



National Park



Paklenica



MANAGEMENT PLAN



N a t i o n a l P a r k

Paklenica

M A N A G E M E N T P L A N



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A Word from the Publisher

In the interest of improving conservation in protected areas, and particularly to preserve karst ecological systems in Croatia, the Ministry of Culture and the World Bank implemented the Karst Ecosystem Conservation (KEC) Project from 2003 to 2007, with financing from the Global Environmental Fund. Under this Project, management plans were developed for Risnjak National Park, Plitvice Lakes National Park, Paklenica National Park, Northern Velebit National Park and Velebit Nature Park.

The development of management plans for national and nature parks is an obligation stipulated by the Nature Protection Act (as published in Croatia's official journal, *Narodne novine*, no. 70/05), which also specifies the content of management plans and modes for their adoption. The park management plans developed by KEC are in fact the first management plans for protected areas drafted in Croatia. The format of this Management Plan and the methodology used to draft it were reached by agreement at KEC Project workshops, at which all stakeholders participated during the period from 2003 to 2007.

The Management Plan consists of a brief, summarized strategy document, which breaks down the strategic objectives and guidelines for management, and the action plans. The actions plans further refine the strategic management guidelines and provide a detailed specification of management "in the field". The action plans adhere to the vision, mission, policies and general management strategy specified by the Management Plan.

The management plans are prepared on the basis of existing research studies and data on the status of individual park, and a great deal of supplementary research of plants and animals was conducted, particularly in the karst subterranean zone. Useful documentation on physical planning and the state of local economies (concerning tourism in particular) was also gathered, and local populations and interested parties in and around the park were constantly consulted at all phases of plan development. The vision, mission and objectives of the management plans are presented to the wider public every year at annual KEC Project workshops organized by the Ministry of Culture and the public institutions which manage these protected areas.

The management plans for Risnjak National Park, Plitvice Lakes National Park, Paklenica National Park, Northern Velebit National Park and Velebit Nature Park were developed by a team from the firm Agriconsulting of Rome, working together with Croatian experts under the active leadership of the management teams at each park. We believe that the KEC management plans will serve as a sound model for the development of these strategic documents in other Croatian protected areas.

The Ministry of Culture would like to express particular gratitude to the World Bank team for its leadership of the project and for conveying international experiences to the staff of the Ministry and the public institutions, which greatly contributed to enhancement of capacity to implement international projects.

We would like to thank all participants in the plan development process for their contribution to this document, for only the cooperation of all participants made it possible to deliberate on all vital aspects and finally develop this Management Plan.

Božo Biškupić, M.A.

Minister of Culture

Foreword

During the last two years, preparations have intensified to compile the Management Plan, which contains the management vision, mission and objectives, confirmed activities and action plans to manage the Park in the upcoming ten-year period. This task was complex and laden with numerous activities and workshops involving both Park staff and stakeholders. The roughly sixty people, including numerous experts, participating in the preparation team provided a valuable contribution to this Plan. To be sure, one of the most important purposes of the Management Plan is to strike a balance between conservation of nature in the National Park and visits to its territory and the interests of the local population, which is sometimes not easy. Nevertheless, we believe that what we have here is a strategic planning document which, in its zoning chapter, indicates the exceptional value and diversity of Paklenica National Park. The Park merits the strictest protection and ongoing care for its territory area, albeit with the possibility of visits which do not impinge upon conservation.

The Park is visited by two groups of visitors: climbers and hikers. Prior figures on the number of annual visitors have exceeded 100,000, so the need arose to ascertain the Park's carrying capacity in individual sections and zones, particularly in its most frequented sites, the Velika Paklenica and Mala Paklenica Canyons, the Park's central area, the Manita Peć cave, and the high-altitude peak zones between Struge, through Vaganski Vrh, Malovan and Sveto Brdo. This is why the zoning chapter contains detailed descriptions of the zones, their purpose, permitted activities and restrictions.

The action plans, all eleven of them, clearly define activities for the following ten-year period, from preservation and conservation of forest ecosystems to conservation of meadows and reintroduction of the Griffon Vulture. The monitoring chapter specifies nature monitoring based on the wealth and diversity of bird species, tracking of large carnivores and monitoring of caves.

In practice, implementation of the Management Plan will depend on the involvement of all Park services and staff, and also on available funds, and it will be based on annual conservation, preservation, use and promotion plans and scheduled activities. It will be revised after five years to align its activities and ascertain the extent to which the activities outlined in the Management Plan and action plans are being conducted to achieve set objectives, and whether these activities comply with the Park's vision. We believe that this Management Plan will serve as an exemplar for the formulation of management plans for other protected areas.

Management of Paklenica National Park



Paklenica National Park

Basic information

Protected area:	Paklenica
Conservation category:	National park
Date established:	October 19, 1949
Legal founding instrument:	Act Proclaiming Paklenica Forest a National Park (<i>Narodne novine</i> , no. 84/49) Amendments to Act Proclaiming Paklenica Forest a National Park (<i>Narodne novine</i> , no. 15/97)
Total surface area:	95 km ^{2*}
Physical plan:	Decision on Adoption of Paklenica National Park Physical Plan (<i>Narodne novine</i> , no. 23/01)
Physical planning period:	10 years
Date of management plan's adoption:	October 4, 2007
Planning period/plan revision:	10 years/revision after 5 years

Information on park management

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Public institution's charter:	Charter of the Paklenica National Park Public Institution, adopted by Governing Board on May 12, 2006
Internal regulations:	Paklenica National Park Internal Rules of Order (<i>Narodne novine</i> , no. 76/00)

* The actual surface area of the National Park is different than that cited in the 2001 Physical Plan, which is a result of more precise GIS measurements.

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On the trail to Vaganski vrh: Peak zone.



1. INTRODUCTION

1.1. Paklenica National Park



The Paklenica Forest, together with portions of the Velika Paklenica and Mala Paklenica Canyons, was proclaimed a national park in 1949 due to its exceptional natural beauty and scientific importance. Velika Paklenica Canyon, as one of the most striking relief formations of the Velebit massif and a phenomena of Paklenica National Park, is thus emphasized in the Park's logo.

Paklenica National Park extends along the coastal slope of southern Velebit, above the settlement Marasovići to Velebit's highest peaks (Vaganski Vrh, Babin Vrh, Sveto Brdo) –between 44° 18' and 44° 25' north and 15° 23' and 15° 34' east. Most of the Park lies inside Zadar County (64 km²) while only a smaller portion lies in Lika-Senj County (31 km²). The Park is situated in the attractive tourism zone of the eastern Adriatic coast, adjacent to the settlements Starigrad-Paklenica and Seline. The closest city is Zadar, 45 km away. The Park covers a surface of 96 km² and it is entirely encircled by Velebit Nature Park, which in fact encompasses all of Velebit.

Velebit is the largest Croatian mountain, and it belongs to the Dinaric system which extends from the eastern Alps to the Šar-Pindus massif. The overall length of Velebit is 145 km, while its width varies from 10 to 30 km, with a surface exceeding 2,200 m². The elevation of Paklenica National Park ranges from 30 m. to 1,757 m. The



Fig. 1: Location of Paklenica National Park



latter is Vaganski Vrh, Velebit's highest peak, characterized by the exceptional richness of its geomorphological features and formations, diverse flora and fauna, attractive landscapes and intact nature.

Since the bulk of the Park rests on carbonate rock – i.e. limestone, dolomite and carbonate breccias – it contains an immense wealth of karst relief forms, such as scarps, sink-holes, crests, solution pans, karst wells, and dripstones, as well as speleological features such as caves and pit-caves. So far, 76 speleological phenomena have been recorded in the Park. Among them, the Manita Peć cave and Vodarica pit-cave stand out in terms of size and rich ornamentation. Although the surface water flow is very rare in the karst area, and due to its porosity it usually disappears underground, several permanent and temporary water flows and many permanent springs can be found in the Park.

Forests, which greatly influenced the establishment of the National Park, cover more than a half of the Park's surface area with a wide range of biocenotic communities. Particularly valuable are the old beech forests, as well as indigenous black pine forests. The name Paklenica is actually derived from the Croatian word for the sap of the black pine, *paklina*, which was extracted from the trunks of logged black pine trees. This sap was for torches and illumination, as a propellant, to heal wounds and as a primer on ship hulls. Among the Park's non-forest vegetation, the vegetation of rock crevices, cliffs and gullies is particularly important, as it is here that most of Velebit's endemic species grow. So far, 67 endemic species have been recorded in the Park, which is 6.1% of its plant species, making this one of Croatia's central endemic plant sites.

Animal life is also rich and diverse. Among the invertebrates, the order *Insecta* is quite rich, in which the butterfly (*Lepidoptera*) family is notable. Particularly frequent and interesting are the Southern Festoon, Apollo and Clouded Apollo, and a rare species, the Vagana Fritillary (*Erebia gorge vagana*). The exceptionally high numbers of other butterfly species, such as the Southern White Admiral (*Limenitis reducta*), Silver-washed Fritillary (*Argynnis paphia*), and Marbled White (*Melanargia galathea*) indicate the intact ecosystem. The subterranean fauna is extremely rich and diverse, and characterized by many endemic species. An endemic spider, *Histopona egonpretneri*, pseudoscorpion, *Chthonius (Chthonius) radjai*, and underground amphipod, *Bogidiella sketi*, were found for the first time in Manita Peć cave. Sniježnica cave, opposite to the peak Babin Vrh, is the habitat of a beetle species, *Astagobius angustatus vukusici*. Birds are particularly numerous among the vertebrates. So far, 225 bird species, 102 of them nesting species, have so far been recorded in the National Park's wider territory. The Park is particularly enriched by petrophilous bird species, i.e. those that nest in rock crevices and on cliffs, such as the golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), short-toed eagle (*Circaetus gallicus*), eagle owl (*Bubo bubo*) and raven (*Corvus corax*). Among the large carnivores, the Park is home to the brown bear (*Ursus arctos*), wolf (*Canis lupus*), wild cat (*Felis sylvestris*), and, occasionally, the lynx (*Lynx lynx*). Among the large herbivores, the most notable species are the chamois (*Rupicapra rupicapra*), roe deer (*Capreolus capreolus*) and red deer (*Cervus elaphus*), whose numbers are growing.

The presence of humans in the Park's territory can be traced to prehistoric times. Archeological evidence dates back to the Neolithic, and a wealth of artifacts from the Bronze and Iron Ages have also been found. The Park's cultural heritage also consists of mills, *mirila* (stones tied to specific local funerary customs), stacked-stone walls and the ruins of summer huts belonging to shepherds, which bear witness to past times when this area was more densely populated.

There are 150 km of trails in the Park. Paklenica is also considered the most important Croatian hub for climbing, well known throughout Europe and the world, with 367 climbing routes of various lengths and difficulties. The best known route is the cliff Anića kuk, with a 400 m vertical face. The National Park is visited by over 100,000 people every year, and more than 30% of them are climbers.

Paklenica National Park accords great attention to scientific research and education, especially of young people. The Park has established sound collaboration with many institutions, NGOs and individuals, both at the national and international levels.



Fig 2: Territory of Paklenica National Park

1.2. Paklenica National Park in the international context

The karst tracts of the Croatian highlands constitute a natural resource of exceptional value to Europe and the world. The area is rich in endemic species and habitats, and the morphology and hydrology of the terrain are very specific. Although Croatia's karst zones are relatively well preserved, especially in highland Croatia, they require, due to their extreme vulnerability, special attention in terms of strategic development planning and incorporation of biological and landscape diversity measures into all human activities in this region.

It is precisely due to the aforementioned reasons that Paklenica National Park became a beneficiary of

Karst Ecosystem Conservation (KEC) Project funds via a grant (IBRD GEF TF 050539 HR) from the Global Environmental Fund (GEF). The basic objective of this project is to safeguard biodiversity and facilitate sustainable development in local communities based on available natural wealth. This included the enhancement of institutional and professional capacity to conserve biodiversity, improve management of protected areas and promote business and tourism that uphold sustainable use and conservation of natural resources.

Within the framework of the Ecological Network, Paklenica National Park has been specified as a focal point of international significance, and it is a potential area for inclusion in the Natura 2000 ecological network. Furthermore, since 1978, Velebit has been encompassed in UNESCO's Man and Biosphere (MAB) Program, while the World Wildlife Fund has included Velebit on its list of ten hot-spots under the Mediterranean Forests Protection Program.

1.3. Vision of Paklenica National Park

The vision of the Paklenica National Park brings together all interest groups and stakeholders in insuring a higher quality future for both the local community and all stakeholders. All management activities should be consistent with this vision since it reflects the Park's purpose and management objectives.

The National Park's Public Institution has, in cooperation with all interested parties, formulated the following vision statement:

Paklenica National Park remains the most intense expression of Velebit as the largest Croatian mountain, revered in the national mythology, with exceptional value in terms of its plant and animal diversity and geomorphological features. The Park has significant tourism and recreational functions, organized on the principles of sustainability and education at all levels.

The National Park takes seriously its role as the driver of regional sustainable development and a place that offers new experiences to visitors, particularly with reference to natural value and recreational possibilities. Also, the vision statement underscores the Park's educational role.

Every decision in the National Park is made on the basis of this vision statement, and all activities must lead to achievement of the long-term vision. The following long-term objectives have been set with a view to achieving the vision:

- Preserve and improve the unique karst biological and landscape diversity by facilitating natural processes and securing protection of the area with negligible human impact.
- To facilitate cooperation between the local community and the National Park's Management, and to enable visitors to truly experience, understand and appreciate the natural value of the National Park.

The objectives formulated during development of the Management Plan are identical to the original objectives underlying the National Park's establishment. This pertains in particular to preservation and protection of nature and the possibilities for visitor education and recreation. A new aspect introduced by this Management Plan is wilderness conservation as a special feature of the National Park and its potential role as a resource base for sustainable development of the local community and the latter's active involvement in conservation and management of the protected area.

Paklenica National Park is notable for its highly-valuable and diverse landscape, with pristine and unaltered karst features. Most of the Park has not been actively used over the past several decades, while other parts were impacted by human activities (e.g. alpine grasslands). The National Park's territory will certainly change with time, but all stakeholders involved in management must ensure that these changes proceed such that the Park retains its importance, natural value and cultural heritage.

Three principal management objectives have been formulated for the long-term sustainable management of the National Park:

- Conservation – to conserve and restore biodiversity and the cultural heritage in perpetuity.
- Education and recreation – to promote understanding of the importance of conservation and enjoyment of its pristine nature and other specific qualities of the National Park.
- Strengthening local communities – intensify cooperation with local communities in the sustainable use of natural resources with the objective of economic growth and development, ensuring income for the local community and the creation of new jobs.

View of Velika Paklenica Canyon from Anića kuk.



Cliffs of Debeli kuk.



2. CURRENT STATUS AND VALUE OF PAKLENICA NATIONAL PARK

2.1. Institutional and legislative framework

2.1.1. Legislative framework underlying the Management Plan

Nature conservation in Croatia is regulated by a large number of legal instruments. The fundamental legislation governing the conservation of biological and landscape diversity is the Nature Protection Act (as published in Croatia's official journal, *Narodne novine*, no. 70/05). This law defines the categories of protected areas, the methods for management thereof, in this regard, and the basic relevant documents.

National parks and nature parks are managed by public institutions established by the Croatian Government. The obligation to draft management plans is stipulated by Article 80 of the aforementioned law. The management plan is adopted by the public institution's Governing Board after securing consent from the Ministry of Culture and technical approval by the State Institute for Nature Protection, for a period of 10 years. Public hearings must be held during development of such plans. The management plan is implemented in practice through annual programs of conservation, use and promotion of the protected area.

Nature Protection Act – Narodne novine, no. 70/05

Article 80

- 1) Management of strict reserves, national parks, nature parks, regional parks, special reserves and protected landscapes shall be based on management plans.
- 2) The management plan shall be adopted for a period of ten years.
- 3) The management plan shall specify developmental guidelines, protection methods, use and management of the protected area, including detailed guidelines for protection and conservation of its natural values, respecting the needs of the local population.
- 4) The management plan shall be binding for all natural and legal persons engaged in activities within the protected area.
- 5) Upon the close of a five-year period, implementation of the management plan and the results achieved shall be analysed and, if necessary, the management plan shall be revised in the manner and under procedures as determined for the adoption thereof.

In addition to the management plan and the annual operating programs, the management of a protected area is regulated by internal regulations which define measures for protection, conservation, improvement and use pertaining to the protected area.

Besides the Nature Protection Act, during development of this Plan, all effective laws and subordinate regulations and documents governing management of protected areas were taken into account (Appendix 1).

2.1.2. Planning instruments in Croatia

The Croatian Parliament proclaims national parks and nature parks and enacts physical plans for special areas, national parks and nature parks. Physical plans have been mandatory since the 1970s as the core planning and conservation instrument for protected areas in Croatia. They are developed by the county physical planning departments which are under the jurisdiction of the Ministry of Environmental Protection, Physical Planning and Construction. Physical plans encompass the organization, use and purpose of a given area, as well as the conservation policies for specific areas of parks as well as zoning according to various types of usages. Since physical plans for protected areas are approved by the Croatian Parliament, they constitute fundamental legal documents for the management of national and nature parks in Croatia.

The Paklenica National Park Physical Plan was adopted on March 8, 2001 (*Narodne novine*, no. 23/01), and it was developed by the Zadar County Physical Planning Department. This Management Plan was drafted in close cooperation with the Department, to ensure that both the Physical Plan and Management Plan are closely aligned.

2.1.3. Responsible ministries and institutions

Nature protection and all activities related to management of the protected areas were under the authority of the Ministry of Environmental Protection and Physical Planning until the beginning of 2004. After public administration reform in January 2004, all activities related to nature protection were transferred to the jurisdiction of the Ministry of Culture.

Ministry of Culture, through its Nature Protection Directorate, is responsible for implementation of the Nature Protection Act and international conventions governing nature protection, and it coordinates the protection of species, habitats and landscape diversity, and is responsible for planning sustainable use of the natural heritage for the future.

Ministry of Environmental Protection, Physical Planning and Construction, although not directly involved in the management planning process for protected areas, has great responsibility for the development of protected areas through coordination of preparation of physical plans in close cooperation with the county physical planning departments and through inspections thereof.

The State Institute for Nature Protection performs expertise-based tasks pertaining to nature protection in the Republic of Croatia.

Throughout the preparation of the Management Plan, vital inputs from other ministries and regional and local governments were taken into account and addressed.

2.2. Paklenica National Park Public Institution

2.2.1. Organizational structure of Paklenica National Park

The National Park is administered by the Public Institution under the authority of the Ministry of Culture. The Public Institution's activities encompass protection, conservation and promotion of the National Park with the objective of safeguarding and preserving the authenticity of its natural environment, ensuring that natural processes proceed unimpeded and that natural resources are used sustainably and overseeing all nature protection criteria and measures in the protected area.

The bodies of the Public Institution are: Governing Board, Director General and Conservation Manager. The Governing Board administers the Institution, while the Institution's operations are organized and guided by the Director General, who is appointed by the minister in charge of nature protection for a period of four years. The Institution's expertise-based tasks are led by the Conservation Manager. The internal structure, jurisdiction and operating methods of the Public Institution are governed by the Charter and Internal Structure and Operating Rules.

In the interest of the Public Institution's coordinated, professional and systematic performance of activities in administration of Paklenica National Park, it is divided into five service units managed by the Office of the Director General.

The Institution's internal organizational units are:

- Office of the Director General;
- National Park Conservation, Promotion and Use Department;
- Ranger Service;
- Publicity, Hospitality and Tourism Department;
- Technical and Maintenance Department;
- General and Joint Services Department.

Paklenica National Park Public Institution currently (December 2006) has a staff of 33 employees (both full and part-time). Out of this number, twenty are financed by the central state budget, while the remaining are financed by the National Park's own revenues. Counting seasonal employees, the number varies from 35 to 40 annually. The optimum situation would entail the possibility of filling all systemized posts as foreseen under the Internal Structure and Operating Rules, which call for a total of 47 posts. According to an assessment by the Park's management, currently the so-called technical level of National Park services has been met, while the Conservation, Promotion and Use Department must be expanded to meet professional criteria.

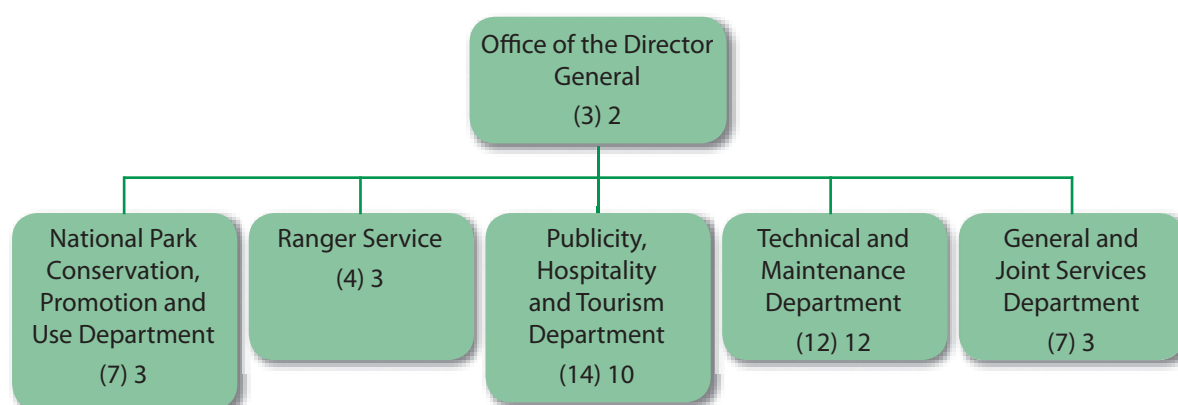


Fig. 3. Organizational structure of Paklenica National Park according to the Internal Structure and Operating Rules, with planned number of positions (in parentheses) and number currently employed in each unit (December 2006).

2.2.2. Existing infrastructure

Paklenica National Park Public Institution owns a series of buildings and other structures used for administrative, tourism, educational and fire-prevention purposes.

Table 1: Overview of infrastructure owned by the Public Institution.

Real estate	
Designation	Description
Lugarnica - Forester house	Located in Velika Paklenica Canyon; half-hour hike from mountain lodge.
Headquarters building with functional out-buildings	Building in Starigrad-Paklenica, with National Park offices and out-buildings (garage, warehouse, restrooms, camp reception).
Auto-camp	Area around headquarters in Starigrad-Paklenica.
Fire brigade storage	Warehouse to store firefighting equipment and gear.
Business premises in Starigrad-Paklenica	Next to headquarters, leased (currently a bank branch).
Business premises in Starigrad-Paklenica	Next to headquarters, leased (currently a café).
Souvenir shop	At southern entrance to Velika Paklenica Canyon, leased.
Reception at Velika Paklenica	Building at entrance to Velika Paklenica Canyon.
Mala Paklenica Education Center	Building at entrance to Mala Paklenica Canyon.
Ivine Vodice Mountain Shelter	Mountain shelter.
Bunkers	Bunkers in Velika Paklenica Canyon, currently being renovated into visitor center.
Crni Vrh firefighting outpost	Automated fire detection outpost with video-surveillance.
Marasovići ethno-house	Traditional house in Marasovići, information point for the Park with souvenir shop and small inn.
Transit infrastructure	
Designation	Description
Access road	Road inside National Park's boundaries (2 km).

2.2.3. Current financial status

To provide a better picture of the Public Institution's finances, Table 2 shows total revenues and expenditures for the period from 1999 to 2006. The principal sections of the 2006 budget are shown in Table 3.

