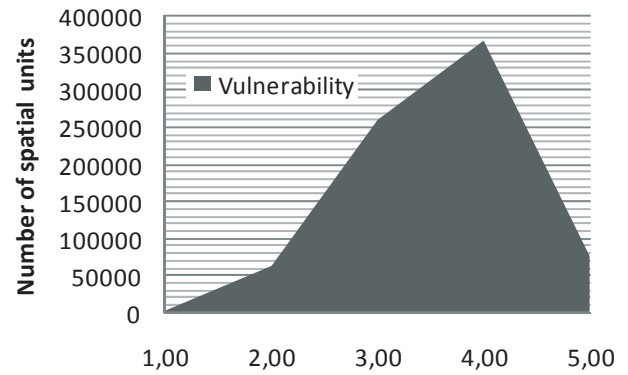
Table 5. Matrix of protecting aspect of suitability

		Attractiveness					
		0	1	2	3	4	5
Vulnerability	0	0	0	0	0	0	0
	1	0	1	2	3	4	5
	2	0	1	2	3	3	4
	3	0	1	1	2	2	3
	4	0	1	1	1	1	2
	5	0	1	1	1	1	1

Where i_D - is differentiation index, \overline{VL} - is the median value of location vulnerability, \overline{SA} - is the median value of suitability aspect, $\sum xi$ - is the sum of values of the spatial units according to location suitability, $\sum yi$ - is the sum of values of the spatial units according to location vulnerability, n - is the number of spatial units. In this case the index is not a criterion used for decision making but a statistical ratio of relations with the basic purpose of perusing spatial conditions and relations.

Results

The attractiveness analysis represented the most attractive zones for a winter sports activity settlement in the researched area, in terms of best development. Development criteria were obtained and evaluated through the attractiveness concept. Central criteria upon the making of the attractiveness model were slopes appropriate for winter sports, favorable exposure for winter sports developing, traffic accessibility, pleasant views and the proximity to an existing recreation facility. The obtained valuation map (Figure 3) indicates a concentration of attractive sites on the north side, which was expected considering altitudes and terrain configuration.



Graph 1. Vulnerability value distribution

Accordingly, impacts of all actions that some activity brings to an environment were observed in relation to three different conservational requests; (1) protection of the unpolluted human habitat that includes natural, social and psychological uncontamination and cultural heritage preservation, (2) protection of natural resources, which includes preservation of all resources that can be developed in the future and (3) protection of the naturalness and/or authenticity of the environment, which entails preservation of the biosphere, atmosphere, hydrosphere, pedosphere and geosphere. By density assessment of the most influential new activities to a certain quality, through the matrix of interaction, the most vulnerable areas were extracted, and a concept of vulnerability was made for them.

The valuation map of vulnerability of the area (Figure 4) was obtained after overlapping valuation maps of human habitat vulnerability, natural resources vulnerability and naturalness vulnerability. The obtained valuation map indicates the concentration of the most vulnerable areas on the north side.

The average value of the area vulnerability is 3.59.

Average value of the area vulnerability, 3.59, on a 5-point value scale (1-5) (Graph 1), shows many vulnerable parts of the selected area considering all the qualities that are desirable to be preserved. Vulnerability analysis means implementation of environmental requirements into finding less environmentally burdensome spatial position (Marušič et al., 2004).

It can be concluded that the environment provides sufficient development possibilities, also with taking into consideration the most vulnerable sites, but it is consequential to come upon it using the appropriate methodology. Every activity planned in a new site should be settled in the most suitable location. That location at the same time meets the conditions of development as well as protection. Considering the difference between developing, compromising and protecting aspects of suitability, the suitability values are completely different for the certain places. The most suitable location is evaluated as 5, because it simultaneously meets the development and conservation criteria.