Table 2. Annual budgets of Paklenica National Park in 1999-2006

Year	Paklenica National Park budget (in HRK)			
	Own revenues	Central budget	Other	Total
1999.	804,849.00	2,242,563.00	80,295.00	3,127,707.00
2000.	1,555,591.00	1,938,464.00	407,889.00	3,901,944.00
2001.	2,078,423.00	2,401,228.00	520,009.00	4,999,660.00
2002.	2,573,619.00	2,691,319.00	139,753.00	5,404,691.00
2003.	2,875,878.00	2,751,385.00	171,094.00	5,798,357.00
2004.	2,948,440.00	2,460,798.00	132,979.00	5,542,217.00
2005.	3,398,084.00	4,263,781.00	982,618.00	8,644,483.00
2006.	3,156,460.00	5,087,101.00	320,314.00	10,958,824.00

Table 3. Overview of Public Institution's revenues and expenditures for 2006

Description	Amount (in HRK)	Percentage (%)
Revenues	10,958,824.00	100
Revenues from Central Budget	5,087,701.00	46.31
Revenues generated by own activities	3,156,460.00	28.73
Aid from other financial institutions	41,696.00	0.38
Earnings generated by financial assets	7,679.00	0.07
Current donations	355,000.00	3.23
Sale of manufactured fixed assets	337,888.00	3.08
Loans	2,000,000.00	18.21
Expenditures	12,776,053.00	100
Employees	2,628,058.00	20.57
Supplies, energy and services	1,599,751.00	12.52
Other operating expenses	320,414.00	2.51
Financial expenditures	103,246.00	0.81
Current donations	45,500.00	0.36
Procurement of non-financial assets	7,937,175.00	62.13
Outlays for financial assets and debt servicing	142,009.00	1.11

2.3. Natural value of Paklenica National Park

2.3.1. Geology, hydrology and soil

Velebit belongs to the one of the most striking karst complexes in the world, the Dinaric karst, characterized by very specific geological, geomorphological and hydrological features. The Park contains an immense wealth of karst relief forms such as scarps, sink-holes, crests, solution pans, karst wells and dripstones, as well as caves and pit-caves. Solution pans with karrens and channels are particularly well developed in the Bojinac area, while at Buljma the karst formations were created by glaciation, evident in the numerous moraine deposits.

Carbonate rock predominates in the National Park: limestone, dolomite and breccia. The bulk of the Park, including its peak zone, is covered by Jurassic limestone, while the lower southwestern slopes are covered by Cretaceous and Paleogene layers. At the source area of the Velika Paklenica and Mala Paklenica valleys, as well as Orljača and Brezimenjača, carbonate and clastic sediments, dating from Triassic and Paleozoic, can be found.

Clastic sediments are not permeable by water, and thus they made possible the formation of several permanent and temporary water flows as well as numerous permanent springs. The permanent springs of potable water in the Park are Stražbenica, Kontinovo vrilo, Crno vrilo, Velika Močila, Jukica vrilo, Marasovac and Pećica. The highest-volume spring of Velika Paklenica is Crno vrilo at an elevation of 780 m, followed by Kontinovo vrilo at 870 m, Jukića vrilo at 600 m and Ivine vodice, at 1,200 m.

Several soil types stand out in the National Park. The lower portions of the Velika Paklenica and Mala Paklenica Canyon floors are generally under rocky soils, which are notable on the canyon walls, below Manita Peć, and



at the foot of Sklop, Anića kuk, Crljeno, Babin kuk, Klimenta and Vlaški grad. The arrangement and size of rocky soils, turfs and shallow carbonate soils correspond to the relief and geomorphological circumstances. Shallow brown soil encompasses a portion of the central Velika Paklenica valley and the belt north and south of the upper course of Velika Paklenica, the slope under Buljma and part of the Brezimenjača Valley. Turf soils of medium depth cover parts of the Velika Paklenica and Mala Paklenica Canyons, Orljača, the area adjacent to Močila, Ivine vodice, and the hamlets of Ramići and Parići. The tracts under brown soils on limestone are covered with beech and pine forests and dwarf pine at the higher, alpine sections of the Park. The plateau between the canyons is covered with a thin layer of rendzina.

The Velika Paklenica stream usually disappears underground below the Anića kuk area. Its full length flows into the sea during the rainy season in spring, autumn and winter. Water from the mid-section of the stream is still partially used to supply the nearby settlement Starigrad-Paklenica. Given the scarcity of water within the National Park, this practice should be discouraged. One of the dangers to water quality in this stream is the permeability of the existing septic tanks and the lack of alternative biological sewage treatment at the forester house and Paklenica mountain lodge.

The other waterway in the park, in Mala Paklenica Canyon, has its source above Višegradska draga, at an elevation of 1000 m. Its capacity is lower and it is dependent on the season and precipitation. Its course gradually disappears underground until it reaches the Orljača, while in the canyon the stream is active during rainy autumns, winter and early spring.

Babino Lake is situated at an elevation of 1,650 m.





Suva Valley and Golić Peak in winter.

2.3.2. Climate

In Paklenica National Park, the influence of sub-Mediterranean, continental and alpine climates meet. There is a great variety of microclimates due to different altitudes, inclinations and orientations of slopes.

Currently meteorological observations are not recorded in the Park. According to the measurements of the closest weather station situated in Starigrad-Paklenica, the warmest month is August, with average monthly temperatures of 25.7°C, while February is the coldest month, with average temperatures of 7.46°C. As one moves away from the coast, temperatures decline, so the average monthly temperature in Velebit's peak zone can be 15°C lower than temperatures along the coast.

Due to the exposure of southern Velebit to humid air streams from the sea, abundant orographic precipitation is present. Precipitation is the lowest on the coast (ca 1,200 mm/yr.). This amount increases with altitude – at 900 m it is over 2,000 mm, while in the peak zone (e.g. Vaganski Vrh) it is 3,500 mm. In the Park, the most significant wind is the bora, particularly strong at the Buljma Pass (1,398 m) and in Čičina Valley (1,550 m), below Sveto Brdo peak. Among the other winds, the sirocco, a southern wind, and the maestrale, a summer western wind, deserve mention.

2.3.3. Landscape

Paklenica National Park, with its exceptional diversity of geomorphological forms, is the most attractive and valuable part of southern Velebit. The most prominent relief forms found here are the Velika Paklenica and Mala Paklenica Canyons.

Velika Paklenica Canyons is 14 km long and only 500-800 m wide. At its most narrow point, near the bunkers, the canyon is only 50 m wide. Vertical cliffs reaching heights of 700 m rise on both sides of the canyon. The most attractive part of the canyon where the stream makes a steep descent, downstream from Anića kuk, and steep rock crests rise just above it, creating the narrowest part of the canyon between Anića kuk and the parking lot.

Mala Paklenica Canyon has more modest dimensions, and the torrent found here is much weaker. The width of the canyon ranges from 400 to 500 m, while the surrounding rocks rise up to 650 m. The narrowest part is only 10 m wide. The whole area is less accessible and not easy to pass.

The pass between Velika Paklenica and Mala Paklenica Canyons is an extremely inaccessible karst zone with steep cliffs. There are a few summer lodges here, and the occasional residents are generally small livestock herders and beekeepers.

The picturesque mountain villages Parići, Ramići and Kneževići are situated at the area where the Brezimenjača flows into the stream in Velika Paklenica and on their banks. Well-maintained gardens and smaller cultivated fields can still be seen around them.

The Borovik and Crni Vrh complex is typical of the Park's central section, where the Mala Močila and Velika Močila expanded depressions can be found. Velika Močila is a very interesting bowl-shaped depression at the elevation of 850 m, surrounded by Crni Vrh (1,110 m), Škiljića kosa (1,015 m) and Zeleno brdo, while Borovik, named after a local pine forest, stretches on the southern edge.



View of Anića kuk and Velika Paklenica Canyon by helicopter.

The eastern part of the Park is very geomorphologically differentiated, inaccessible and wild. Further east this wilderness acquires more gentle forms, in the area of Malo Libinje and Veliko Libinje, which create karst plains with numerous sinkholes whose bottoms were once cultivated. There is a very interesting and diverse geomorphological site in the Bojinac area (1,100 m) on the coastal slope of the Park's western section, where a labyrinth of solitary rocks constitutes a particularly valuable landscape.

The narrow ridge of Velebit, 1 to 3 km wide, forms the peak zone of Paklenica National Park. This is the site of Velebit's highest peak, Vaganski Vrh (1,757 m) and the area is almost entirely covered by a mosaic of dwarf pine shrubs and the vegetation of mountain meadows, scree and cliffs. In addition, Babino Lake (32.9 x 15.9 m, 2.5 m deep) is situated here. Summer huts could once be found here.

2.3.4. Land cover

In the framework of KEC Project activities, a land cover map has been developed at the scale of 1:25,000. This map shows distribution of each land cover type based on Corine land cover classification. Two sets of Landsat TM satellite images (spring and autumn 2000) were used for protected area. This map constitutes a tool for monitoring of the Park's development in the forthcoming years.

2.3.5. Habitats

As a part of preparations for development of the Management Plan, the Paklenica National Park habitat map was made at a scale of 1:25 000. In compliance with the National Habitat Classification, 12 habitat types were ascertained at classification level III, of which 7 are threatened or rare habitats. Among the threatened and rare habitat types in the Nature Park, the most common are thermophilous beech forests with autumn moor grass, subalpine beech, littoral thermophilous and Dalmatian white oak underbrush and southeastern alpine beech forests. For the purpose of maintaining favorable conditions for threatened and rare habitat types, all activities under the Management Plan will be concluded in compliance with the Nature Protection Act.

Table. 4. Habitat types in the territory of Paklenica National Park (National Habitat Classification Level III)

NHC_CODE	NHC descriptions
B.1.	Rocky terrain with no or slight vegetation growth
B.2.	Gullies
C.3.3.*	Sub-Atlantic mesophilous grasslands and mountain meadows
C.3.5.*	Sub-Mediterranean and epi-Mediterranean dry grasslands
C.4.1.*	Mountain turfs
D.2.1.	Subalpine juniper forests
D.3.1.	Jerusalem thorn groves
E.3.5.*	Littoral thermophilous Dalmatian white oak forests and underbrush
E.4.2.*	Central European acidophilous beech forests
E.4.6.*	Southeast alpine/Illyrian thermophilous beech forests
E.6.1.*	Subalpine beech forests
E.7.4.	Scots and black pine forests on dolomites

* threatened and rare habitats pursuant to the Rules governing Habitat Types, Habitat Maps, Threatened and Rare Habitat Types and Measures to Maintain Habitat Types (*Narodne novine*, no. 07/06)



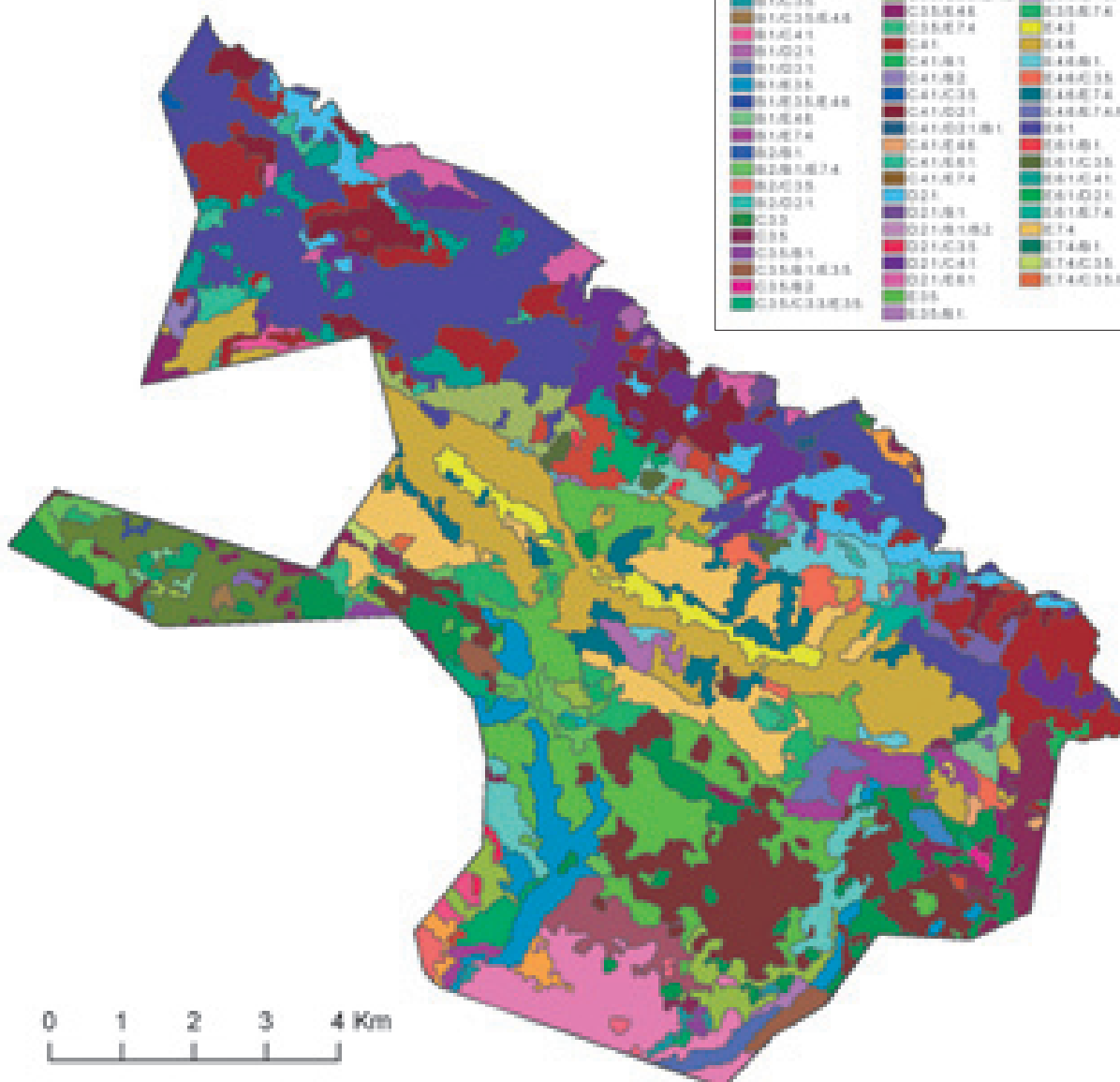
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Fig. 4. Paklenica National Park habitat map

2.3.5.1. Plant communities

The vegetation features greatly influenced the establishment of Paklenica National Park. Old growth forests which are rare in the southern part of the Velebit cover over 50 percent of the Park, with a high variety of associations.

The following forest communities are present in the Park:

- Dalmatian white oak and hornbeam forest and underbrush (*Querco-Carpinetum orientalis*), E.3.5.1; extends from the sea to an elevation of 450 m. This community enters even deeper into the Park's interior through Velika Paklenica Canyon, so it even appears above the hamlet of Ramići (650 m).
- Hop hornbeam forest and underbrush with autumn moor grass (*Seslerio autumnalis-Ostryetum*), E.3.5.6.; present in the elevation zone from 450 to 700 m, and at sheltered places on southern exposures, its coolest sub-association with whitebeam (*Seslerio-Ostryetum sorbetosum*) extends to 950 m. The loveliest forests of this sub-association can be found at Njive Lekine, below Borovnik and Komići, along Bukova and Lipa Trails.
- Black pine and cotoneaster forest (*Cotoneastro-Pinetum nigrae*), E.7.4.4; this azonal and relict forest association covers a significant surface in the Park's high-altitude zone from 700 to 1,200 m, and it generally grows on Triassic dolomites. A permanent test surface is located in this association which has been monitored since 1984.
- Illyrian coastal beech forests with autumnal moor grass (*Seslerio autumnalis-Fagetum*), E.4.6.3.; present in the elevation zone from 750 to 900 m, the most typical beech association in the Park. This association is the location of another permanent test surface in the Park, also monitored since 1984.
- Beech forest with white viburnum shrubs (*Luzulo-Fagetum*), E.4.3.2.; an azonal association which, due to a cooler microclimate and greater moisture, is present in the longitudinal depressions of Velika Paklenica and Brezimenjača, on top of acidy Triassic clastics.
- Beech forest with giant deadnettle (*Lamio orvalae-Fagetum*), E.4.5.1.; association which, due to a cooler microclimate and greater moisture, is present in the longitudinal depressions of Velika Paklenica and Brezimenjača, above dolomites.
- Subalpine beech and sycamore maple forest (*Polysticho lonchitis-Fagetum*), E.6.1.2.; present in the elevation zone from 1,000 to 1,400 m. The tree trunks are bent in their lower sections as a result of long-lasting snows.
- Dwarf pine and honeysuckle forest (*Lonicero borbasianae-Pinetum mugii*), D.2.1.1.1.; constitutes the upper limit of forest vegetation in the Park, present on Velebit's highest ridge from Oglavinovac to Sveto Brdo. This is also the largest surface covered by dwarf pine in Croatia.

In general, forests in Paklenica National Park are not managed. Under extraordinary circumstances (wildfire, insect infestations, etc.), the appropriate action is undertaken in cooperation with the relevant authorities. According to the vertical zoning, in the area above forests, mountain meadows and turfs predominate. The most common vegetation of this type is the sharp fescue turf (*Festucetum bosniacae* ("pungentis")), C.4.1.2.1. Smaller surfaces at lower elevations and southern exposures are covered by fine-leaved moor grass (*Sesleria tenuifolia*) while ridges exposed to wind and ice are covered by a community of Kitaibel's sedge and alpine rockrose (*Carici kitaibelianae-Helianthemum alpestris*), C.4.1.1.3. A sedge and buttercup community (*Carex ferruginea-Ranunculus thora*) grows on deeper soils in the peak zone.

Among the Park's non-forest vegetation, plants growing on cliffs, rock crevices and scree merit particular attention, as it is here where the highest number of endemic species on Velebit grow. In Velika Paklenica





Pine forest after a fire on the trail to Stražbenica.

and Mala Paklenica Canyons, the meadow-rue and window bellflower community (*Campanuletum fenestrellatae*) is present, while in the Velebit peak zone (below Vaganski Vrh, Babin Vrh, Malovan, Badanj, Golić) the Kitaibel's primrose and cinquefoil (*Potentilletum clusianae*) B.1.3.3.1 and Croatian Aubrietia (*Aubrietia croatica*) communities can be found.

Scree vegetation on the coastal slope includes the *Drypetum jacquinianae* community (B.2.2.1.1.), while at higher altitudes the pignut and rocket flower community (*Bunio-iberetum carnosae*) B. 2.1.1.3., can be found. At the Velebit peak zone, the *Drypetum spinosae* community has been recorded.

Currently the human impact on the Park's plant life is negligible. However, the almost complete depopulation of the National Park's territory also means that many habitats created by long-term human activity (pastures, small mowed meadows, plow-fields, orchards and gardens, and various forest degradation phases) are disappearing or have already disappeared. The following negative trends, associated with advancing natural succession of vegetation, have been observed in the Park:

- Overgrown grasslands (mostly mowed meadows) mainly in the sub-Mediterranean zones of oriental and hop hornbeam (Velika Močila, Mala Močila, Jurline, Ramići and Parići, Njive between Ramići and Marasovići, Bužanića Valley, Zapadak, Ogradica),
- Succession of alpine meadows (pastures), formed by clearing of sub-alpine beech forests and dwarf pine brush. Mountain meadows and rocky pastures along the mountain ridge are important habitats of numerous endemic and rare plant species and butterflies, especially *Erebia spp.*
- Succession on the eastern slopes of the Velika Paklenica Canyon, where open habitats are being overgrown by oriental hornbeam shrubs.

2.3.5.2. Subterranean habitats

In terms of speleology, the area of Paklenica National Park is one of the most explored areas in Croatia. 76 speleological sites have been recorded and explored in the Park. 39 (53%) are pit-caves, while 37 (47%) are caves, mainly horizontal. Smaller caves predominate – shallower and shorter than 50 m. Altogether, there are 55 such caves (70%). 23 speleological sites (29%) belong to the group of mid-sized caves – whose depth or length range from 50 to 500 m. Among these, pit-caves predominate – there are 16 of them (70%).

Only the pit-cave Ponor na Bunovcu can be classified as a large speleological site – those deeper or longer than 500 m. It has been explored to a depth of 534 m, and is considered the deepest speleological site of central and southern Velebit. Additionally, Kaverna u Crljenom kuku (-154 m), Jama u Zubu Buljme (-139 m), Jama pod Počiteljskim vrhom (-123 m) and Jama lijepih fosila (-103 m) stand out in terms of depth.

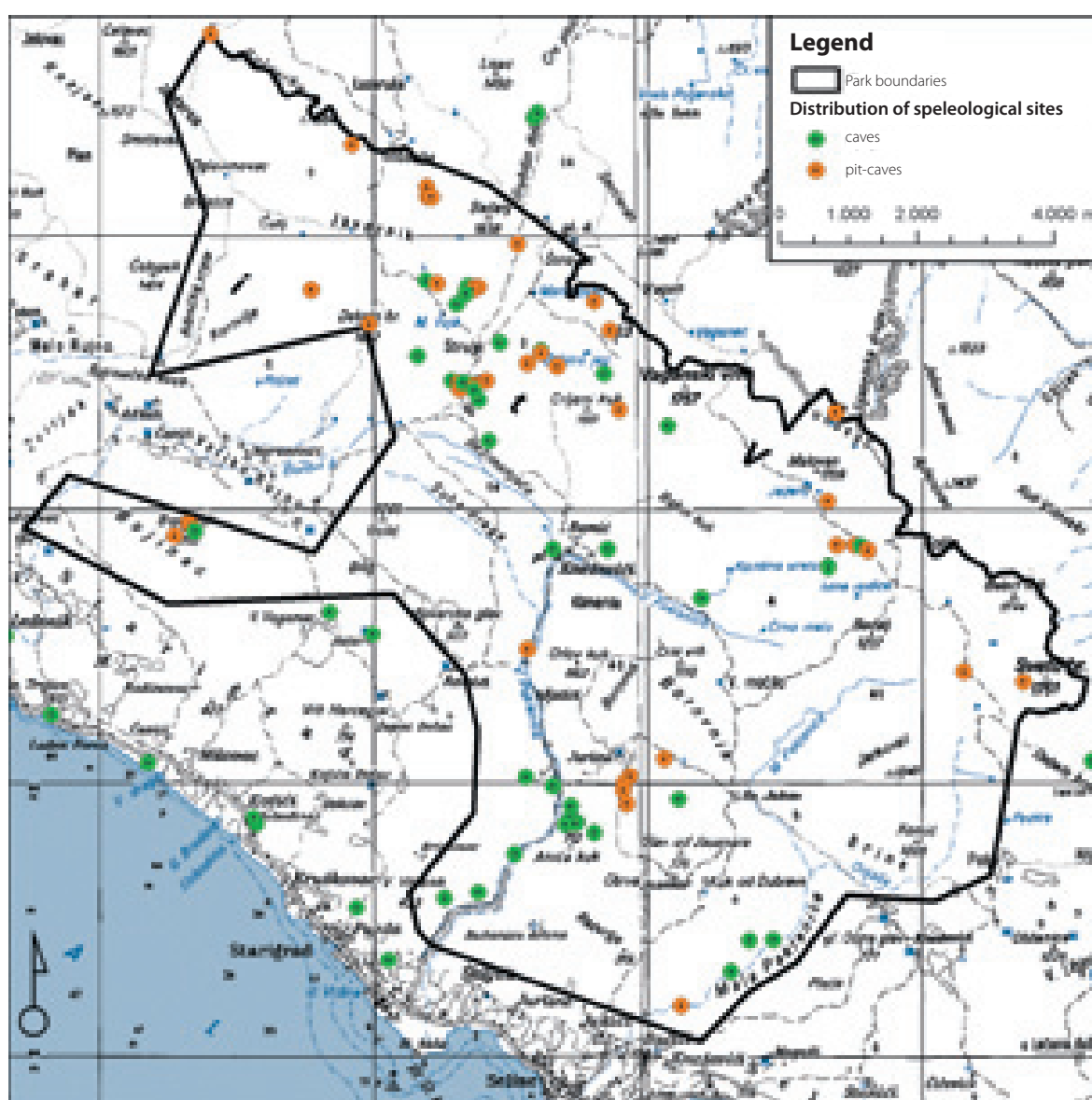


Fig. 5: Distribution of speleological objects in and around Paklenica National Park

The deepest caves in the Park are Jama Vodarica, 270 m long, and Špilja u Zubu Buljme, explored up to 250 m. The well-known Manita Peć cave follows, at 175 m in length, and the Lucinka cave, 132 m long. The 51 m high entrance to Lucinka is one of the largest cave entrances of the Croatian karst, and its interior also has exceptional dimensions.