But, it is not always possible to obtain an area big or suitable enough for a certain activity. Accordingly it is necessary to look for the location evaluated suitable as much as possible. Upon the analysis of the decision about activity settlement, the median value of vulnerability must be taken into account. For that matter the median value of suitability must not be more

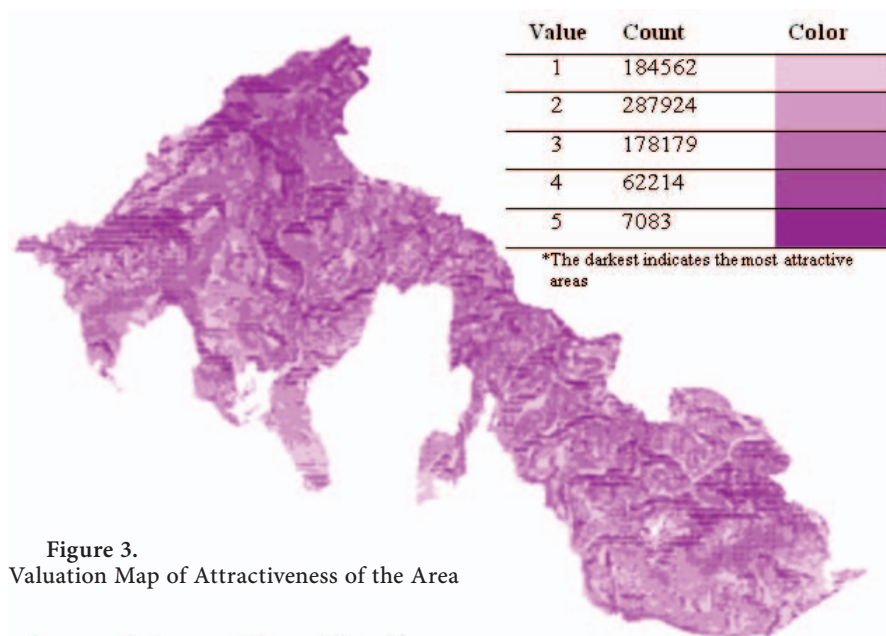


Figure 3.
Valuation Map of Attractiveness of the Area

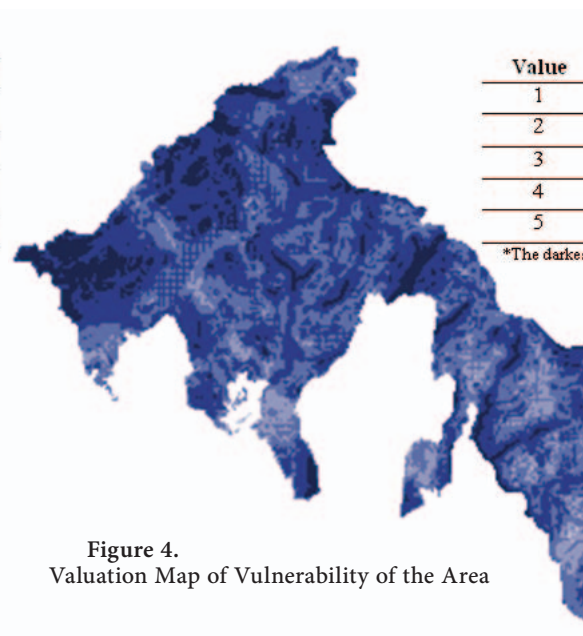


Figure 4.
Valuation Map of Vulnerability of the Area

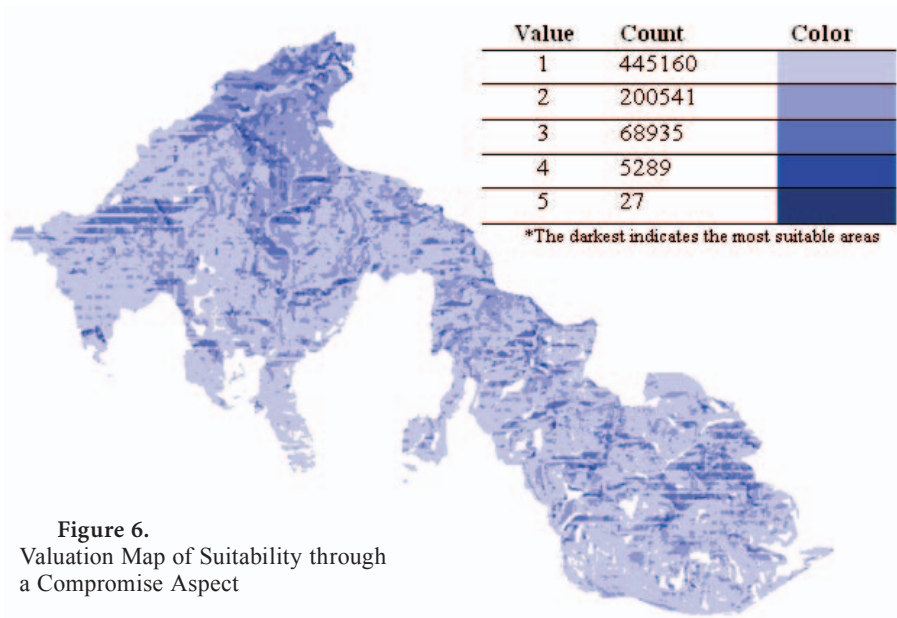


Figure 6.
Valuation Map of Suitability through
a Compromise Aspect

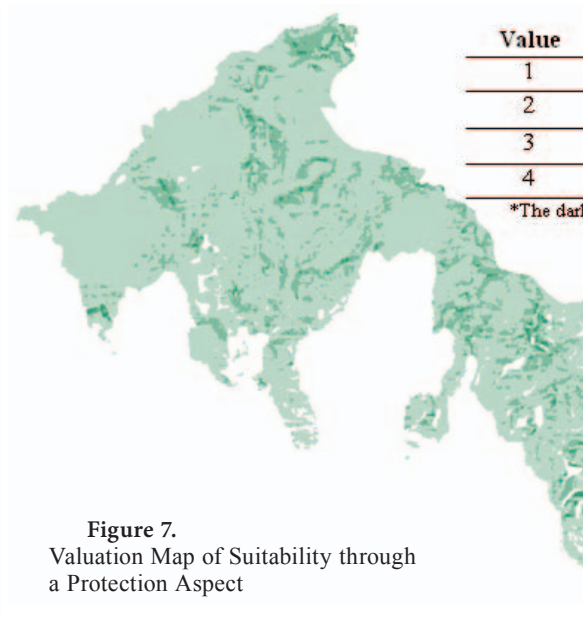


Figure 7.
Valuation Map of Suitability through
a Protection Aspect

minor than the median value of vulnerability. If that were so, it would mean that the vulnerability weight of the location is greater than the attractiveness, and that cannot be an option for achieving the goal of development and protection optimization. It is important to find such a site location where the attractiveness weight is greater, while negative impacts, or site vulnerability is 'As Least as Reasonably Achievable' (ALARA¹) (Butula, 2003).

1 The ethical principle As Least as Reasonably Achievable (ALARA), introduced by Taylor (1986, 57): "There must be no available alternative that is known to be equally effective but to cause less harm to attacking organisms". The principle requires minimal harm to the human environment and minimal harm to the natural components of the environment.

In this way the median value of suitability would certainly be greater than the median value of vulnerability.

Considering that condition, valuation maps of developing (Figure 5), compromising (Figure 6) and protecting (Figure 7) suitability aspects were analyzed.

Median value of vulnerability of the location scheduled for activity development amounts to 3.29, while median value of the development suitability aspect of the location (Figure 8) amounts to 2.92. According to the efficacy evaluation review of activity allocation (Table 6), considering the very small negative differentiation index, it can be concluded that settlement on this location can be suitable for development of the activity as well as nature protection.