Some of explored speleological sites are exceptionally valuable from the archeological, paleontological, biospeleological, tourism and ethnographic standpoints, thus enhancing the basic value of the National Park.

From the archeological aspect, Pazjanica cave is quite valuable (see the cultural heritage chapter). The cave bear skull from the pit-cave Jama u Zubu Buljme can be considered a valuable paleontological discovery. In this sense, the cave Špilja u Zubu Buljme has greater potential, as indicated by preliminary test digs conducted as a part of research in 2001. A large number of explored speleological sites can be classified as exceptionally significant in terms of biospeleology. Due to the poor development or complete lack of the cave dripstones (stalagmites and stalactites) in most the explored caves, only a few may be deemed valuable for tourism. Besides the Manita Peć cave, which is already a part of the Park's tourism product, the Vodarica pit-cave also has great potential, as does, to an extent, the considerably smaller Sklop IV cave. Prior to any potential use of these sites for tourism, a detailed analysis should be conducted. In 2006, a cave management plan was drafted under the KEC project for Manita Peć.

In the past, some exceptionally small speleological objects also served the local population as shelters and storage sites for cattle or other goods, thus they have an ethnographic value. These include Babunjuša, Špilja kod Kneževića, Mokrača, Krumpirova pećina, Marasovića pećina and Škiljića stan caves.



2.3.6. Plants

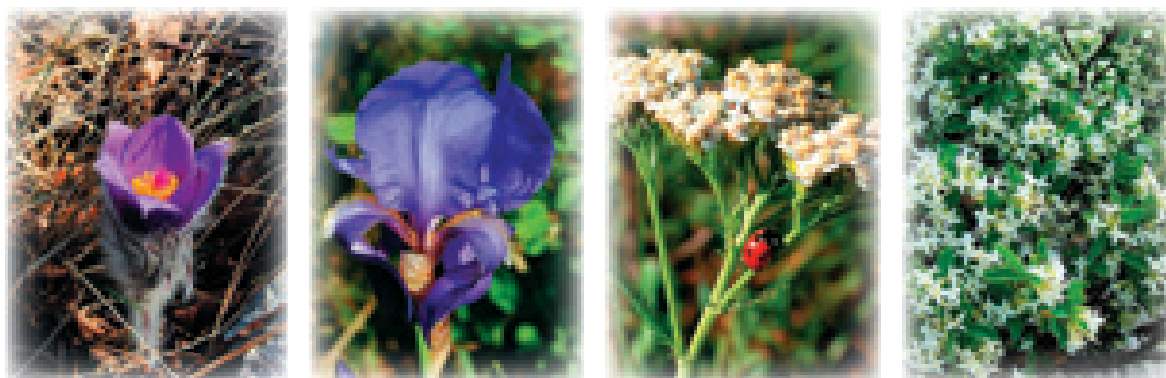
Paklenica National Park is characterized by an exceptional wealth of plant life. Due to the specific relief and microclimate, Mediterranean, continental and mountain plant species are found here, many of them endemic to Velebit.

In the scope of the Karst Ecosystem Conservation Project, systematic vegetation inventories were conducted over the entire area of Paklenica National Park (except of the eastern peak zone – a possibly mined area of 2,000 ha). Field research and analysis of the geo-referenced data has been completed. A condensed picture of plant diversity and summary data is provided in Table 5.

Table 5. Concise overview of plant diversity in Paklenica National Park based on: (1) field research in 2004-2006 under the KEC Project, (2) data from literature and associated data on the number of endemic and endangered species (Nikolić and Topić 2005), and the presence of taxa covered by the Bern Convention (1979 Annex I and Recommendation 46 of 1996) and the Habitats Directive (Annexes II, IV and V of 2004) (according Flora Croatica database status in February 2007).

Priority area	PAKLENICA National Park
Species	
Total	1,013
Field observations	731
Literature consulted	825
Species and sub-species	
Total	1,110
Field observations	781
Literature consulted	866
Endemic species and sub-species (s.l.)	67
Bern Convention	49
Habitats Directive	11
RED LIST STATUS	
CR – critically endangered	0
EN – endangered	7
VU – vulnerable	14
NT – near threatened	41
LC – least concern	11

The main characteristics of the Park's plant life are the high number of species in relation to the relatively small area of the Park and the high number of endemic species – 6% of all species recorded (inventory and literature). During the field inventories conducted between 2004 and 2006, almost 90% of the species listed in the existing literature have been confirmed and mapped. The number of endangered taxa, according to the National Red List, is not high (1.3%) in relation to the variety of habitat types. The number of taxa, e.g. total plant diversity, is certainly higher because a part of the area was not visited due to the presence of land-mines and difficult terrain. Also, new finds or confirmation of early spring taxa can be expected, since inventories in the first part of the year were not uniform.



The following families dominate the Park's plant life: the aster family (*Asteraceae* and *Cichoriaceae*), grasses (*Poaceae*), legumes (*Fabaceae*), the mint family (*Lamiaceae*), roses (*Rosaceae*) and carnations (*Caryophyllaceae*). So far, 67 endemic species have been recorded in the Park, which is 6.7% of all plants, which makes this area one of the centers of endemic species in Croatia. Among the Park's endemic species, the most valuable are the Velebit steno-endemic species, with ranges limited to Velebit, such as the sandwort *Arenaria orbicularis*, only found in Velika Paklenica and Mala Paklenica Canyons. Other endemic species are the window bellflower (*Campanula fenestrellata*), Waldstein's bellflower (*Campanula waldsteiniana*), Velebit bellflower (*Campanula velebitica*), Kitaibel's columbine (*Aquilegia kitaibelii*), the Velebit carnation (*Dianthus velebiticus*), Kitaibel's primrose (*Primula kitaibeliana*), a variety of moon-carrot (*Seseli malyi*), etc.

As an area of exceptionally rich plant life with almost all endemic, relict or rare plant species represented, the small area of Buljma Pass and the scree below Bili Vrh (1,657 m) with gullies and rock on the southern and southwestern slopes stand out.

2.3.7. Fauna

Paklenica National Park encompasses four different but characteristic parts of southern Velebit. A part of the species listed in the Annexes to the Birds Directive, as well as Annexes II and IV of the Habitats Directive, are also listed in the IUCN list of endangered species and their conservation should be a particular concern in management of Paklenica National Park through implementation of action plans to continually monitor their populations.

Table 6. Overview of species protected by European directives (BD – Birds Directive; HD – Habitats Directive), which are deemed priority due to their habitats and/or populations, or due to their threat status (based on IUCN categories: CR – critically endangered, EN – endangered, VU – vulnerable, DD – data deficient, RE – regionally extinct).

English name	Latin name	BD I	HD II	HD IV	IUCN	HR
Leopard snake	<i>Zamenis situla</i>			+	DD	DD
Meadow viper	<i>Vipera ursinii</i>		+		VU	EN
Garden dormouse	<i>Eliomys quercinus</i>				VU	
Martino's vole	<i>Dinaromys bogdanovi</i>					DD
Greater horseshoe bat	<i>Rhinolophus ferrumequinum</i>		+	+		
Lesser horseshoe bat	<i>Rhinolophus hipposideros</i>		+	+		
Alpine long-eared bat	<i>Plecotus macrotis</i>			+		DD
Geoffroy's bat	<i>Myotis emarginatus</i>		+	+	VU	
Griffon vulture	<i>Gyps fulvus</i>	+				RE
Apollo	<i>Parnassius apollo</i>			+	VU	

2.3.7.1. Small terrestrial vertebrates and bats

As a part of preparations to develop the Management Plan, inventories were conducted in which five species of amphibians, nineteen species of reptiles, fifteen species of small mammals and fifteen species of bats were confirmed. Small terrestrial vertebrates have not been fully studied, and some questionable finds dictate the need for further verification.

Typical species of the Dinaric karst are characteristic to limestone cliffs and gullies. Among them the most important for conservation purposes are the Martino's vole (*Dinaromys bogdanovi*), and the Aesculapian snake (*Zamenis longissimus*) and leopard snake (*Z. situla*). Insufficient knowledge of their numbers and possible key micro-locations make them vulnerable to possible construction or other works, so for the time being it is impossible to ascertain the necessary status for conservation and area management. These



species are also threatened by uninformed local residents and visitors, as well as collectors for the European house-pet market.

The Park's central section around spring areas and waterways, as well as the entire area around Ramići, Parići and the rest of the mainly abandoned settlements on the coastal slope, have relatively poor but particularly mixed Mediterranean and continental animals with the most prominent species connected to man-made structures (attics, abandoned houses, stacked-stone walls), such as the blue-throated keeled lizard (*Algyroides nigropunctatus*) and western green lizard (*Lacerta bilineata*), and the lesser horseshoe bat (*Rhinolophus hipposideros*) and Geoffroy's bat (*Myotis emarginatus*). Migratory bats such as the lesser noctule (*Nyctalus leisleri*) and the common noctule (*Nyctalus noctula*) find shelter in the openings of old beech trees. In future research, the priority will be to find the location of the Geoffroy's bat nursery colony.

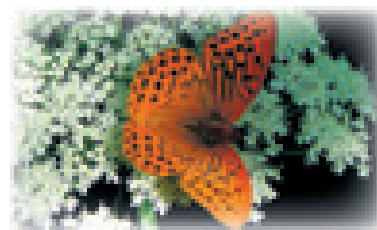
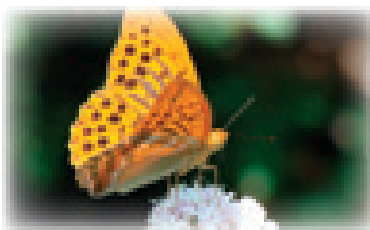
The Park's peak zone, extending from Buljma and Ivine vodice to the highest peaks of Velebit, is inhabited by all species characteristic to the northern part of Velebit (*Lacerta vivipara*, *Iberolacerta horvathi*, *Dryomys nitedula*, *Chionomys nivalis*, *Microtus (multiplex) liechtensteini*, *Sorex alpinus*, and *Parnassius apollo*), but also some species that are found here only because of the high altitudes (the butterfly *Erebia gorge vagana*). A very important species for conservation is definitely the small venomous snake *Vipera ursinii macrops*, which has so far been found solely at two sites on Velebit, Sveto brdo and Veliki Štirovac. The integral range and abundance of the species has yet to be determined.

In the northern-most part of the Park, which includes the area of Bunovac and part of the mixed beech and fir forests around it, all species characteristic of the northern slopes of Velebit are present, including the rare (for Velebit) agile frog (*Rana dalmatina*), and the bank vole (*Clethrionomys glareolus*), for which this is the southern-most point of its range in Croatia.

2.3.7.2. Butterflies

During the course of two years of butterfly research, the presence of 55 species has been ascertained. Rota (1999) recorded 78 species over several years. Most species belong to the Nymphalidae family. The species listed on the Red lists of threatened species of Croatia (Šašić and Kučinić, 2004) are particularly important, and legally protected under the Rules on Proclamation of Protected and Strictly Protected Wild Taxa (*Narodne novine*, no. 7/06), as are species in the Red Data Book of European Butterflies (van Sway and Warren, 1999) as well as Annexes II and IV of the Habitats Directive:

- Apollo (*Parnassius apollo*) – Annex IV of Habitats Directive (van Sway and Warren, 1999; Šašić and Kučinić, 2004), found in July 2006 at Struge and Veliki Javornik;
- Swallowtail (*Papilio machaon*) – Rules on Proclamation of Protected and Strictly Protected Wild Taxa (*Narodne novine*, no. 7/06), found in July 2006 in Malovanski stanovi and on the trail to Bunovac;
- Checkered blue (*Scolitantides orion*) – Annex IV of the Habitats Directive (van Sway and Warren, 1999; Šašić and Kučinić, 2004), found in August 2005 at Parići;
- Purple emperor (*Apatura iris*) – (Šašić and Kučinić, 2004), found in July 2006 at Struge;



- Woodland ringlet (*Erebia medusa*) – (van Swaay and Warren, 1999; Šašić and Kučinić, 2004), found at Malovanski stanovi in July 2006.

The Vagana silky ringlet (*Erebia gorge vagana* – Šašić and Kučinić, 2004), an endemic sub-species, merits particular attention, as it was not found during inventorying, but was described on the northeastern slopes at elevations ranging from 1,600 to 1,660 from Babin Vrh to Vaganski Vrh (Lorković, 1954).

The main threat to butterflies in the Park is vegetation overgrowth in meadows and illegal collection of certain attractive species (e.g. Apollo, swallowtails, purple emperors). Effective conservation of the listed species in Paklenica National Park will require identification of the size of the population and establishment of a monitoring program.

2.3.7.3. Birds

So far, 225 bird species have been recorded in the wider territory of Paklenica National Park, of which 102 are nesting species, two nesting species are now extinct in the Park, while there are 10 nesting species that live in the National Park's immediate vicinity. The relatively high number of nesting species in relation to the Park's size is the result of great habitat diversity. Almost half of the nesting species are tied to open habitats (rocky and mixed open habitats). The rocky habitats can mainly be found in Velika Paklenica and Mala Paklenica Canyons.

The National Park's most valuable species are the 22 petrophile birds, which nest on rocks and cliffs, including these endangered species: the golden eagle (*Aquila chrysaetos*), the short-toed eagle (*Circus pygmaeus*), the raven (*Corvus corax*), the peregrine falcon (*Falco peregrinus*) and the eagle owl (*Bubo bubo*). A typical nesting bird of the rocky meadows is the rock partridge (*Alectoris graeca*). Hop hornbeam thickets are home to the rock bunting (*Emberiza cia*) and the lesser spotted woodpecker (*Picoides minor*), while beech forests are inhabited by rare woodpecker species such as the white-backed woodpecker (*Picoides leucotos*), the black woodpecker (*Dryocopus martius*) and the gray-headed woodpecker (*Picus canus*).

Among the 102 nesting birds, 32 are on the Red lists of threatened species of Croatia: one in the EN category (golden eagle), two in the VU category (peregrine falcon and short-toed eagle), ten in the NT category and nineteen in the LC category. Among the nesting birds, 12 are listed in Annex I of the Birds Directive and 80 in the Annex II of the Bern Convention. Unfortunately, two species of birds of prey have recently become extinct in the Park: the Egyptian vulture (*Neophron percnopterus*) and the griffon vulture (*Gyps fulvus*). Paklenica National Park was the last nesting ground of the Egyptian vulture in Croatia, and after they stopped nesting in Paklenica during the 1980s, this species became extinct in Croatia. The griffon vulture, which was last recorded as nesting in the Park in 1999 (Lukač et al. 2003, Lukač 2004), is a threatened nesting bird in Croatia, and Paklenica was its last nesting ground on the Croatian mainland (today it only nests on the northern Adriatic Kvarner islands).



2.3.7.4. Large mammals

Among the large carnivores recorded in the Park are the brown bear (*Ursus arctos*), the wolf (*Canis lupus*) and the wildcat (*Felis sylvestris*), while the lynx (*Lynx lynx*) visits the area only occasionally. The wolf is an endangered species listed on the IUCN Red List and protected by law. Existing trails do influence these large carnivores, but they are not new and do not threaten them directly. However, any potentially new trail in the future should be regarded with caution.

The number of chamois (*Rupicapra rupicapra*) in the Park is growing, due to protection of the area from hunting and the placement of two salt licks and a decline in poaching. Among the other large herbivores, the roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*) and wild boar (*Sus scrofa*) are present.

Hunting is not allowed in the Park, nor is luring animals using food, water and other means allowed in a 400 m buffer zone around the Park's boundaries. Hunting in hunting zones around the Park is governed by existing game management guidelines. However, failure to observe the 400 m buffer zone has been noted. In 2004 and 2006, wolves were poisoned at the very boundary of the Park. Hunting zones around the park are shown in Fig. 6.

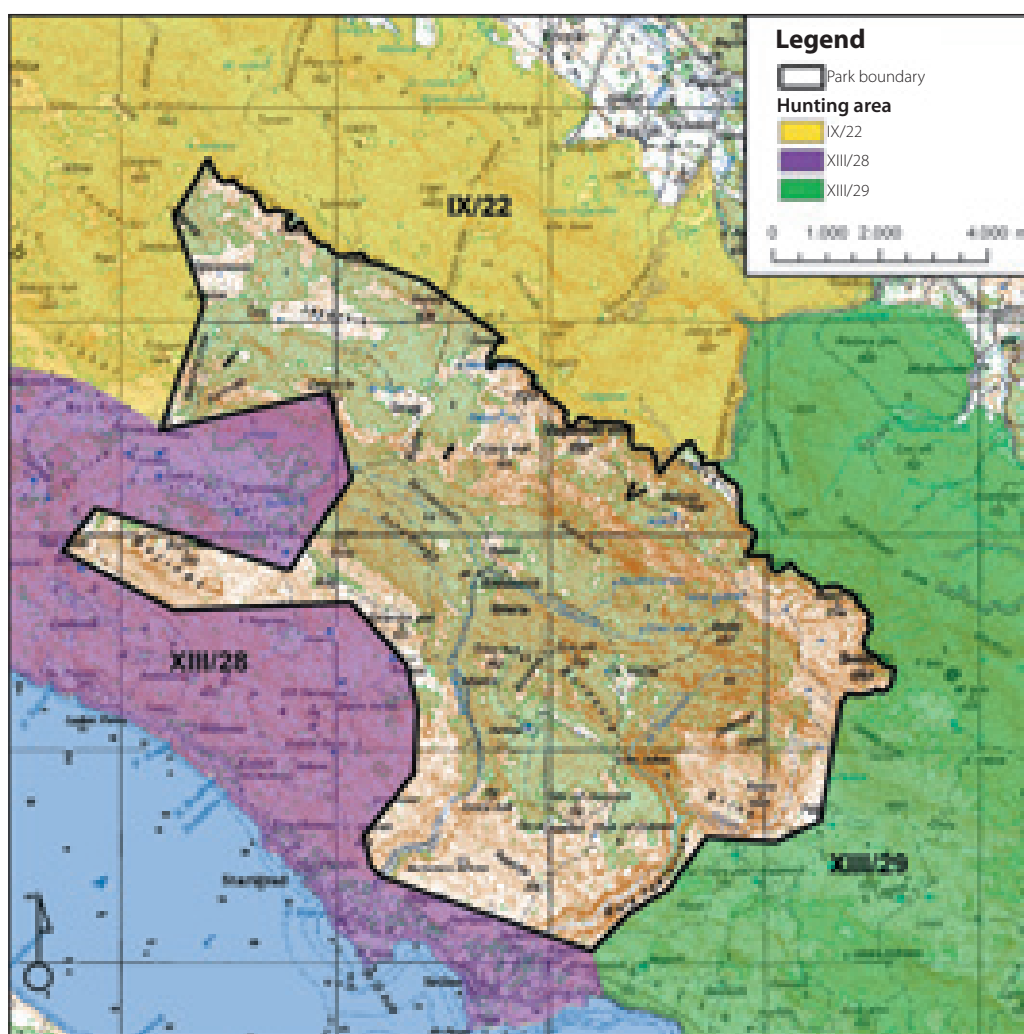
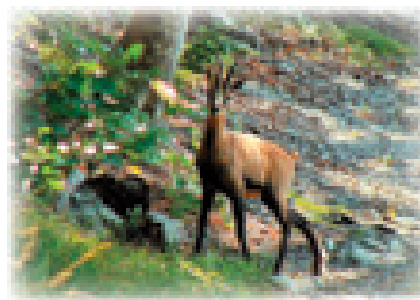
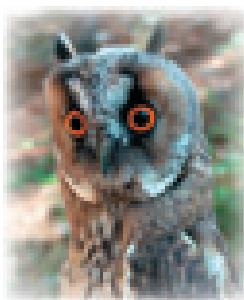
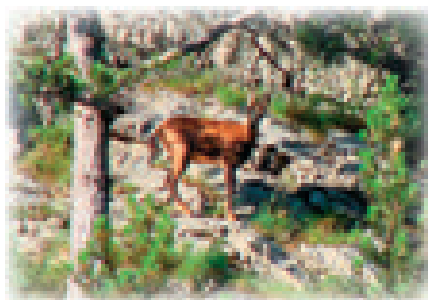


Fig.6: Hunting areas around Risnjak National Park



2.3.7.5. Water habitat fauna

Temporary waterways are typical of Paklenica National Park, and these are home to the probably introduced crayfish (*Astacus astacus*), the larvae of fire salamanders (*Salamandra salamandra*), and the alpine newt (*Triturus alpestris*) and others on which the grass snake (*Natrix natrix*) feeds. These waters are rich in larvae of stoneflies (*Plecoptera*) and caddisflies (*Trichoptera*), while ponds are traditional spawning sites for amphibians (e.g. the green toad – *Bufo viridis*) as well as watering sites for birds and mammals (including bats). These ponds have been neglected since local livestock raising stopped, and they should be maintained. The small Babino Lake is situated in the peak zone, which is home to the alpine newt (*Triturus alpestris*). Until roughly ten years ago, Malovan Lake also existed, with a population of primitive crayfish (*Chirocephalus sp.*), but it disappeared with the end of transhumant livestock herding and also due to climate change.

2.3.7.6. Cave fauna

Biospeleological data from the literature, collections and field research conducted for the needs of the Management Plan, exist for 40 sites. So far 60 taxa have been recorded, including 30 taxa adapted to subterranean habitats. Most of the data from the literature originate from the lower part of the National Park (up to an elevation of roughly 1,000 m), which includes both Velika Paklenica and Mala Paklenica Canyon up to the Paklenica Mountain Lodge. Until the most recent research in 2006, only beetles have been recorded in the Park's upper sections above elevations of 1,000 m, while other invertebrate groups have not yet been studied. Biospeleological research conducted as part of the Karst Ecosystem Conservation Project and preparations for the Management Plan has covered most of the National Park and all subterranean invertebrate groups.

The most common among the Park's subterranean species are the beetles, with 15 taxa recorded so far, followed by crustaceans with 12 taxa, spiders with 10 taxa, pseudoscorpions with 10 taxa, millipedes with 7 taxa, harvestmen with 4 taxa and other invertebrate groups with not more than 3 taxa. Six taxa have been described from sites within the Park. Manita Peć is a type locality for four taxa, the spider *Histoipona egonpretneri*, pseudoscorpion *Chthonius radjai*, the aquatic isopod *Proasellus coxalis lucifugus* and the amphipod *Bogidiella sketi*. All of them are endemic to Croatia, and the *Chthonius radjai* has only been found at one other locality, while the *Bogidiella* has not been recorded after it was first discovered. Snježnica Cave, near Babin Vrh, is a type locality for the beetle *Astagobius angustatus vukusici*, which is endemic to southern Velebit.

The taxa *Neotrechus ganglbaueri ganglbaueri* was described on the basis of discoveries in caves northeast of Starigrad-Paklenica. The exact location of these caves is unknown. This taxa is endemic to southern Velebit and northern Dalmatia. Many other taxa are endemic as well, such as the pseudoscorpion *Neobisium stribogi*, endemic to southern and southeastern Velebit, the beetles *Astagobius hadzii* to southern Velebit, *Nebria velebiticola*, *Leptodirus hohenwarti velebiticus* and *Typhlotrechus bilimeki likanensis* to Velebit, *Duvalius eurydice* to southern Velebit and the Lika region, *Redensekia likana likana* and *Spelaeodromus pluto* to the

Lika region and Velebit, *Laemostenus elongates elongates* and *L. cavicola* to the Dinaric Alps, the terrestrial isopods *Androniscus wolffi* to the costal part of Velebit and *Alpioniscus balthasari* to the Dinaric Alps, the millipede *Haasia likanum* to the Lika region, etc. The discovery of the rare endemic species of the genus *Egonpretneria*, the spider *Stalita pretneri* and *Troglohyphantes roberti*, the harvestman *Hadzinia karamani* and the pseudoscorpion *Troglochtonius doratodactylus* are crucial.

The high value and biodiversity of subterranean fauna of Paklenica National Park is also indicated by the newly-found species. Thus, there has been confirmation of what are probably two new genera of centipedes and spiders, a new spider species from the *Sulcia* genus, a harvestman of the *Cyphophthalmus* genus, a pseudoscorpion of the *Neobisium* genus, a paligrade of the *Eukoenenia* genus, and two species of sub-class *Pselaphinae*, *Bryaxis* sp. and *Bythoxenus* sp. They are probably all new taxa and will be described in the future.

Impact on speleological sites and the accompanying animal life:

- The main threat to subterranean fauna in the caves near hiking routes such as Kapljarka, Devnjača, Mokrača, etc. is visitors. Most of these sites are rock shelters, so the impact on troglobiotic fauna is low, but high on troglophiles. Visitors leave behind organic and other matter, including batteries, thus physically devastating the caves.
- The pit-cave Jama Vodarica was devastated in the past, and tourists still visit it and leave organic and hazardous materials behind (including batteries). Therefore visits pose danger not only to the cave and its fauna, but also for other visitors.
- Manita Peć is an indicator cave, and there is no problems with uncontrolled entry, although the impact on the cave's microclimate and fauna is not presently (2006) known since there is no monitoring in place. A management plan for Manita Peć was developed in 2006.
- In the upper, northern section of the Park, a road passes near the 534 m deep pit-cave Ponor u Bunovcu (elevation: 1,200 m). There is a high possibility that the pit-cave has been devastated with waste and explosives.

2.3.7.7. Other animal groups

Among the other animal species, the most important are beetles (*Coleptera*) which live in cavities in trees, such as the hermit beetle (*Osmoderma eremita*), and species whose larvae feed on dead wood, such as the Rosalia longicorn (*Rosalia alpina*), Cerambyx longicorn (*Cerambyx cerdo*), and stag beetle (*Lucanus cervus*). Their presence in older and logged forests testifies to the pristine state of nature of these forest habitats.



Bark beetle larva feeding on wood.

2.3.8. Ecological network in the territory of Paklenica National Park

In Croatia, the Ecological Network is stipulated by the Nature Protection Act. This is actually a system of mutually linked or spatially proximate areas of ecological significance that are vital to threatened species and habitats. Their biogeographic balance considerably contributes to the conservation of the natural equilibrium and biological diversity. In compliance with the EU's NATURA 2000 ecological network, ecological network areas are classified as areas important to wild taxa and habitat types (potential SACs – Special Areas of Conservation) and internationally important bird taxa (potential SPAs – Special Protection Areas). Within the ecological network, its components are linked by natural or artificial corridors. An ecological corridor is an ecological component or series thereof which enables movement of live organism populations from one site to another.

In compliance with the mechanisms specified in the EU Habitats Directive, the Nature Protection Act stipulates that parts of the ecological network can be protected as specially protected areas or by means of management plans, and also by means of procedures to evaluate the acceptability of any undertaking that may be harmful to nature.

The territory of Paklenica National Park is entirely encompassed in the Ecological Network, and it includes the following areas:

1. Important areas for wild taxa and habitat types

The entire territory of Paklenica National Park has been designated as an important zone for wild taxa and habitat types. Within this zone 8 areas have been ascertained, of which 5 are dotted sites (Table 7).

Table 7. Areas important to wild taxa and habitat types in the Ecological Network within the boundaries of Paklenica National Park. (*-priority habitat; #-internationally significant area =potential Natura 2000 area).

Area code	Area designation
HR2000052#	Pit-cave under Bojin crest
HR2000082#	Manita Peć
HR2000122#	Sniježnica near Babin Vrh
HR2000756#	Pit-cave under Buljma cliffs
HR2000757#	Pit-cave at Buljma spur
HR2000871#	Paklenica National Park
HR2000961#	Babino Lake
HR5000022#	Velebit Nature Park

2. Important international bird areas

Based on an assessment made by the Croatian Academy of Science and Arts Ornithology Department, this area has been evaluated as an area of broader international importance for the birds of *Velebit* (Table 8).

Table 8. Important areas for birds in the Ecological Network within the boundaries of Paklenica National Park.

Area code	Area designation
HR1000022 #	Velebit

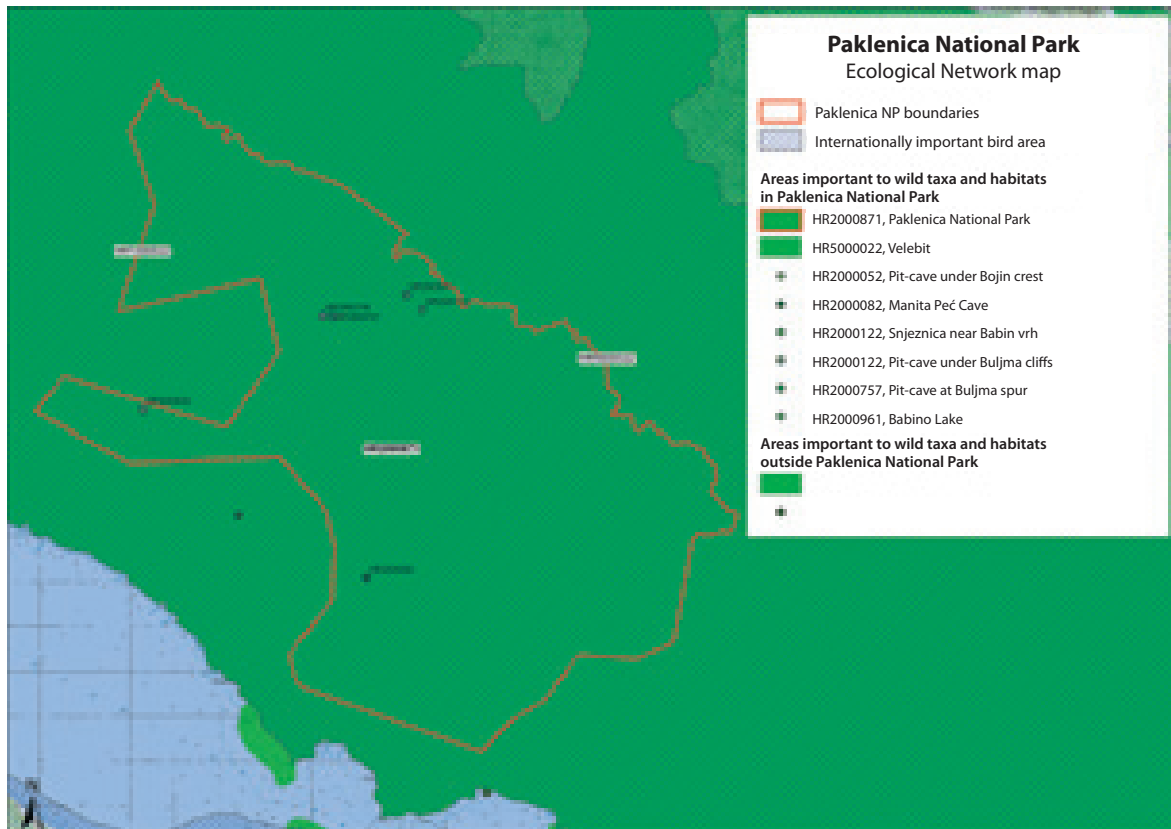


Fig. 7. Ecological network in the territory of Paklenica National Park.

2.4. Population and cultural heritage

2.4.1. Population

In the Park, there are only two elderly permanent residents living in the village of Ramići. The majority of other villages (e.g. Kneževići, Katići, Jurline, Škiljići) are abandoned, while Parići, Ramići and the households at Veliko Rujno, are only occasionally inhabited during the summer and weekends, mainly for rental of rooms to interested visitors and hikers. Summer livestock grazing is only characteristic for the eastern part of the National Park, around Malo Libinje, and next to Mala Paklenica and Bucići. Fig. 8 shows the administrative borders of the municipalities in and around the Park, and the principal households inside the Park.

Traditionally, forestry, animal husbandry and non-intensive agriculture were the main activities of the local population. Along the stream in Velika Paklenica, mills were constructed while the waterway was often used for transportation of tree trunks that were heavily logged in the area until World War II. Since the establishment of the National Park, all commercial activities have been banned inside the Park. The subsequent development of coastal tourism attracted people living in the Park to move to the seacoast. Although today there are almost no inhabitants in the Park, the surrounding coastal tourist settlements are oriented towards the Park, such as Starigrad-Paklenica, Seline, Modrič, Rovanjaska and Tribanj, where tourism activities have developed. Many residents of these settlements, mostly Starigrad-Paklenica and Seline, own land and other real estate in the Park.

The Public Institution has acknowledged the need for improvement of cooperation with the local community. Currently, local people benefit from the Park mainly in terms of employment. Additionally, because of the Park, the tourist season is longer and lasts from spring to late autumn (March to November). Park visitors stay in Starigrad-Paklenica and Seline briefly or for longer periods, and use available accommodations (private rooms, camps, hotels).

Additional opportunities for the local community's involvement have been recognized by the Public Institution in the development of sustainable tourism (revitalization of mountain settlements and traditional accommodations, traditional cuisine, revival of handcrafts, production of local food and other products), additional full-time or part-time employment (for example, as guides) and the possibility of using the Park's resources (cattle grazing, traditional agriculture).

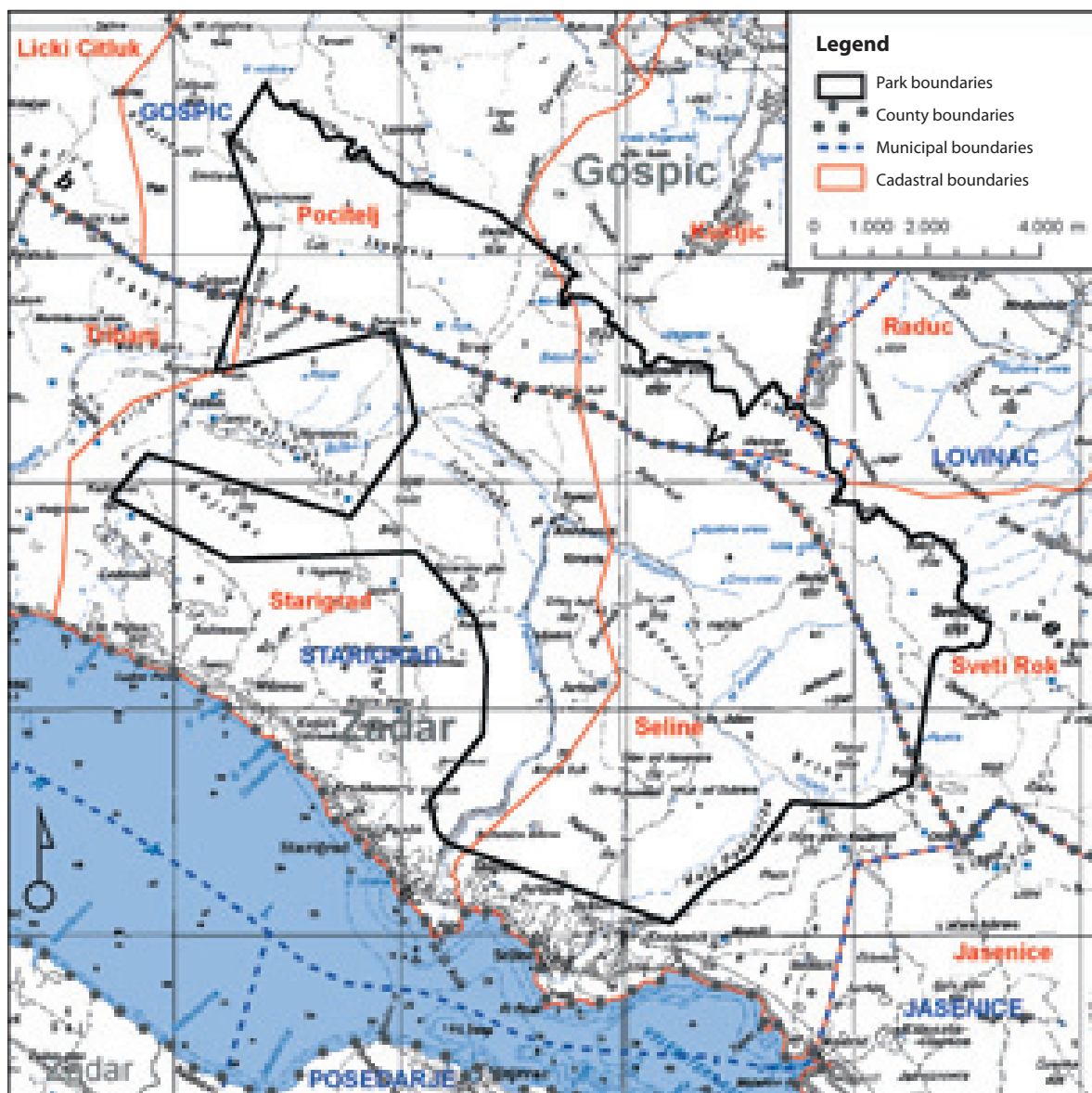


Fig. 8: Administrative boundaries and settlements in Paklenica National Park

2.4.2. Cultural heritage

The human presence in the National Park's territory goes back to prehistory, as evidence derived from research in Vaganačka Cave, Pazjanica Cave and other nearby caves indicates, where Impressed Ware pottery the Early Neolithic has been found, including various ceramic artifacts and lithics of the Danilo culture, as well as abundant material from the Bronze and Iron Ages. The Paklarić archeological site was also discovered in the Park, and a viewpoint was arranged nearby. This site consists of the remains of a fortification most likely dating to the Late Middle Ages (sixteenth century), when several similar citadels were built along the coast in order to secure a trading route and to protect coastal residents at the same time.

Additionally, there are seven mills along the stream of Velika Paklenica, built in the first half of nineteenth century. The mills were in function until the 1960s. As a specific form of traditional architecture, one of the mills was reconstructed and included in the Park's tourism product. Currently, the ethno-house in the village of Marasovići is also being renovated and will serve as an information point and souvenir shop. Among the traditional architectural styles in this region in the early twentieth century, the concrete, barrel-shaped roofs are particularly interesting, and they have been preserved to this day on houses, out-buildings and mills.

Furthermore, another form of local craftsmanship involving stone are the *mirila*, special funeral stones placed near Velebit's trails, which can also be found in the Park. They are unique and permanent traces of the culture heritage on Velebit.

2.5. Visitors and tourism

In compliance with the Paklenica National Park Internal Rules of Order (*Narodne novine*, no. 76/00), the Public Institution applies the visitor and touring model which thoroughly defines potential visitor sites, the number of visitors, visiting modes and organization of the Park's presentation center.



Visitors in a parking lot in Velika Paklenica Canyon.



Currently, there are two official entrances to the Park. The first, or main entrance is at the beginning of Velika Paklenica Canyon, where all-day reception is organized, and visitor numbers and structure have been recorded since 1999. The steady increase in the number of Park visitors since 2000 is visible in Table 9. The exceptions were 2003 and 2006, when the planned 5% increase in number of visitors was not reached, rather 3% and 7% decreases were recorded. The main reason for the lower number of visitors in those years were the often and long-lasting fires at the Park's borders in 2003, occurring in the peak season, July and August, when the greatest number of visitors was expected, while in 2006 the decrease was caused by other unfavorable conditions (poor weather). The second entrance is at Mala Paklenica and Seline, and the reception desk commenced operations in mid-June 2007.

Table 9. Number of visitors in Paklenica National Park, 2000-2005.

Year	2000	2001	2002	2003	2004	2005	2006
No. of visitors	70,363	86,737	105,017	102,183	108,414	113,929	104,071

The most numerous visitors are hikers, followed by climbers, representing one third of all Park visitors (Fig. 9). Both groups visit the Park individually, therefore individual visits account for 87%, while only 13% of visitors come to the National Park in organized groups. Also, foreign visitors predominate in the Park (approximately 79%).

Due to the hikers and climbers, the visit season in the Park is longer, lasting from early April to early November, with its peak in July and August, when the Park receives 45% of its annual visits. In May and June, besides climbers and hikers, the number of school children and students visiting the Park is also notable.

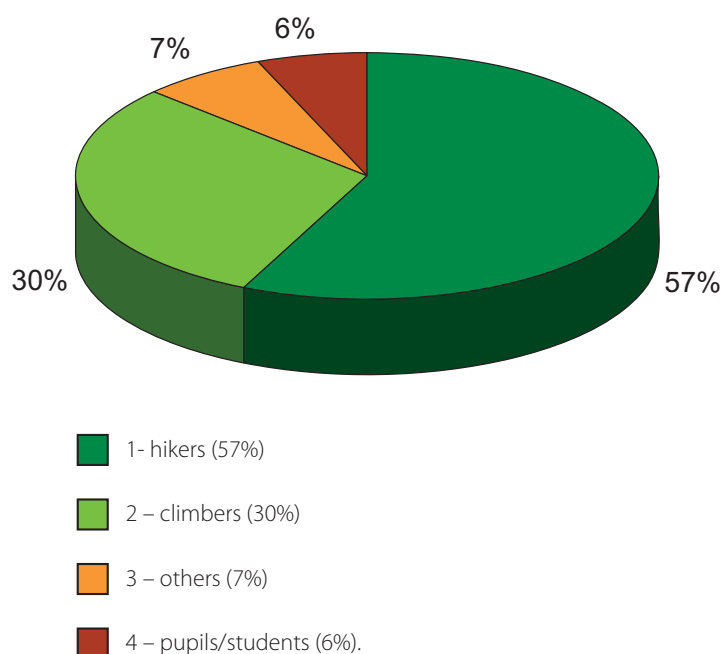


Fig. 9. Share of individual groups of visitors in Paklenica National Park.

Data on the spatial distribution of visitors within the Park (Fig. 10) are based on records of visitor numbers at the entrance, in the so-called “bunkers”, Manita Peć cave and Lugarnica foresters house. The statistics for the rest of the Park area are estimates.

Visitors arrive by car, bicycle, on foot or in organized groups – by bus. During the highest-volume (July and August), the Park provides organized transportation from the reception to the parking lot in Velika Paklenica Canyon, and it organizes a regular bus line from Zadar to Seline, Starigrad-Paklenica, the National Park and back. The Public Institution is planning to minimize the impact of private transportation by improving bus transfers with the objective that all personal automobiles are parked outside the Park, so bus transport is a temporary solution.

Potential activities in the Park include sightseeing, hiking, free climbing, mountain-climbing, bicycling, bird-watching, etc. There are 150 km of trails in the Park. The most used is the trail that leads from the reception

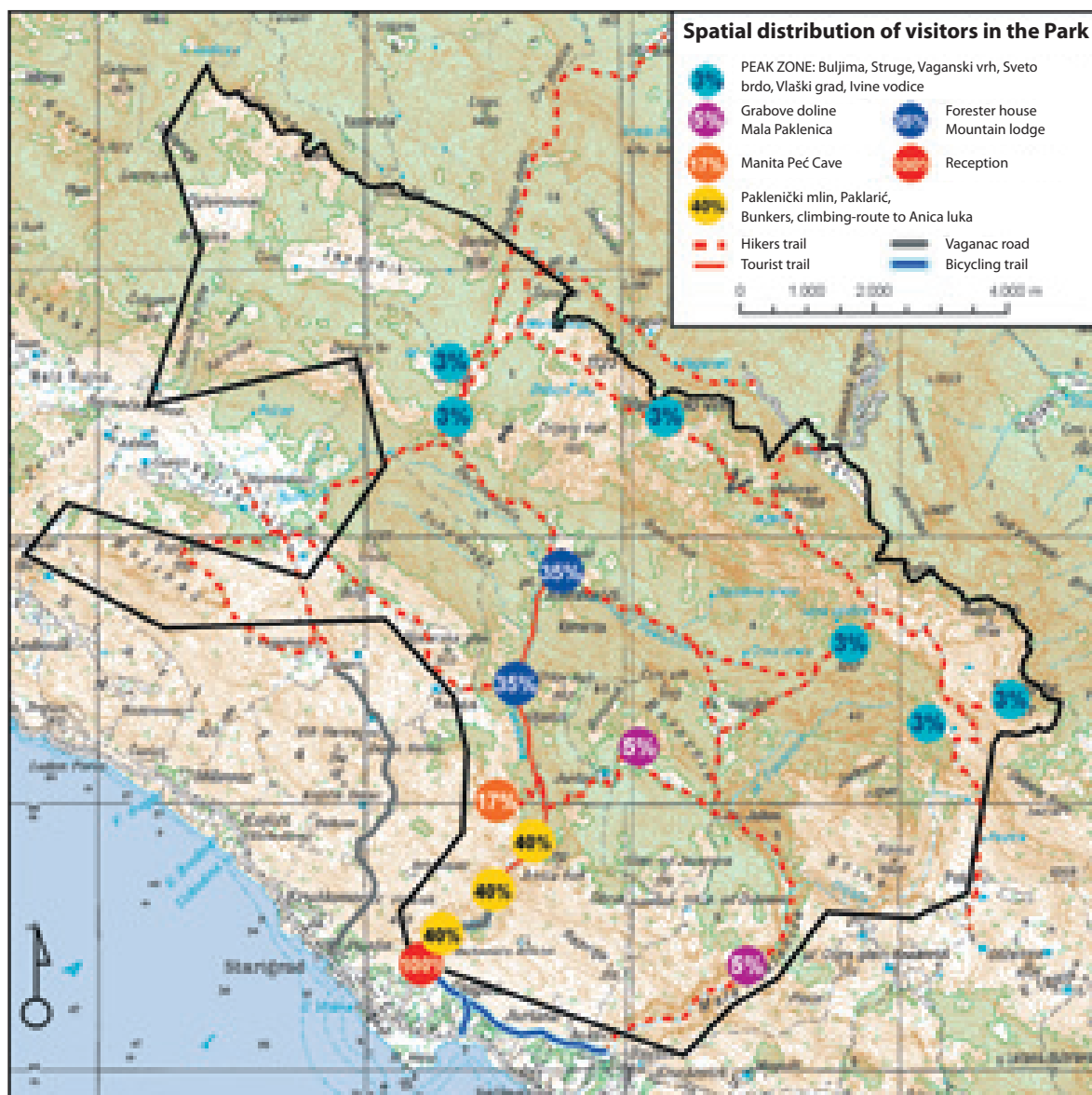


Fig. 10: Spatial distribution of visitors within the Park



Fig. 11: Transit and visitors infrastructure within the Park

through Velika Paklenica Canyon to the Paklenica mountain lodge (taking about 2 hours). In addition, the trail that passes from Velika Paklenica Canyon, over Jurline and Njive to Mala Paklenica Canyon, is also popular among visitors (5-6 hours). To protect natural treasures, but also to secure rapid intervention and mountain rescue in case of accidents, climbing activities inside the Park are allowed only in the southern part of Velika Paklenica Canyon in the so-called recreation zone. Currently there are 368 climbing routes of various lengths and difficulties in the Park, and the creation of new routes or supplements to existing routes must be approved by the Institution. Every year, at the beginning of May, a famous international climbing meet is held in the Park: "Big Wall Speed Climbing."