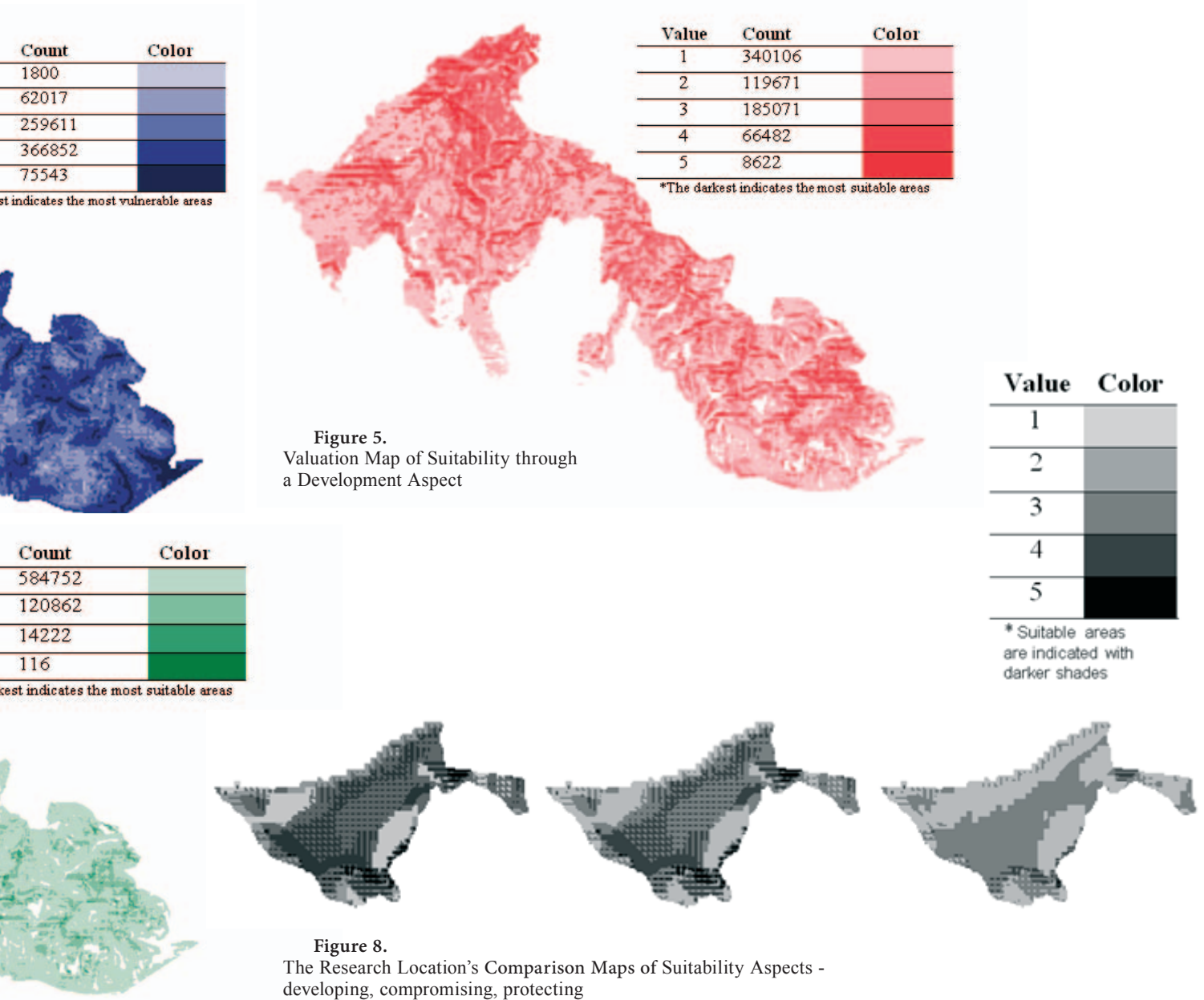


Table 6. Efficacy evaluation review of activity allocation considering vulnerability and suitability results