Sites included in Park's tourism product are: a renovated mill, the Paklarić archeological site, viewpoint and learning trail ('a view into history'), the Marasovići ethno-house, the "Short Stroll Through History" bicycling and learning trail, the complex of underground tunnels called the "Bunkers," which are currently being

adapted to serve the purpose of multimedia visitor center, the attractive cave, Manita Peć, which may be visited solely as a part of a guided tour, the Lugarnica forestry house, which offers basic hospitality services, the Paklenica mountain lodge, and the Velika Paklenica learning trail and mountain shelters (Struge, Ivine vodice, Vlaski grad). A presentation center has been organized in and around the Park's headquarters building, where educational and interpretative activities are conducted.

Inside the Park, it is possible to find accommodations in the Paklenica mountain lodge (45 beds) and in the mountain shelters (Struge, Ivine vodice and Vlaški grad). Private rooms can also be booked in Ramići and Parići. The shelters are not envisaged for longer stays of hikers, but only as an overnight accommodations during longer trekking tours and in the case of bad weather. Camping, pitching tents and campfires are not allowed inside the Park. The Park also offers accommodations in its camp next to the presentation center in Starigrad-Paklenica, with capacity of 100 people.

In the summer of 2004, a survey of visitor needs, expectations and satisfaction was conducted. A total of 284 visitors were interviewed. The results indicated that most visitors were exceptionally satisfied with the protected area (74%) and the pristine landscapes. Park accessibility was assessed as exceptionally satisfactory by 60% of visitors, while the lowest satisfaction was expressed for the cuisine (see Fig. 12).

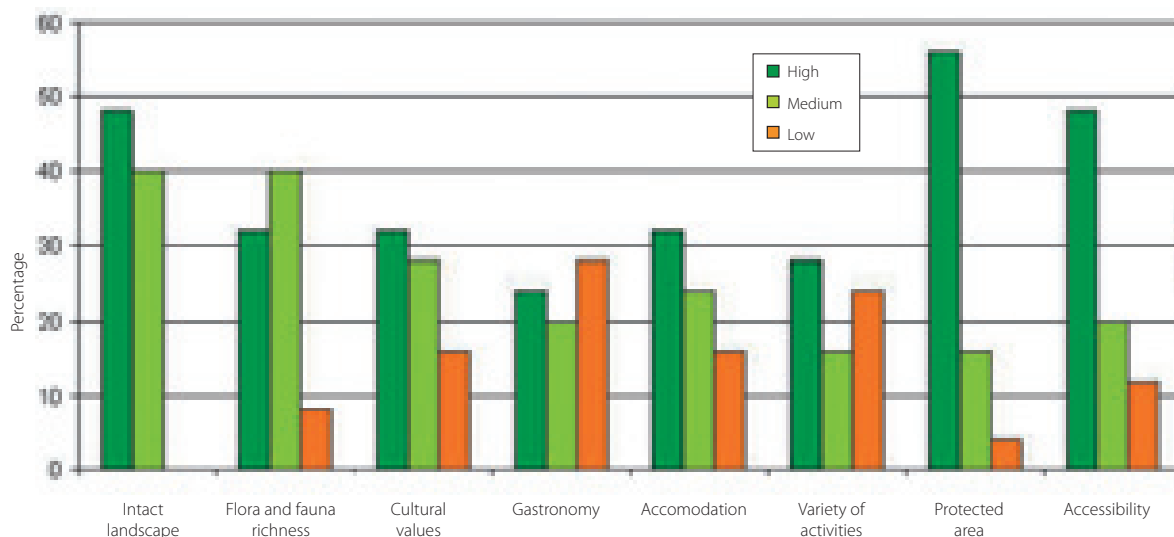


Fig. 12: Visitor satisfaction with various key factors in Paklenica National Park





Climbers in the recreation zone
in Velika Paklenica Canyon.

3. FUNDAMENTAL PARK MANAGEMENT OBJECTIVES

Based on the Park's vision and an assessment of the Park's biological, geomorphological, socio-economic and tourism resources, the objectives and measures for conservation natural resources and the cultural heritage have been elaborated and these form the core of the Management Plan.

This Plan is valid for ten years, and is subject to revision after five years. The details of planned activities in different zones will be covered by specific action plans, which are separate documents, with different timetables, which will be revised and updated during their implementation. Implementation of these management policies will reflect transparency and openness, public participation, education and interpretation, partnerships, international cooperation, action plans, monitoring, and research.

During development of the Management Plan, intense consultations with stakeholders, tourism studies and surveys were conducted, biological inventories were taken and deliberations were held within the Park. All issues identified as relevant were taken into account during formulation of the objectives and measures listed below.

3.1. Objectives and measures

3.1.1. General

Objective:	Settle property rights within the National Park
Measures:	<ul style="list-style-type: none"> • Cooperation with local and regional governments to settle property rights issues in the territory of Paklenica National Park. • National Park will actively endorse initiatives to settle property rights issues.
Indicators:	Settled property rights and demarcation between private and public property throughout the National Park by the end of the planning period.

3.1.2. Biodiversity conservation

Given the high biodiversity of the Park and the different objectives and measures identified for the different components, this chapter has been divided into several subordinate sections which provides the appropriate measures for each.

Overall objective:	Preserve the existing high biodiversity in the Park
Measures:	<ul style="list-style-type: none"> • Monitor the status of biodiversity in selected area with an exceptionally high number of species. • National Park will actively conduct projects to inventory lesser known taxa.
Indicators:	High biodiversity in Paklenica National Park preserved at the end of the planning period.

3.1.2.1. Meadows

Objective:	Maintain and conserve the favorable status of various important and representative meadow ecosystems
Measures:	<ul style="list-style-type: none"> • Classify meadows given the need for management and ascertain priority areas for active management by 2009. • Establish and apply methods to manage select priority meadows. • Permanently monitor meadow ecosystems and their butterfly species, and various approaches and activities during their management. • Develop an action plan for Velika Močila that will thoroughly specify the activities necessary to manage meadows and protect them from wildfires and serve as a pilot project for other, similar meadows.
Indicators:	The surface area of identified priority meadows does not diminish.

3.1.2.2. Forests

Objective:	Ensure the natural and undisturbed development of forest ecosystems where they do not endanger other important ecosystems
Measures:	<ul style="list-style-type: none"> • Permanently monitor forest ecosystems. Monitoring conducted at existing surfaces in cooperation with Jastrebarsko Forestry Institute. • Monitor development of forest peripheries in dwarf pine and black pine associations spreading toward meadows for the purpose of prevention of meadow overgrowth. • Undertake no management activities except under exceptional circumstances which gravely threaten forest ecosystems (e.g. wildfires). • Draft the Forest Ecosystem Conservation Program pursuant to Nature Protection Act. • Monitoring the wealth and diversity of bird communities in forest ecosystems. • Ascertain sites of importance as refuges for migratory forest bats.
Indicators:	Monitoring of plants and animals does not indicate significant reductions in population sizes and biodiversity.

3.1.2.3. Water ecosystems

Objective:	Conservation of streams, waterways, springs, lakes and ponds
Measures:	<ul style="list-style-type: none"> • Cooperate with Velebit Nature Park and the national water management company to preserve water quality in and around the National Park. • Ensure solutions to wastewater treatment at the Lugarnica and Paklenica mountain lodges. • Monitor status of insect and larvae groups (bioindicators) in streams, waterways, springs and ponds. • Maintain flow of streams and springs the National Park by regular cleaning. • Address the problem of use of potable water from the National Park for the needs of the local population to the relevant institutions, with the goal of gradually reducing the potable water supply.
Indicators:	Water quality level in springs and mountain streams remains unchanged.

3.1.2.4. Subterranean ecosystems

Objective:	Safeguard existing caves and pit-caves from direct and indirect human impact
Measures:	<ul style="list-style-type: none"> • Continue work to improve the database on caves and gather new field data. • Conduct the Management Plan for Manita Peć cave. • Draft action plan to open the Vodarica pit-cave to organized adventure tourism in the next 5 years.
Indicators:	Diversity of cave ecosystems remains at its current level.

3.1.3. Cultural heritage

Objective:	Maintain the typical architectural heritage and restore select traditional buildings (summer lodges, stacked-stone walls, <i>mirila</i>, trails, etc.) for presentation and interpretation
Measures:	<ul style="list-style-type: none"> • Develop a database of cultural treasures inside the National Park, evaluate the existing architectural heritage and place buildings under formal protection. • Support the National Park in settling property rights and assist in the restoration of buildings and structures in a traditional manner. • Include restored structures in the National Park's tourism product. • Secure bat refuges during remodeling of old houses in agreement with owners.
Indicators:	Conservation and awareness of important cultural treasures in the National Park are enhanced.

3.1.4. Visitors and tourism

Overall objective:	Develop moderate, sustainable cultural tourism, based on the area's natural value which does not threaten biodiversity and the objectives of National Park conservation
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3.1.4.1. Climbers and hikers

Objective:	Ensure high-quality experiences according to international standards for climbers and safe and quality hiking within the National Park
Measures:	<ul style="list-style-type: none"> • Establishment of new climbing routes exclusively with the permission of the Park's management. • Promote new scientific research on the impact of climbing on cliffside plants, plant communities and animals. • Permanently monitor the success of nesting by select bird species in areas where climbing occurs. • Exchange information between the National Park's management and climbers with the goal of improving biodiversity conservation in the Park and raising awareness of the need to protect natural treasures among climbers. • Improve information materials on the natural value of the National Park intended for climbers, and correct forms of inappropriate behaviors (shouting on cliffsides, climbing between routes, destroying and knocking down rocks, picking and harming plants).
Indicators:	Increased awareness by climbers of the Park's natural values and improved climbing safety. Understanding that certain tracts of the Park must be exempted from climbing activities, such as Mala Paklenica Canyon.



3.1.4.2. Interpretation and education

Objective:	Education of all types of visitors and the local population at all levels for the purpose of raising awareness of biodiversity and nature conservation
Measures:	<ul style="list-style-type: none"> • Establish a new job for education and interpretation in the Public Institution by 2009. • Prepare educational curricula and materials intended for school children of various ages. • Install information panels along the main trails in the National Park, intended for visitors to improve their knowledge and understanding and develop a sense of respect for nature. • Develop interpretation panels using contemporary approaches and methods. • Build educational playgrounds and other facilities intended for education at the entrance to Velika Paklenica Canyon. The final design will depend on available funds.
Indicators:	Increased number of participants in educational programs and development of new programs adapted to various age groups and different visitor types.

3.1.4.3. Marketing and promotion

Objective:	Promotion of Paklenica National Park as the most intense expression of Velebit with all of its specific features
Measures:	<ul style="list-style-type: none"> • Develop informative materials intended for various target groups and ensure their appropriate distribution. • Improve joint activities with Velebit Nature Park and Northern Velebit National Park to promote the entire region. • Enrich the existing visitor management program and packages for National Park visitors with new content, in cooperation with the local tourism board and the local population in Starigrad-Paklenica, Seline and Tribanj.
Indicators:	Increased knowledge of the National Park, its natural and cultural values. Each visitor has simple access to the necessary information.

3.1.4.4. Visitor access

Objective:	Ensure safe and pleasant visits to all National Park visitors
Measures:	<ul style="list-style-type: none"> • Determine carrying capacity for various Park areas. • Regularly monitor visitor impact and satisfaction with services through a standardized questionnaire. • Prohibit breaking of new trails and maintain existing trails. • Restrict movement of visitors to marked trails and specified areas and regulate their visits. • Establish additional entrances to National Park, Bunovac by 2010 and Dušice, if the ski slope project is carried forward. • Adapt the existing infrastructure for persons with special needs in the lower part of Velika Paklenica Canyon by 2009. • Cooperate with mountain clubs to direct visitors and designate hiking trails and maintain shelters.
Indicators:	Visitors do not cause any visible damage to the National Park. Access to Velika Paklenica Canyon enabled for all visitors.

3.1.5. Register of endangered species and monitoring

Objective:	Continual enhancement of knowledge of all National Park treasures for the purpose of improving and advancing species and habitat conservation
Measures:	<ul style="list-style-type: none"> • Conduct continuous research into biodiversity and upgrade the GIS biodiversity database. • Regularly monitor biodiversity indicators with special emphasis on Velika and Mala Paklenica Canyons due to visitor pressure. • Improve public knowledge and awareness of biodiversity, including subterranean ecosystem diversity. • Monitor threatened habitats, scree and gullies and meadow ecosystems, particularly at the Buljma Pass area. • Encourage research by scientists from Croatia and abroad. Store all data generated by research conducted in the National Park in the Public Institution's archives to establish a usable database.
Indicators:	Regular and systematic knowledge on threats to plant and animal species and monitoring and regular analysis, with periodic publication.

3.1.6. Public participation

Objective:	Ensure partnership and transparency of National Park management
Measures:	<ul style="list-style-type: none"> • Organize at least one public meeting with local population annually. • Organize "Open Door Day" once annually. • Cooperate with local population. • Cooperate with local institutions, NGOs and businesses and develop joint projects. • Regularly notify the regional and national media of the National Park's work and activities.
Indicators:	Regular and documented meetings.



3.2. Zoning concept

Paklenica National Park is divided into several different zones based on natural value, distribution and needs of the local population and management needs. The types of zones and their characteristics were defined in a workshop in which staff from different Croatian national and nature parks participated. The classification is based on the IUCN classification of protected areas, adopted within the framework of the KEC Project. Areas of high natural value with little need for management have been proclaimed strict conservation zones. Active conservation zones are those demanding special management techniques to preserve their most important protected value. Areas visited frequently with a great need for management are deemed usage zones.

3.2.1. Zoning in Paklenica National Park and management by zones

Zoning in Paklenica National Park is based on the values described in the second chapter, on appreciation of the problems and proposals ascertained during public hearings and on plans for local tourism development. For each zone, a precise location on the map, its size, zoning criteria and management objectives and possibilities have been determined.

Paklenica National Park should be viewed with reference to Velebit Nature Park and all of Velebit. The recreational area and areas with existing tourist infrastructure are designated as usage zones (3b). In addition, due to existing practices (sheep and goat grazing), the plateau between Velika Paklenica and Mala Paklenica, from Jasenar to Rimenići, has been declared a settlement zone (3a). The rest of the Park is a strict conservation zone (1), except sites requiring active conservation (2), i.e. sites needing human intervention, either for habitat, ecosystem or species conservation (Oglavinovac, Javornik, the area between Štirovac, Vaganski Vrh and Bunovac) or cultural heritage preservation (e.g. summer lodges). With more data available, some sites will be excluded and some designated as strict conservation zones, if needed. In the strict conservation zone, no forestry activity is allowed (which includes thinning) and visits are limited to trails classified in very strict conservation zones (1b).

The size of the different zones is shown in Table 10 and Figure 13. The buffer zone around the Park's boundaries has not been determined since the National Park is fully situated within the borders of Velebit Nature Park. Therefore, special policies for that area should be defined in cooperation with the Nature Park.

Tables 11 depict the management by zones.

Various zones defined for the Park with all relevant information: name and zone type, area concerned, selection criteria, objectives and management/use possibilities is given in following pages.

Table 10. Areas of various management zones in the Park.

Zone		Area (m²)	Total (m²)	Percentage (%)
Zone 1 – Strict conservation zone				
1a) Strictest conservation zone Areas of particular significance with unaltered overall environment, high biological and landscape diversity and great conservation importance in which visitor access is restricted, with the exceptions of marked trails/paths separated into zone (1b).	Area	47,742,820	47,742,820	50.3
	1 – peak zone from Oglavinovac to Sveto Brdo, Mala Paklenica at source area, Borovnik, Jerkovac, Komić, Vlački grad			
1b) Very strict conservation zone Area with unaltered and/or negligibly altered environment, high biological and landscape diversity in which minimum management activities are conducted to conserve biological and landscape diversity and in which visitor access is possible in trails/areas marked and intended for visitors.	Area	10,035,536	12,724,846	13.4
	2 – Bojinac and Suva draga			
	3 – Mala Paklenica	2,689,310		
Zone 2 – Active conservation zone				
2a) Active habitat, species and cultural heritage conservation zone Area with great value for habitat/ species/forest ecosystem conservation, which is subjected to active intervention as a management method which ensures conservation, revitalization and maintenance of favorable habitat/species condition.	Area	1,059,457	10,758,828	11.3
	4 – mountain meadows (turfs) at Oglavinovac			
	5 – mountain meadows (turfs) at Javornik	1,560,827		
	6 – alpine meadows (turfs) from Štirovac to Sveto Brdo	8,138,544		
Zone 3 – Usage zone				
3a) Settlement zone Settlement area, traditional organic farming, eco-tourism, natural and cultural value.	Area	7,780,346	7,780,346	8.2
	9 – plateau between Velika Paklenica and Male Paklenica Canyons – Jasenar-Rimenić			
3b) Recreation and tourism infrastructure zones Area with active cultural, educational and tourism/recreational value with emphasis on development of visitor infrastructure in compliance with environmental standards.	7 –Struge mountain refuge	57,539	15,953,926	16.8
	8 – Velika Paklenica Canyon to Velika Močila	15,953,926		
OVERALL TOTAL			94,960,766	100

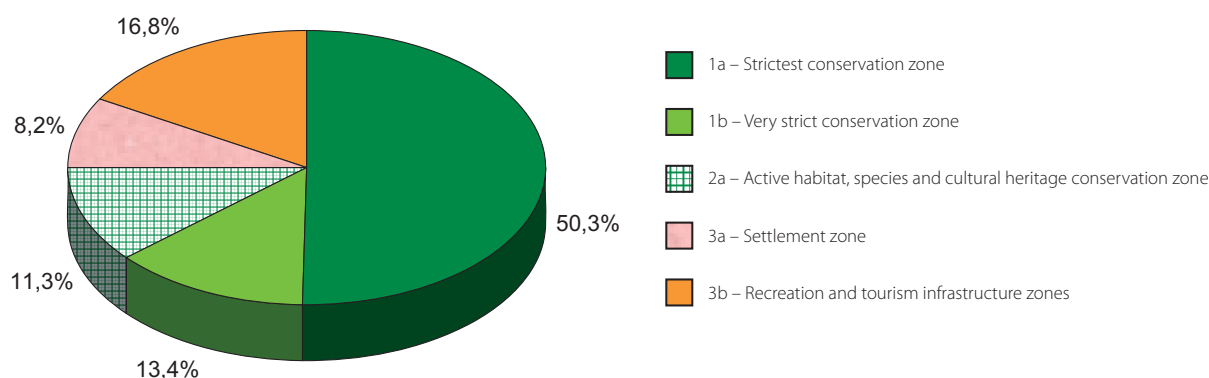


Fig. 13: Share of individual zones in Paklenica National Park.

Table 11. Management by zones.

Zone	Management	Restrictions
Zone 1a – Strictest conservation zone	<ul style="list-style-type: none"> Any active management that may threaten natural processes excluded. Management is aimed at preservation, conservation and monitoring of ecosystems and biological and landscape diversity. Groups guided by National Park staff member for highly interested and motivated visitors, without individual access. In case of emergency, e.g. wildfires, helipad used to disembark firefighters. Monitoring of bird communities, forest ecosystems and endemic plant species. 	<ul style="list-style-type: none"> This area, except along marked trails (which are included in zone 1b) is restricted for visitors. Only necessary interventions are permitted which are intended to preserve and protect biological and landscape diversity.
Zone 1b – Very strict conservation zone	<ul style="list-style-type: none"> Minimum activities to preserve, protect and monitor ecosystems and biological and landscape diversity and maintain and improve existing visitor infrastructure (i.e. learning trails). Surveillance and monitoring of nesting birds in forest ecosystems and Velika Paklenica and Mala Paklenica Canyons. 	<ul style="list-style-type: none"> Only interventions to preserve and protect biological and landscape diversity are permitted. Minimum facilities for visitors (learning trails). No motor vehicles allowed, except with permission of the authorities.
Zone 2a – Active habitat, species and cultural heritage conservation zone	<ul style="list-style-type: none"> Area subject to active intervention as management method which secures protection, preservation and maintenance of favorable status of habitat types/species. Implementation of measures and activities to protect and preserve the cultural heritage. Marked and learning trails, emphasis on monitoring the impact of visitors on habitats/species. Improvement and maintenance of minimum visitor infrastructure for education and interpretation. Monitoring of meadow habitats, rare and endangered plants and nesting birds therein. 	<ul style="list-style-type: none"> Obligation of visitors to remain on marked trails/areas intended for sightseeing and visits. Minimum visitor infrastructure and learning trails.
Zone 3a – Settlement zone	<ul style="list-style-type: none"> Area of active management for the purpose of exploiting natural resources. Active management of area based on sustainable growth with cooperation of local community. Sustainable tourism in a rural environment. Traditional farm products offered to visitors. Education and interpretation. 	<ul style="list-style-type: none"> Visits limited by carrying capacity of individual sites. Development of mass visitor infrastructure prohibited. Acknowledgement of environmental standards, especially for water protection and biodiversity conservation.
Zone 3b – Recreation and tourism infrastructure zones	<ul style="list-style-type: none"> Management in line with carrying capacity and in cooperation with the local community. Development and improvement of visitor infrastructure (learning trails, eco-camps, visitor centers) based on sustainable growth and conducive to biological and landscape diversity conservation. 	<ul style="list-style-type: none"> Development of mass tourism prohibited, restrictions dictated by carrying capacity.

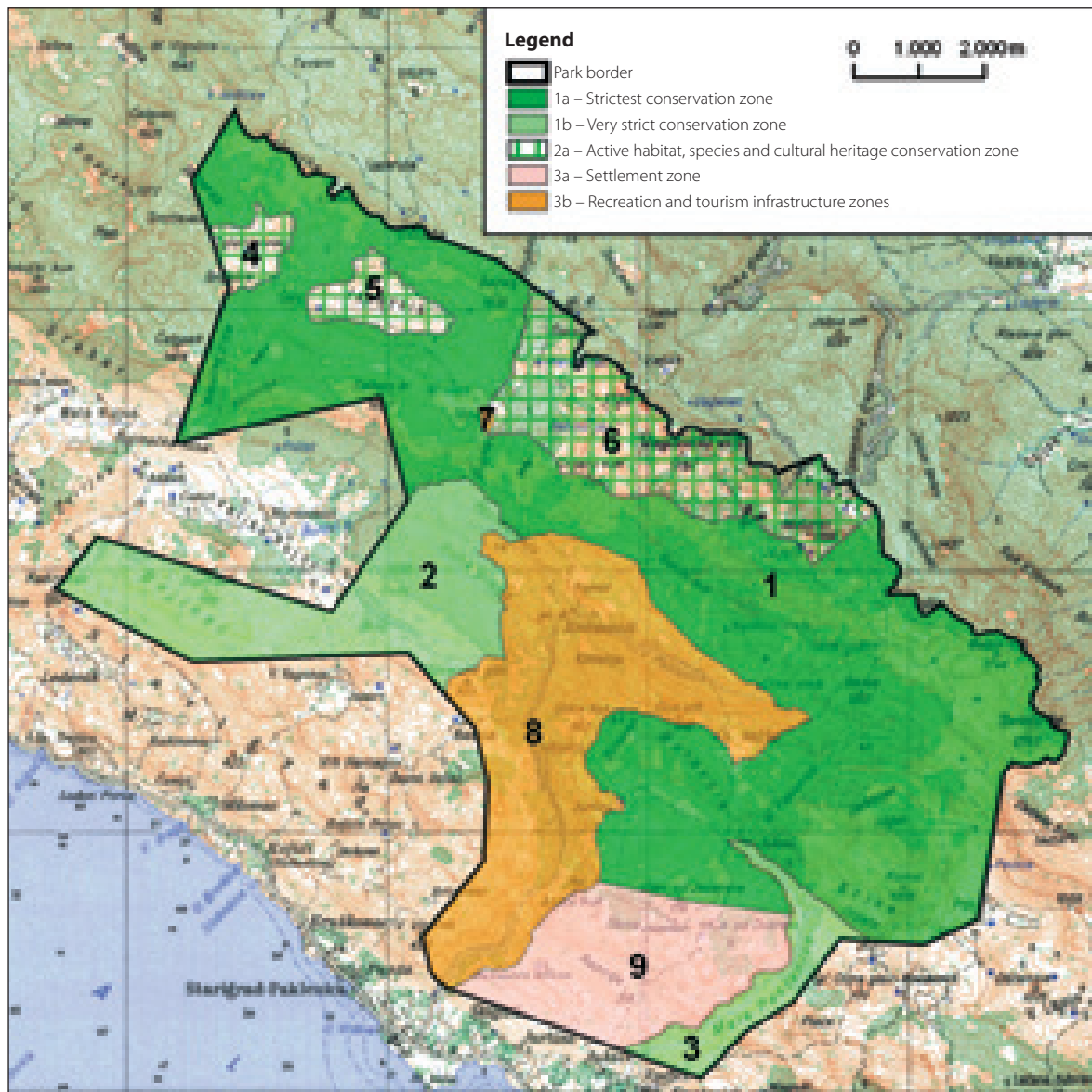
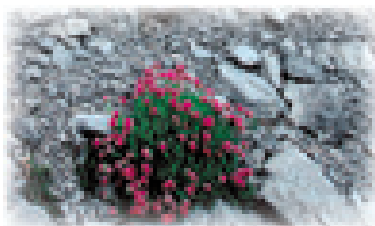


Fig. 14: Conservation zones in Paklenica National Park



3.2.1.1. Zone 1 – Strict conservation zone

Zone 1a – strictest conservation zone. Area 1: peak zone from Oglavinovac to Sveto Brdo, Mala Paklenica at source area, Borovnik, Jerkovac, Komić, Vlaški grad.

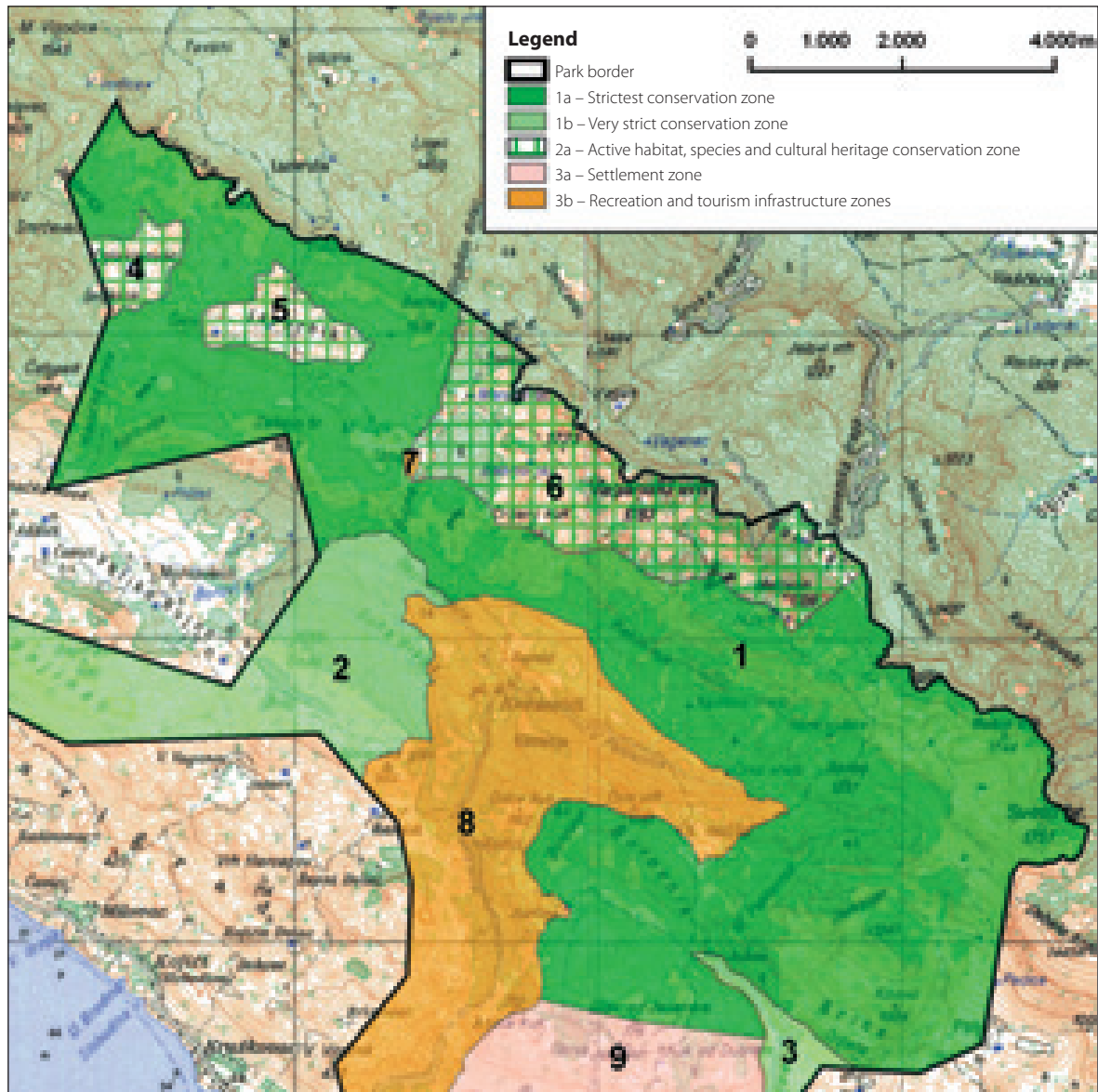


Fig. 15: Area 1 – peak zone from Oglavinovac to Sveto Brdo, Mala Paklenica at source area, Borovnik, Jerkovac, Komić, Vlaški grad

Zone type: Zone 1a – strictest conservation zone

Description: This zone has included the alpine meadows and expanded northern parts of the National park since 1997, various types of rocky and karst habitats and forests with tertiary black pine (*Pinus nigra*) and dwarf pine (*Pinus mugo*) composition. There are also old growth beech (*Fagus sylvatica*) forests.

Criteria: Area is significant due to its vegetation value. This area is particularly valuable due to the diversity of animals and the presence of large carnivores: brown bear (*Ursus arctos*), wolf (*Canis lupus*) and wildcat (*Felis sylvestris*), and the endangered golden eagle (*Aquila chrysaetos*) and meadow viper (*Vipera ursinii macrops*). Various species of beetles (*Osmoderma eremita*) and longicorns (*Cerambyx cerdo*, *Rosalia alpina*) are indicators of this habitat's quality.

Objective: Conservation of natural value and biodiversity of habitats with all endemic plant taxa and animal groups.

Permitted activities: Surveillance and supervision. Research and/or monitoring permitted with permission of the proper authorities. Limited access allowed for educational purposes with the consent of the relevant institutions and with the obligation of visitors to remain on marked trails/paths classified in zone (1b). Intervention allowed only in case of wildfires.

Visitor access: Possibility of limited visits (movement allowed along marked trails/paths classified in zone (1b)) with proper surveillance and supervision by National Park staff. Guided group visits, with adherence to rules of conduct in the strictest conservation zones.



Zone 1b – very strict conservation zone. Area: 2 – Bojinac and Suva draga

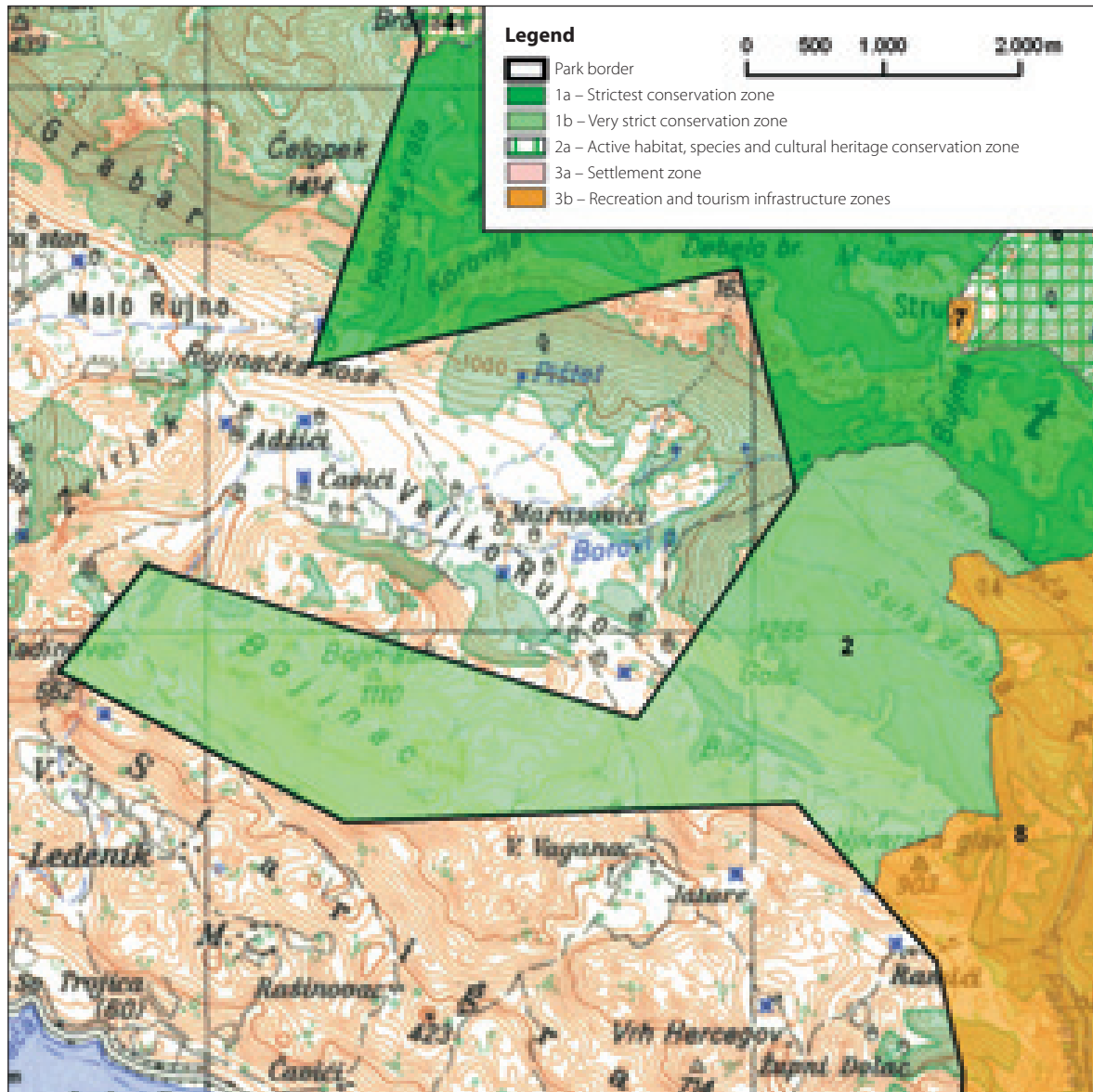


Fig. 16: Area: 2 – Bojinac and Suva draga

Zone type: Zone 1b – very strict conservation zone

Description: This zone includes the particularly valuable geomorphological parts of the Park, with numerous specific geomorphological features. The surroundings of Jagin crest and the Jezerce solution pan stand out in this regard. The area is characterized by a great wealth of plants and a diversity of animals. This area also includes particularly valuable forest ecosystems of beech (*Fagus sylvatica*), black pine (*Pinus nigra*) and mixed beech and black pine associations. The environs of Golići, Grabar and Suva draga also stand out, as this is the main corridor for large herbivores: red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*) and chamois (*Rupicapra rupicapra*).

Criteria: The area abounds in floral and vegetation diversity. The numerous endemic plants are interesting: window bellflower (*Campanula fenestrellata*), Waldstein's bellflower (*C. waldsteiniana*), and wild tulip (*Tulipa sylvestris*). The animal life is also rich and diverse. The herds of chamois (*Rupicapra rupicapra*) in this part of the Park are quite valuable.

Objective: Conservation of the natural value and biodiversity of habitats with all endemic plant taxa and animal groups with emphasis on large herbivores (roe and red deer, chamois).

Permitted activities: Scientific research with permission from the proper authorities, monitoring of plants and animals in this zone with emphasis on habitat bioindicators with consent from the relevant institutions. Monitoring of forest habitats with special emphasis on endemic and threatened plant species. Monitoring of nesting birds in forest and rocky habitats.

Visitor access: Visits allowed only in areas with marked trails/paths, with proper surveillance and control. Guided group visits, with adherence to rules of conduct valid in very strict conservation zones.



Zone 1b – very strict conservation zone. Area 3: Mala Paklenica

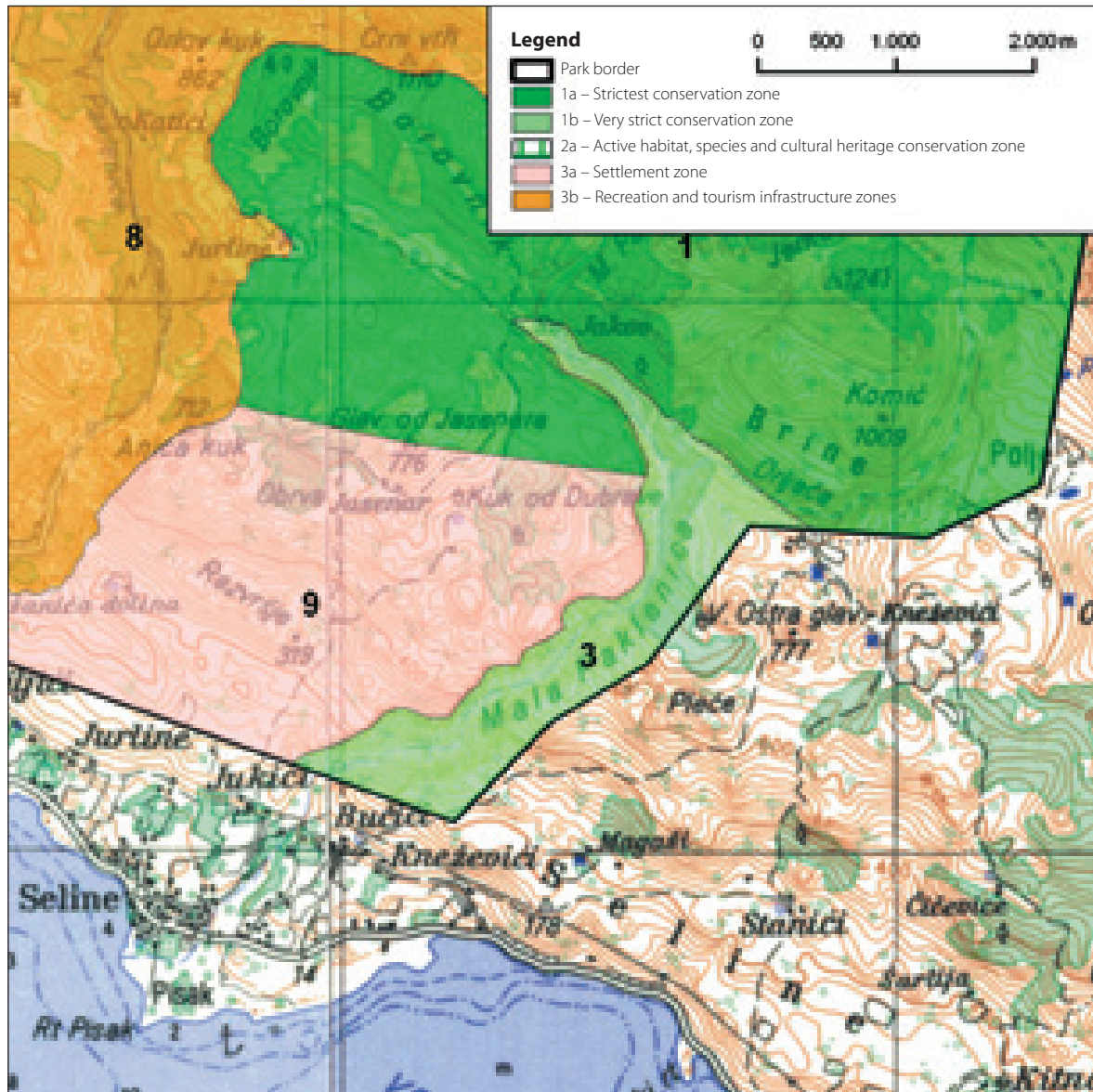


Fig. 17: Area 3: Mala Paklenica

Zone type: Zone 1b – very strict conservation zone

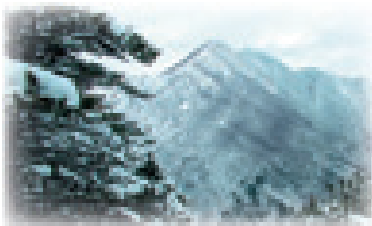
Description: This zone includes particularly valuable sections of Mala Paklenica Canyon with its geomorphologically interesting parts, a relict species of common yew (*Taxus baccata*), thermophilous species of holm oak (*Quercus ilex*), phyllirea (*Phyllirea media*), and the unique endemic species of sandwort (*Arenaria orbicularis*). The petrophilous (rock-dwelling) community of birds is particularly valuable, with species such as the peregrine falcon (*Falco peregrinus*), short-toed eagle (*Circaetus gallicus*), golden eagle (*Aquila chrysaetos*) and eagle owl (*Bubo bubo*).

Criteria: The area is characterized by great plant diversity, a wealth of endemic taxa and a diversity of vegetation. Besides these endemic plant taxa, the area also features rock-dwelling bird species which add value to the National Park. This area is also has a wealth and diversity of animals.

Objective: Conservation of the natural value and biodiversity of habitats with all endemic plant taxa and animal groups with emphasis on petrophilous birds.

Permitted activities: Surveillance, scientific research, monitoring of plants and animals in this zone with emphasis on habitat bioindicators, especially petrophilous bird species – birds of prey and owls.

Visitor access: Strictly restricted visitor access as this part of the National Park is vital to the maintenance and conservation of petrophilous bird communities. Possibility of visits by guided groups along marked trails/paths with daily limits on the number of visitors/groups. The canyon's carrying capacity is 80-100 visitors/hikers per day. Visits in compliance with the rules of conduct for very strict conservation zones, visitor education and lectures on the importance of birds of prey in the National Park's ecosystems.



3.2.1.2. Zone 2 – Active conservation zone

Zone 2a – Active habitat, species and cultural heritage conservation zone. Areas 4, 5 and 6: Alpine meadows (turfs) in Oglavinovac and Javornik areas and from Štirovac to Sveto Brdo.

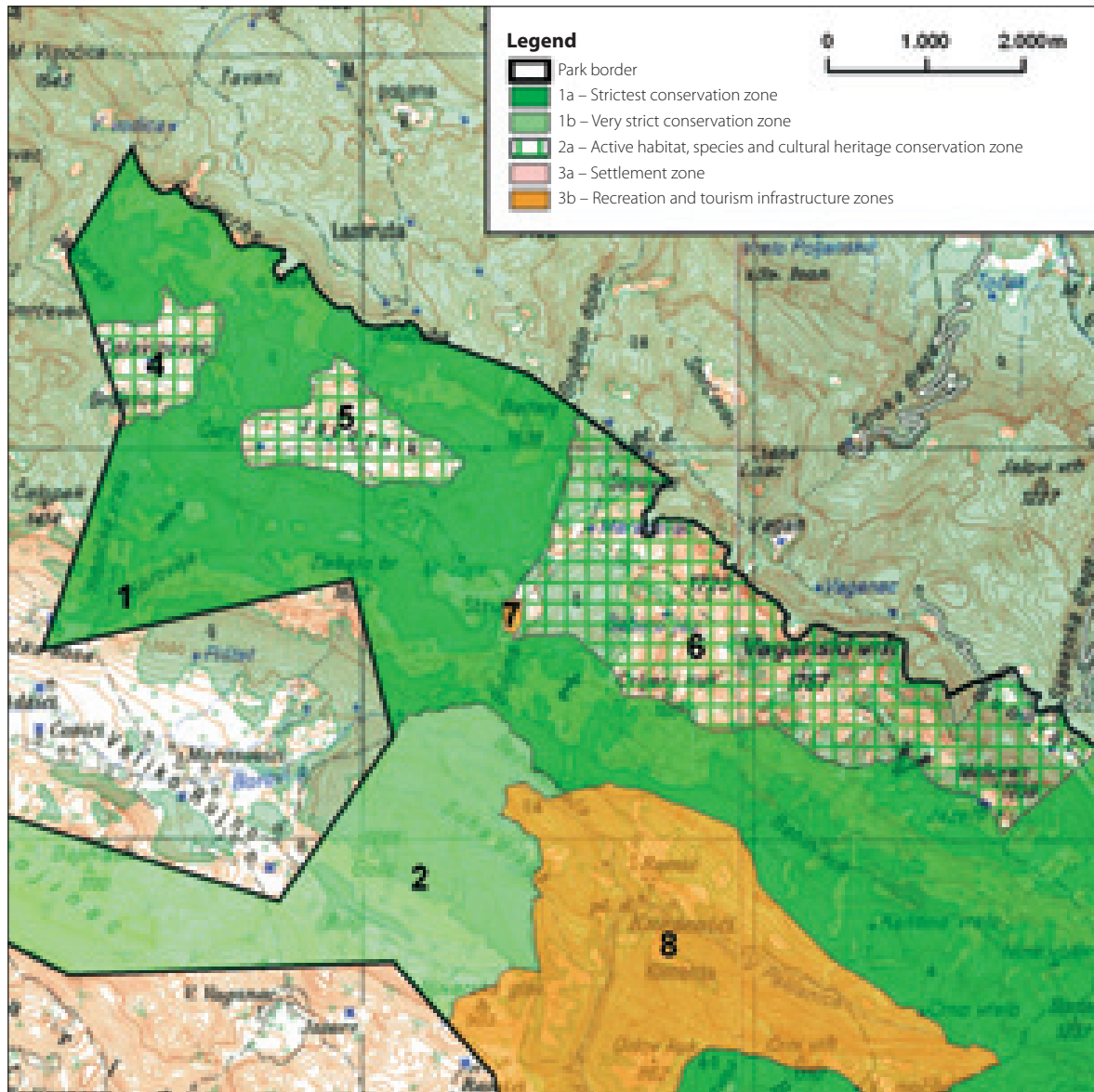


Fig. 18: Areas 4, 5 and 6: Alpine meadows (turfs) in Oglavinovac and Javornik areas and from Štirovac to Sveto Brdo.

Zone type: Zone 2a – Active habitat, species and cultural heritage conservation zone.