Suitability aspect	Average value of suitability aspects	Average value of location vulnerability	Diferentiation index
Developing	2.92	3.29	-0.37
Compromising	2.08	3.29	-1.21
Conservating	1.53	3.29	-1.76

The darkest indicates more impact

Median value of vulnerability of the location scheduled for activity development amounts to 3.29, while median value of the compromising suitability aspect of the location (Figure 8) amounts to 2.08. According to the efficacy evaluation review of activity allocation (Table 6), considering the negative differ-

entiation index, it can be concluded that the settlement on this location is not suitable for the development of the activity and nature protection. Median value of vulnerability of the location scheduled for activity development amounts to 3.29, while median value of the protecting suitability aspect of the location

(Figure 8) amounts to 1.53. According to the efficacy evaluation review of activity allocation (Table 6), considering the high negative differentiation index, it can be concluded that the settlement on this location in no case is convenient for development of the activity, and also for nature protection.

Discussion

The results, obtained by detailed spatial analysis of the Ozalj municipality and the analysis of the location foreseen for the winter sports activity development, indicate the location's conditional aptitude for activity development as well as protection of the present environmental qualities. If considering the compromising, and especially the developing suitability aspect, the winter sports center can be located in the foreseen location with no high impact on environmental qualities defined in the vulnerability analysis, although there is some impact on the present environmental qualities.

Considering the fact that the Žumberak – Samoborsko gorje Nature Park is protected by the Nature Protection Act, it is important to approach the area from the protecting aspect, moreover as there is no Physical Plan of The Special Features Area for the Nature Park. A nature park is a very sensitive natural area - that fact is also confirmed by the Constitution of the Republic Of Croatia; "the protection of nature and the human environment are the highest values of the constitutional order of Republic of Croatia." (OG, 2001) and "...natural wealth, wildlife and other parts of nature of particular significance, specified as the interest of Republic of Croatia by law, has its special protection" (OG, 2001). Those areas should all have physical planning documentation promptly brought, including physical plans of the special features areas. In the absence of such documentation, facts of spatial values have to be considered while making physical planning documentation of cities and municipalities that enclose a certain area, in this case the Ozalj municipality, to protect present qualities of the environment. The protecting aspect of suitability, obtained by vulnerability and attractiveness analysis, has not provided sufficiently appropriate locations for the activity settlement that can justify the decision of the winter sports activity settlement in the location of St. Gera. Therefore, it would be best to allocate the sports activity settlement in a less vulnerable and more suitable area, especially because analysis has indicated the existence of such areas. For that analysis is suggested, as well as an overview of vulnerability and protecting suitability aspect valuation maps. The valuation map of vulnerability should consider less vulnerable areas, while the valuation map of suitability should consider much more suitable areas.

Conclusion

The results of this paper draw a conclusion that in order to preserve landscape values, inclusion of the conservation criteria in the physical planning process can reduce the options of the possible areas for certain activity settlement. That faction could seem restrictive for the development of an area, and also for the demographic picture of a certain area. Yet, in the long run, giving more attention when selecting locations for activity settlement

and the inclusion of conservation criteria in the process of physical planning can contribute to optimizing decisions about the allocation of land use in certain areas and thus preserve precious environments and ensure the productivity of resources for future generations. Application of the methodology used in this paper provides a systematic and stratified approach to optimizing decisions of physical plans, because it simultaneously includes all aspects of the environment and activity, and also provides spatial adjusted solutions in line with the paradigm of sustainable development. Again, specially preserved parts of the landscape with various natural and cultural altitudes could in time grow into a base of tourism development of an area. Thus, conservation planning criteria could appear as restrictive, but only if the environment and development of an area are observed in a short-term, one-dimensional way and that cannot and must not be an option if the goal is sustainable development.

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