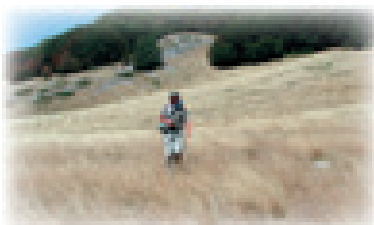
Description: This zone includes alpine meadows that were placed in the National Park's boundaries in 1997 under legislation expanding it, and which should undergo maintenance in the near future. Alpine meadows at elevations of roughly 1,400 m are being gradually overgrown with dwarf pine (*Pinus mugo*) vegetation. Alpine meadows are rich in various plant taxa, which are today protected throughout Croatia: yellow gentian (*Gentiana lutea* subsp. *symphyandra*), alpine sea holly (*Eryngium alpinum*), a sub-species of Martagan's lilly (*Lilium martagon* subsp. *cattaniae*) and others. This area is also home to a protected species of meadow viper (*Vipera ursinii macrops*), while its seasonal ponds are essential spawning areas for amphibians. Birds of prey feed above these meadows, such as the short-toed eagle (*Circaetus gallicus*) and golden eagle (*Aquila chrysaetos*). The territory is also contains a valuable cultural heritage (shepherd's huts) which must be protected and preserved.

Criteria: The area has a great diversity of plants, a wealth of rare and endangered, as well as endemic taxa, and indicates a diversity of vegetation. This area is also has a wealth and diversity of animals. The area also features a valuable cultural heritage (shepherd's huts).

Objective: Conservation of the natural value and biodiversity of habitats with all endemic plant taxa and animal groups with emphasis on birds of prey. Preservation and protection of cultural heritage.

Permitted activities: Surveillance, scientific research, monitoring of plants and animals in this zone with emphasis on habitat bioindicators, especially petrophilus bird and birds of prey. Maintenance of favorable conditions for meadows (mowing and grazing).

Visitor access: Possibility of visits and movement of visitors along hiking trails, with use of guides. Dogs must be led on leashes, and the rules of conduct in the National Park with reference to active conservation zones must be strictly observed.



3.2.1.3. Zone 3 – Usage zone

Zone 3a – settlement zone. Area 9: plateau between Velika Paklenica and Mala Paklenica Canyons – Jasenar-Rimenić.

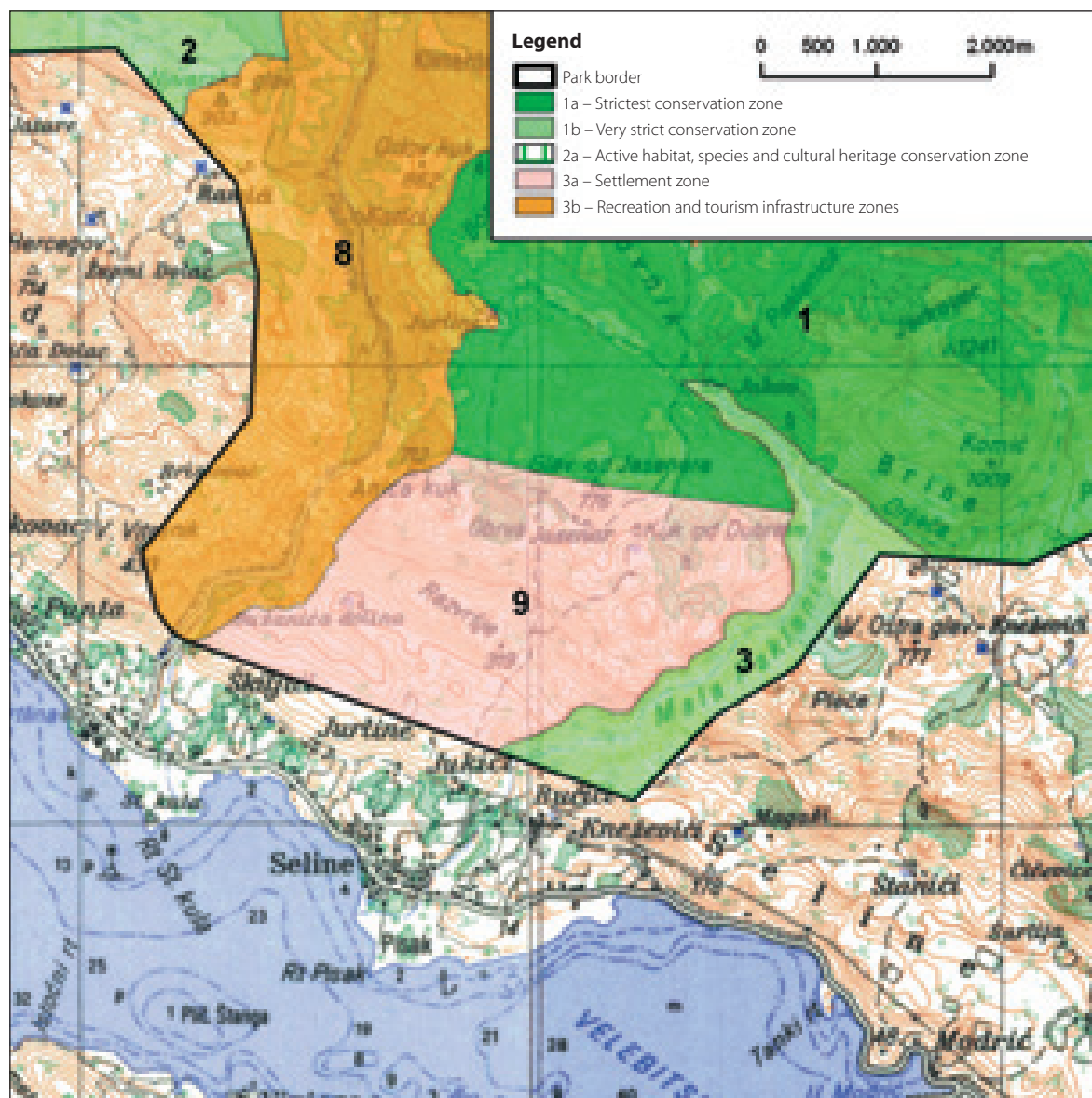


Fig. 19: Area: 9 – plateau between Velika Paklenica and Mala Paklenica Canyons – Jasenar-Rimenić

Zone type: Zone 3a – settlement zone

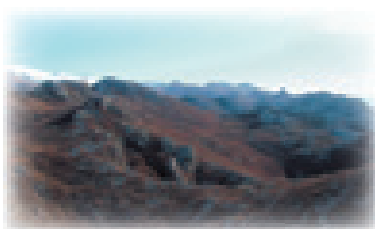
Description: This zone includes the plateau between Velika Paklenica and Mala Paklenica Canyons and the hamlets of Rimenić, Jasenar, Jurline, Škiljići and the small Church of St. James. This is an area of traditional farming and livestock raising.

Criteria: This area has great plant diversity, but it has always been used for traditional forms of livestock raising, farming and beekeeping. The great plant diversity may be lost with the disappearance of these activities. This area is also has a wealth and diversity of animals.

Objective: Preservation of traditional forms of livestock raising, farming and beekeeping to maintain the natural characteristics and habitat diversity with all endemic and rare plant taxa and animal groups.

Permitted activities: Organized and individual visits and recreation are allowed within the limits of carrying capacity. Development of traditional livestock raising and farming, with surveillance and conservation of biological and landscape diversity. Scientific research and monitoring of plants and animals in this zone with emphasis on habitat bioindicators. Development of visitor infrastructure in line with sustainable growth.

Visitor access: Possibility of organized and individual visits, in compliance with carrying capacity of individual sites with obligation to remain on trails/in areas marked and intended for sightseeing and visits.



Zone 3b- Recreation and tourism infrastructure zone. Area: 7 – Struge mountain shelter.

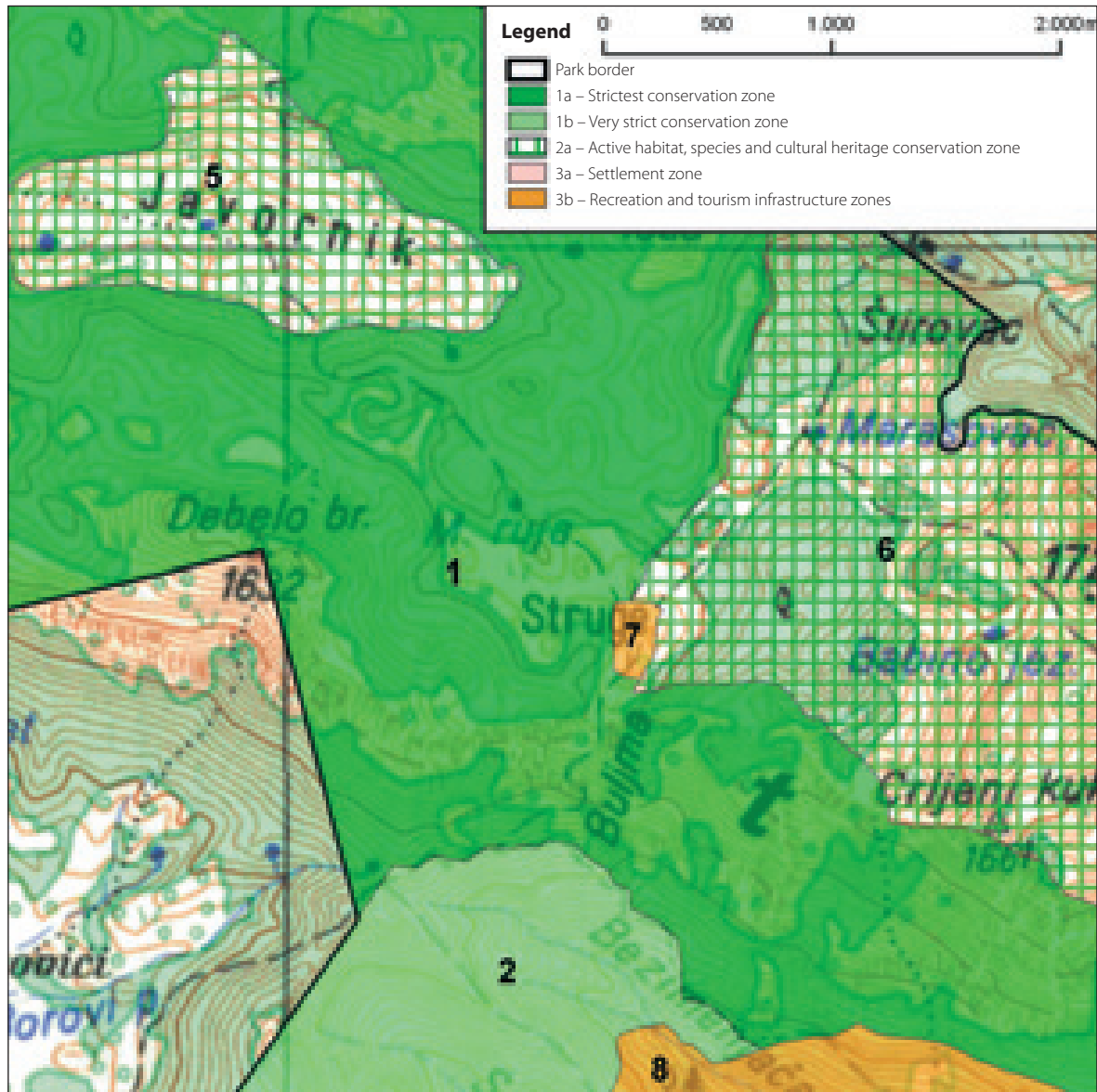


Fig. 20: Area: 7 – Struge mountain shelter

Zone type: Zone 3b – Recreation and tourism infrastructure zone.

Description: This zone includes the area adjacent to the Struge mountain shelter. This shelter is visited frequently in the summer months and it is ideal for tours and visits to the National Park's peak zone.

Criteria: The area adjacent to the shelter and the shelter itself are used by hikers from spring to autumn, and people stay here in the winter and visit to the National Park's peak zone.

Objective: Facilitate overnight stays and accommodation of hikers in the shelter, with adherence to the rules of conduct effective in the National Park. Establish supervision and records of visitors and stays in the shelter and in this zone of the National Park.

Permitted activities: Scientific research, monitoring of plants and animals in this zone with emphasis on habitat bioindicators. Monitoring of nesting bird communities in meadow and forest habitats. Monitoring the flow of visitors.

Visitor access: Possibility of visits, visitors can use marked trails/area. Number of visitors and their movement in the Park's peak zones recorded.



Zone 3b – Recreation and tourism infrastructure zone. Area 8: Velika Paklenica Canyon.

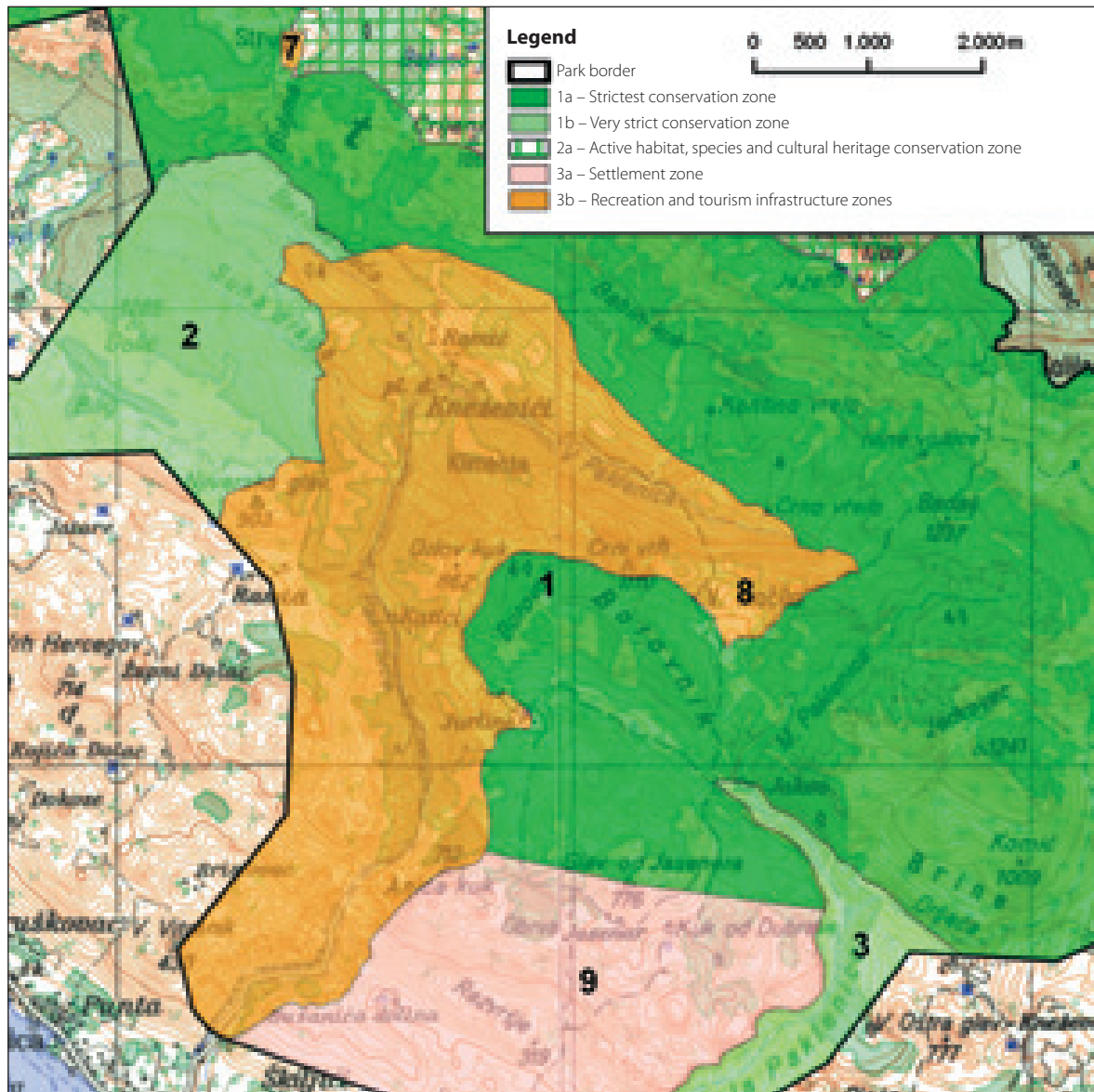


Fig. 21: Area 8 – Velika Paklenica Canyon

Zone type: Zone 3b – Recreation and tourism infrastructure zone

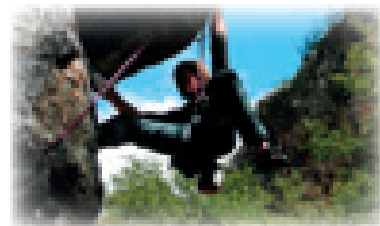
Description: This zone includes Velika Paklenica Canyon, which has been planned as a so-called recreation zone from the reception area to Aniča kuk, with 367 climbing routes. Year-round visits are possible.

Criteria: The area has exceptionally interesting geomorphological features, varied rocks and cliffs, and the over 100,000 visitors annually (approximately 30% are climbers) necessitate adherence to strict conservation and recreation criteria to ensure that the area is not devastated.

Objective: Maintain the high degree of safety and amenities of hiking trails and climbing routes, and take into account conservation of endemic, rock plant taxa and animals.

Permitted activities: Recreational activities in compliance with the National Park's amenities, climbing along equipped and arranged routes. In case certain routes are unsafe, prohibit climbing with the appropriate markers. Scientific research, monitoring of plants and animals in this zone with emphasis on habitat bioindicators. Monitoring of petrophilous nesting bird communities and endemic plant species living on rock. Monitoring flow of visitors and impact on nesting bird communities. Monitoring the number of visitors and determination of the carrying capacity of climbing zones.

Visitor access: Year-round possibility of visits and recreation in areas set aside for recreation, with obligation to adhere to instructions issued by the National Park's management and the relevant authorities.



Jerkovac Peak and the upper part of
Mala Paklenica Canyon.



4. IMPLEMENTATION OF MANAGEMENT PLAN

4.1. Links to other planning documents

The physical plan is the fundamental legal document for management of protected areas in Croatia. Over and above protected areas, plans are also continually prepared at the county and national levels, and after the standpoints adopted at public hearings are aligned, they are enacted by the Croatian Parliament. Physical plans are generally adopted to cover ten year periods. Until the enactment of the Nature Protection Act in 1994, physical plans were the only legal documents that governed land use in protected areas. Today at the park level they specify the fundamental conditions for land use, define the conditions for activity in both developed areas and the natural environment - concentrating primarily on recreation, tourism and housing and transport matters - and provide a platform for activities to be defined by the Management Plan.

The basic management activities for protected areas foreseen by the Physical Plan are:

- Interpretation and breakdown of the county plan at the local level,
- Specification of oversight of development and planning activity application, and
- Prevention of unrestrained developmental activities within the Park.

Alignment between the Physical Plan as the fundamental legal document and the Management Plan as a strategic document and basis for management and conservation activities is crucial to zoning in the National Park. In the Physical Plan, zoning is set forth according to the principal objectives of preservation and use purposes, while in the Management Plan it is defined in greater detail due to conservation management moves and measures in each zone.

The Physical Plan thus indicates “where and what”, while the Management Plan additionally specifies the operative aspects of protected area management, particularly those pertaining to conservation and protection of biodiversity. Consultations with the relevant physical planning departments at the national and county levels tied to the Management Plan for Paklenica National Park were conducted at the very first planning stages, to prevent any potential conflicts.

Besides physical plans, there is a series of other documents (strategies, plans and programs) covering the fields of tourism, agriculture, water, forest, etc. at the national and/or county level, which influence the subsequent implementation of the Management Plan. All existing documents were taken into consideration during development of the Management Plan.

4.1.1. Differences between the Physical Plan and Management Plan

The Paklenica National Park Physical Plan was developed by the Zadar County Physical Planning Department, and it was ratified by the Croatian Parliament in 2001.

The Paklenica National Park Physical Plan and the Management Plan differ in their delineation of the National Park's boundaries. This Management Plan was developed on the basis of the most recent interpretation of the official boundaries (GIS system), from which the visible difference in the maps and surface area of the National Park ensue.

Under the Physical Plan, two fundamental zones within the National Park are classified:

- Wilderness zone
- Recreation zone.



The wilderness zone is defined as that area of the National Park in which no activities are foreseen, rather the original condition as it exists is to be placed under the strictest protection and maintained fully, while the National Park's recreation zone is intended for visits by the broadest range of visitors. This is also a space in which the existing mountain trails and excursion routes must be arranged, while existing shepherd huts must be renovated and viewpoints arranged.

The area encompassed by the zones as specified in the Physical Plan are shown in Fig. 22.



Fig. 22: Zoning according to the Physical Plan

The zones specified within the Management Plan differ in some aspects from the zones originally specified in the Physical Plan. The differences between the Physical Plan and the Management Plan are as follows:

- Area 1 (Peak zone from Oglavinovac to Sveto Brdo, source area of Mala Paklenica, Borovnik, Jerkovac, Komić, Vlaški grad): According to the Physical Plan, this area is classified as a wilderness zone, while in the Management Plan it retains the strictest conservation classification. This zone, for the reasons specified, is divided into active conservation zones and a usage zone (Struge), and the areas of Bojinac, Suva Draga, Borovnik and the area between Velika Močila and Mala Paklenica were added to it.
- Area 2 (Bojinac and Suva draga): According to the Physical Plan, this area is classified as a recreation zone, while the Management Plan accords it a higher degree of conservation due to the need to preserve its exceptional geomorphological value and significance for wildlife conservation.
- Area 3 (Mala Paklenica): According to the Physical Plan, this area is classified as a recreation zone, while the Management Plan accords it a higher degree of conservation due to its significance to bird conservation, particularly birds of prey, owls and petrophilous bird communities.
- Area 4 (alpine meadows (turfs) in the Oglavinovac area), 5 (mountain meadows (turfs) in the Javornik area) and 6 (mountain meadows (turfs) from Štirovac to Sveto Brdo): According to the Physical Plan these are in the wilderness zone, while in the Management Plan they are distinguished as active conservation zones to facilitate the necessary activities for the purpose of biodiversity conservation.
- Area 7 (Struge mountain shelter): According to the Physical Plan this area is a wilderness zone, but due to the existing tourism infrastructure (mountain shelter), which should be re-classified as a mountain lodge in the future, it is set aside as a usage zone in the Management Plan.
- Area 8 (Velika Paklenica Canyon to Velika Močila): This zone was reduced to the Borovnik area to reflect the actual situation – visits generally occur up to the mountain lodge, while the rest of the area requires the proper installations and physical infrastructure, which is the reason for the considerably lower volume of visits. It is for this same reason, but also due to the need to preserve its natural value, that the link between Velika Močila and Mala Paklenica was separated from this zone and accorded a higher degree of conservation.
- Area 9 (plateau between Velika Paklenica and Mala Paklenica Canyon – Jasenar-Rimenić): According to the Physical Plan this area is classified as a recreation zone, but due to existing activities (grazing by sheep and goats), occasionally inhabited summer huts, and the considerable share of private property, this area is classified as a settlement, traditional farming and livestock raising zone in the Management Plan.



4.2. Action Plans

The Nature Protection Act stipulates that the Management Plan is valid for ten years, and that it is reviewed after five years. However, to ensure feasibility, short-term and long-term action plans must be developed to deal with specific priorities in management of the National Park. Action plans are an integral component of management plans, and these constitute very concrete management documents, which ensue from the defined strategic management objectives and measures for the National Park. Action plans thoroughly define the activities, timetables, and human and financial resources needed to implement them.

During formulation of the fundamental management objectives of Paklenica National Park, eleven priority action plans were identified which the Public Institution will carry out in the 2008-2017 period. This list of action plans does not cover all problem areas that will emerge in the Park over the coming years, but it will, as needed, be expanded. Action plans will be implemented through the regular annual Paklenica National Park Protection, Conservation, Maintenance, Promotion and Use Program. Besides the three completed actions plans, the Public Institution will elaborate the eight remaining action plans in detail up to 2009. All stakeholders will be involved in the development of each action plan, so that any potential conflicts are resolved at the very beginning

Table 12. List of action plans for the 2008-2017 period.

List of action plans
Objective: Conservation of landscape and biological diversity
1. Conservation of forest ecosystems in Paklenica National Park
2. Meadow conservation
3. Conservation and monitoring of chamois (<i>Rupicapra rupicapra</i>)
4. Re-introduction of Griffon Vulture (<i>Gyps fulvus</i>)
5. Manita Peć
Objective: Development of visitor system and tourism package for the National Park
6. Enrichment of the quality of the National Park for climbers
7. Interpretation system
8. Conservation and valuation of Mala Paklenica
Objective: Infrastructure development
9. Infrastructure for persons with special needs
10. New environmentally friendly technologies
Objective: Protection and preservation of cultural heritage
11. Revitalization of cultural heritage

4.2.1. Overview of priority action plans

During preparation of the Management Plan, the following priority action plans with specified objectives, principal activities, timetables and cost estimates were identified:

4.2.1.1. Landscape and biological diversity

Action plan: Conservation of forest ecosystems in Paklenica National Park	
Objective:	Development of a framework for all activities tied to forest ecosystem protection.
Principal activities:	Conservation, monitoring, control of overgrowth (succession), removal of dangerous trees, maintenance of trails, purchase of land, compensation for fuel wood, development of forest ecosystem protection and conservation program for Paklenica National Park Monitoring of cavity-nesting and semi-cavity nesting birds in forest ecosystems.
Budget:	HRK 73,500/yr. + land purchases
Timetable:	10 years

Action plan: Meadow conservation	
Objective:	Maintenance of meadows in the active conservation zone (2a) and the usage zone (3) and prevention of their succession.
Principal activities:	Maintenance of favorable condition of meadows (mowing and grazing), determination of meadow surfaces, recording and photographing for documentation purposes.
Budget:	HRK 36,750
Timetable:	10 years

Action plan: Conservation and monitoring of chamois (<i>Rupicapra rupicapra</i>)	
Objective:	Monitoring of the numbers and areas at which chamois linger in the Park; population growth.
Principal activities:	Censuses in winter and summer periods, collection of data on the areas of their principal residence, assessment of habitat characteristics, set up of at least two additional salt-lick areas.
Budget:	HRK 36,750
Timetable:	10 years

Action plan: Re-introduction of Griffon Vulture (<i>Gyps fulvus</i>)	
Objective:	Settling a population of Griffon Vultures in Paklenica National Park.
Principal activities:	Construction of aviaries for the vultures, opening of feeding sites, procurement of vulture chicks and releasing them in the wild, employment of at least one expert.
Budget:	HRK 1,102,500
Timetable:	10 years



Action plan: Manita Peć	
Objective:	Monitoring of ecological conditions in the cave.
Principal activities:	Monitoring temperatures, O ₂ and CO ₂ values, number of visitors.
Budget:	HRK 183,750
Timetable:	5 years

4.2.1.2. Development of visitor system and tourism offer for the National Park

Action plan: Enrichment of the quality of the National Park for climbers.	
Objective:	Improve the quality of the offer and safety for climbers with parallel minimization of their impact on biodiversity.
Principal activities:	Identification and establishment of new routes, improvement of documentation, regular inspections of existing routes, upgrading of safety measures, database on routes, development of local carrying capacity.
Budget:	HRK 257,250
Timetable:	10 years

Action plan: Interpretation system	
Objective:	Develop a program for visits by various types of visitors.
Principal activities:	Develop educational programs and content for various visitor age groups, particularly children (different age groups: kindergarten, elementary school, secondary school, university students).
Budget:	HRK 367,500
Timetable:	5 years

Action plan: Conservation and valuation of Mala Paklenica	
Objective:	Education on the importance of protection of birds of prey and owls in southern Velebit's habitats and the importance of preserving Mala Paklenica.
Principal activities:	Lectures for the broader public on the most frequent forms of threats, the importance of protected areas in preserving populations of birds of prey, watering areas for birds, determination of carrying capacity and regulation of the number of visitors/hikers in Mala Paklenica, educational programs on the importance of preserving the Mala Paklenica area.
Budget:	HRK 735,000
Timetable:	10 years

4.2.2.3. Infrastructure

Action plan: Infrastructure for persons with special needs	
Objective:	Adaptation of access trails or persons with special needs from the parking lot to the visitor center in the underground tunnels ("bunkers").
Principal activities:	Construction of access ramps on the trail to the "bunkers" for persons with special needs; there is currently no wheelchair access – the visitor center must be made accessible.
Budget:	HRK 147,000
Timetable:	1 year

Action plan: New environmentally friendly technologies	
Objective:	Develop wastewater treatment system for mountain lodge, foresters' house and "bunkers."
Principal activities:	Specially adapt wastewater treatment installations in mountain lodge and foresters' house.
Budget:	HRK 1,837,500
Timetable:	10 years

4.2.2.4. Cultural heritage

Action plan: Revitalization of cultural heritage	
Objective:	Settlement of property rights and restoration of old hamlets in National Park.
Principal activities:	Database and determination of number of facilities, renovation of mills in Velika/Mala Paklenica Canyons, hamlet and house renovation projects.
Budget:	HRK 3,675,000
Timetable:	10 years

4.3. Financial aspects and cost estimate

According to the Nature Protection Act, financing conservation and preservation of natural resources of international and national significance is secured through the central state budget. The same applies to financing of Paklenica National Park, in compliance with the needs specified in the annual operating plan, albeit within the scope of budgetary constraints.

Additional funding to finance conservation in Risnjak National Park may be generated by the sale of admission passes or a concessions system.

Over the past several years, Paklenica National Park has been incorporated in projects and programs financed by national and international institutions (e.g. World Bank/GEF in the case of the KEC Project, the European Union in case of the CARDS (ROP) project).

Since action plans are separate projects in and of themselves, the National Park will use them to secure additional funding from international and national endowments and donations. Each action plan has a detailed financial component which will be reflected in the annual operating plan and will comply with the National Park's overall budget.

An estimate of the total funds necessary to implement the Management Plan for the 2008-2017 period is shown in Table 13.



Table 13. Tentative budgetary requirements for Paklenica National Nature Park for the 2008-2017 period.

a) Current costs of Public Institution for the 2008-2017 period

Description	Year										
	2008.	2009.	2010.	2011.	2012.	2013.	2014.	2015.	2016.	2017.	
OPERATING COSTS (HRK)											Total
Staff costs	3,000,000	3,150,000	3,307,500	3,472,875	3,646,519	3,828,845	4,020,287	4,221,301	4,432,366	4,653,985	37,733,678
Supplies and services	1,600,000	1,680,000	1,764,000	1,852,200	1,944,810	2,042,051	2,144,153	2,251,361	2,363,929	2,482,125	20,124,629
Procurement of non-financial assets	2,000,000	2,100,000	2,205,000	2,315,250	2,431,013	2,552,563	2,680,191	2,814,201	2,954,911	3,102,656	25,155,785
Other costs	400,000	420,000	441,000	463,050	486,203	510,513	536,038	562,840	590,982	620,531	5,031,157
Total	7,000,000	7,350,000	7,717,500	8,103,375	8,508,545	8,933,972	9,380,669	9,849,703	10,342,188	10,859,297	88,045,249

b) Costs of action plan implementation in the 2008-2017 period

ACTIONS PLANS (HRK)											
Year	2008.	2009.	2010.	2011.	2012.	2013.	2014.	2015.	2016.	2017.	Total
Conservation of forest ecosystems in Paklenica National Park	73,500	73,500	73,500	73,500	73,500	73,500	73,500	73,500	73,500	73,500	735,000
Enrichment of the quality of the National Park for climbers	25,725	25,725	25,725	25,725	25,725	25,725	25,725	25,725	25,725	25,725	257,250
Meadow conservation	3,675	3,675	3,675	3,675	3,675	3,675	3,675	3,675	3,675	3,675	36,750
Conservation and monitoring of chamois (<i>Rupicapra rupicapra</i>)	3,675	3,675	3,675	3,675	3,675	3,675	3,675	3,675	3,675	3,675	36,750
Infrastructure for persons with special needs	0	147,000	0	0	0	0	0	0	0	0	147,000
Interpretation system	0	0	73,500	73,500	73,500	73,500	73,500	0	0	0	367,500
Re-introduction of Griffon Vulture (<i>Gyps fulvus</i>)	110,250	110,250	110,250	110,250	110,250	110,250	110,250	110,250	110,250	110,250	1,102,500
Conservation and valuation of Mala Paklenica Canyon	73,500	73,500	73,500	73,500	73,500	73,500	73,500	73,500	73,500	73,500	735,000
Manita Peć	36,750	36,750	36,750	36,750	36,750	0	0	0	0	0	183,750
Revitalization of cultural heritage	367,500	367,500	367,500	367,500	367,500	367,500	367,500	367,500	367,500	367,500	3,675,000
New environmentally friendly technologies	183,750	183,750	183,750	183,750	183,750	183,750	183,750	183,750	183,750	183,750	1,837,500
Total	878,325	1,025,325	951,825	951,825	951,825	915,075	915,075	841,575	841,575	841,575	9,114,000
CURRENT OPERATING COSTS + ACTION PLANS (HRK)											
Overall total	7,878,325	8,375,325	8,669,325	9,055,200	9,460,370	9,849,047	10,295,744	10,691,278	11,183,763	11,700,872	97,159,249

4.4. Monitoring

The Management Plan will be implemented over a period of 10 years, during which an entire series of monitoring activities will be carried out to ensure that the objectives of the Plan are met. Monitoring entails the ongoing observation of changes in the environment (habitats, populations, species indicators) and assessment of management activities within the Plan. Based on the data recorded through monitoring, the achievements of the Plan can be assessed and specific corrective actions be taken. Adaptive management loops must be created between field actions, monitoring measurements, checking against expectations and adjusting future actions, with each reiteration of activity based on past experience and new information.

Monitoring activities can be classified into different types, according to the level of monitoring:

- Monitoring Management Plan activities
- Monitoring visitor numbers and satisfaction
- Monitoring landscape changes
- Monitoring selected taxa

In addition, specific monitoring activities are incorporated into the action plans to ensure that the objectives of the action plans are met and to allow for adjustments if necessary.

4.4.1. Monitoring Management Plan activities

The best instrument to monitor performance is the annual operating plan and the annual report, since they contain all Public Institution activities. Once the Management Plan is approved, the annual operating plan should be structured to comply with it. It contains a list of activities tied to objectives, measures and action plans, with an indication of the estimated resources to accomplish these activities (staff and finances). At the end of the year, when the annual report is produced, the same structure is applied, with indication of the activities actually carried out and the resources expended.

Over the course of a few years, these reports will constitute an ideal instrument to assess the degree to which the Management Plan's objectives and measure are achieved and the funds expended for implementation thereof.

4.4.2. Monitoring visitor numbers and satisfaction

In 2004, a study was conducted under the KEC Project to assess the visitor perceptions of the Park. Questionnaires were developed for the study, and the results were tabulated into a database. The information provided through this first survey was used in the preparation of this Management Plan.

The study will be repeated in five years in order to assess the changes in visitor perceptions as a measure of visitor satisfaction. Additional comments provided by Park visitors proved very useful in identifying possible issues which should be addressed by the Park's management in the future.



4.4.3. Monitoring landscape changes

The conservation objectives and measures set forth in this Management Plan have an impact on the landscape. A measure of its effectiveness can be achieved by comparing land cover areas in and around the Park over time.

As a part of Management Plan preparations, a land cover map at a scale of 1:25.000 has been produced according to the first level of Corine land cover classification and based on two sets of Landsat TM satellite images in 2000 (spring and autumn).

The repetition of land cover mapping over five and ten year lapses using the same methodology will facilitate observation of changes in the medium and long terms. Combined with more detailed field research, it will improve the understanding on how the Park's habitats are developing.

4.4.4. Monitoring selected taxa

In addition to the two "desk" monitoring methodologies specified above, the Park will conduct field monitoring that can be easily implemented on a regular basis by the current staff, following a coordinated methodology. These activities are:

- **Counting traces of large mammals along the transect.** A transect crossing the Park should be defined and followed periodically, recording the position, type and number of large mammals traces found. The transect should be monitored once or twice annually under identical conditions and, preferably, the same staff.
- **Bird monitoring along the transect.** In the implementation of the KEC Project, an inventory of birds was conducted throughout the Park, and a monitoring methodology was defined for corncrake, woodpeckers and owls. This monitoring activity should be implemented on a regular basis with strict adherence to the proposed methodology.
- **Cave monitoring.** One of the current problems in the karst area is waste dumping in caves and pit-caves. In order to assess the impact of environmental education on the local population in and around the Park, a selected number of caves and pit-caves near settlements should be monitored regularly and the amounts of waste found should be recorded and disposed.

In order to facilitate monitoring activities, the KEC GIS system will provide the necessary data to record and analyze the different parameters recorded in monitoring activities. The KEC Information System has been set up for parks participating in the KEC Project to store and analyze all biological, environmental, social and economic data about these parks. This system will be the main tool to compare indicator data over space and time, and evaluate the results against the objectives and strategies set forth in this Management Plan and in the action plans.

Through user-friendly data entry forms, all information will be entered by the Park staff or by the scientists engaged in monitoring of plants and animals on the Park's behalf. All entered data will be geo-referenced through GPS readings, allowing for spatial analysis and representation of the results on maps. The same data can be used for general monitoring purposes on the national or regional level.

4.5. Adaptive management

Management planning is an ongoing process. As situations change over time and new information becomes available, it is essential that the Management Plan be reviewed to ensure that it is addressing current needs and to ensure that it remains relevant and applicable to evolving situations.

The review process is periodic (one to five years) and is used to determine the extent to which overall objectives and results have been achieved. It should also identify the reasons for success or failure and areas for improving the plan, including redefining goals and objectives, reviewing policy alternatives and management practices.

The Nature Protection Act requires a formal review of the Plan every five years to assess whether the objectives have been achieved and to revise management policies where appropriate. The five-year review should ensure that the strategic direction is still relevant to the current conditions, e.g. available resources, potential threats, land use trends and prevailing social and economic circumstances. The review may result in the continuation of the Plan, amendments to sections or a complete overhaul.

Normally the Plan will be reviewed annually, when the operating plan and annual report are being developed, when achievements are set against the targets of the previous annual plan. Most of the objectives are long-term and cannot be achieved in a single year.

4.6. Cooperation between the Park and other parks on Velebit

Paklenica National Park is entirely surrounded by Velebit Nature Park which, in its northern section, similarly encompasses Northern Velebit National Park. This is a unique instance among Croatian parks. All three parks are under the authority of the Ministry of Culture. Each park is simultaneously managed by a separate public institution.

Cooperation between the parks has been exemplary so far, although it has been observed that cooperation can nonetheless be improved, particularly in the following areas:

- The Velebit mountain as a UNESCO biosphere reserve (Man and Biosphere Program);
- Joint marketing efforts to promote Velebit to the domestic and worldwide public;
- Supervision of the entire region (poaching, visitors, etc.);
- Joint monitoring programs;
- Creation of joint tourism products (mountain trails, bicycling trails, etc.);
- Coordination of scientific research programs;
- Conservation of large carnivores and other species (e.g. capercaillie, griffon vulture, etc.).

In the interest of improving cooperation and coordination between Velebit's parks, meetings of directors, conservation managers, chief rangers and heads of publicity departments will be organized every three months. Organization of these meetings will be mandatory components of annual park operating plans.



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Anića kuk, the destination of many climbers.



6. APPENDICES

6.1. Appendix 1: During development of the Management Plan, the following laws and subordinate legislation and documents regulating protected areas were taken into consideration:

- Physical Planning Act (*Narodne novine*, no. 30/94, 68/98, 35/99, 61/00, 32/02 and 100/04)
- Forests Act (*Narodne novine*, no. 140/05)
- Agriculture Act (*Narodne novine*, no. 66/01)
- Organic Farming and Foods Act (*Narodne novine*, no. 12/01)
- Agriculture, Fisheries and Forestry State Subsidies Act (*Narodne novine*, no. 87/02)
- Waters Act (*Narodne novine*, no. 107/95, 150/05)
- Environmental Protection Act (*Narodne novine*, no. 82/94, 128/99)
- Fire Protection Act (*Narodne novine*, no. 58/93)
- Mountain and Highland Regions Act (*Narodne novine*, no. 12/02, 32/02, 117/03, 42/05, 90/05)
- Hunting Act (*Narodne novine*, no. 140/05)
- Air Protection Act (*Narodne novine*, no. 78/04)
- Animal Husbandry Act (*Narodne novine*, no. 70/97)
- Farmlands Act (*Narodne novine*, no. 66/01)
- Environmental Impact Assessment Directive (*Narodne novine*, no. 34/97)
- Ecological Network Directive (*Narodne novine*, no. 109/07)
- Republic of Croatia Biological and Landscape Diversity Conservation Strategy and Action Plan (*Narodne novine*, no. 81/99)
- Republic of Croatia Physical Planning Strategy
- Croatian Tourism Developmental Strategy (*Narodne novine*, no. 113/93)

The conservation, improvement and use of Paklenica National Park are defined in the following laws and subordinate legislation:

- Act Proclaiming Paklenica Forest a National Park (*Narodne novine*, no. 84/49)
- Amendments to the Act Proclaiming Paklenica Forest a National Park (*Narodne novine*, no. 15/97)
- Paklenica National Park Internal Rules of Order (*Narodne novine*, no. 76/00)
- Decision to Adopt the Paklenica National Park Physical Plan (*Narodne novine*, no. 23/01)
- Rules on Rates for Compensation of Damages Caused by Illegal Actions Involving Protected Animal Species (*Narodne novine*, no. 84/96 and 79/02)
- Amphibian Protection Rules (*Narodne novine*, no. 80/99) (Article 2 rescinded)
- Terrestrial Snail (*Gastropoda terrestria*) Protection Rules (*Narodne novine*, no. 29/99) (Article 2 rescinded)
- Nature Protection Sign Rules (*Narodne novine*, no. 178/03)
- Mushroom (*Fungi*) Protection Rules (*Narodne novine*, no. 34/02) (Article 4 rescinded)
- Rules on Proclamation of Protected and Strictly Protected Wild Taxa (*Narodne novine*, no. 7/06)
- Rules on Habitat Types, Habitat Maps, Threatened and Rare Habitat Types and Habitat Maintenance Measures (*Narodne novine*, no. 7/06)
- Rules on Trans-border Traffic and Trade of Protected Species (*Narodne novine*, no. 34/06)
- Rules on Risk Assessment of Intentional Release of Genetically-modified Organisms into the Environment (*Narodne novine*, no. 136/06)

6.2. Appendix 2. Surface of habitat types according to Paklenica National Park habitat map (3rd level of National Habitat Classification)

Table 14. Surface area of habitat types in Paklenica National Park

NHC code	NHC description	Surface (ha)
B.1.	Rocky terrain with no or slight vegetation growth	119.2
B.1./B.2.	Rocky terrain with no or slight vegetation growth/Gullies	94.5
B.1./B.2./C.4.1.	Rocky terrain with no or slight vegetation growth/Gullies/Mountain turfs	60.5
B.1./B.2./C.4.1./E.6.1.	Rocky terrain with no or slight vegetation growth/Gullies/Mountain turfs/Subalpine beech forests	120.9
B.1./B.2./E.6.1.	Rocky terrain with no or slight vegetation growth/Gullies/Subalpine beech forests	42.6
B.1./C.3.5.	Rocky terrain with no or slight vegetation growth/Sub-Mediterranean and epi-Mediterranean dry grasslands	23.1
B.1./C.3.5./E.4.6.	Rocky terrain with no or slight vegetation growth/Sub-Mediterranean and epi-Mediterranean dry grasslands/Southeast alpine/Illyrian thermophilous beech forests	8.5
B.1./C.4.1.	Rocky terrain with no or slight vegetation growth/Mountain turfs	22.9
B.1./D.2.1.	Rocky terrain with no or slight vegetation growth/Subalpine juniper forests	31.0
B.1./D.3.1.	Rocky terrain with no or slight vegetation growth/Jerusalem thorn groves	39,1
B.1./E.3.5.	Rocky terrain with no or slight vegetation growth/Littoral thermophilous Dalmatian white oak forests and underbrush	274.4
B.1./E.3.5./E.4.6.	Rocky terrain with no or slight vegetation growth/Littoral thermophilous Dalmatian white oak forests and underbrush/Southeast alpine/Illyrian thermophilous beech forests	5.2
B.1./E.4.6.	Rocky terrain with no or slight vegetation growth/Southeast alpine/Illyrian thermophilous beech forests	45.4
B.1./E.7.4.	Rocky terrain with no or slight vegetation growth/Scots and black pine forests on dolomites	120.8
B.2./B.1.	Gullies/Rocky terrain with no or slight vegetation growth	3.1
B.2./B.1./E.7.4.	Gullies/Rocky terrain with no or slight vegetation growth/Scots and black pine forests on dolomites	6.0
B.2./C.3.5.	Gullies/Sub-Mediterranean and epi-Mediterranean dry grasslands	17.6
B.2./D.2.1.	Gullies/Subalpine juniper forests	32.7
C.3.3.	Sub-Atlantic mesophilous grasslands and mountain meadows	3.9
C.3.5.	Sub-Mediterranean and epi-Mediterranean dry grasslands	222.4
C.3.5./B.1.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Rocky terrain with no or slight vegetation growth	17.6
C.3.5./B.1./E.3.5.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Rocky terrain with no or slight vegetation growth/Littoral thermophilous Dalmatian white oak forests and underbrush	49.7
C.3.5./B.2.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Gullies	6.7
C.3.5./C.3.3./E.3.5.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Sub-Atlantic mesophilous grasslands and mountain meadows/Littoral thermophilous Dalmatian white oak forests and underbrush	17.7

NHC code	NHC description	Surface (ha)
C.3.5./C.4.1.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Mountain turfs	17.5
C.3.5./D.2.1.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Subalpine juniper forests	59.7
C.3.5./D.3.1.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Jerusalem thorn groves	320.8
C.3.5./D.3.1./B.1.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Jerusalem thorn groves/Rocky terrain with no or slight vegetation growth	9.9
C.3.5./D.3.1./E.3.5.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Jerusalem thorn groves/Littoral thermophilous Dalmatian white oak forests and underbrush	118.7
C.3.5./E.3.5.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Littoral thermophilous Dalmatian white oak forests and underbrush	393.6
C.3.5./E.3.5./B.1.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Littoral thermophilous Dalmatian white oak forests and underbrush/Rocky terrain with no or slight vegetation growth	158.0
C.3.5./E.3.5./E.4.6.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Littoral thermophilous Dalmatian white oak forests and underbrush/Southeast alpine/Illyrian thermophilous beech forests	205.9
C.3.5./E.4.6.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Southeast alpine/Illyrian thermophilous beech forests	37.5
C.3.5./E.7.4.	Sub-Mediterranean and epi-Mediterranean dry grasslands/Scots and black pine forests on dolomites	31.6
C.4.1.	Mountain turfs	513.5
C.4.1./B.1.	Mountain turfs/Rocky terrain with no or slight vegetation growth	12.6
C.4.1./B.2.	Mountain turfs/Gullies	16.7
C.4.1./C.3.5.	Mountain turfs/Sub-Mediterranean and epi-Mediterranean dry grasslands	7.4
C.4.1./D.2.1.	Mountain turfs/Subalpine juniper forests	305.0
C.4.1./D.2.1./B.1.	Mountain turfs/Subalpine juniper forests/Rocky terrain with no or slight vegetation growth	3.4
C.4.1./E.4.6.	Mountain turfs/Southeast alpine/Illyrian thermophilous beech forests	13.6
C.4.1./E.6.1.	Mountain turfs/Subalpine beech forests	56.9
C.4.1./E.7.4.	Mountain turfs/Scots and black pine forests on dolomites	2.4
D.2.1.	Subalpine juniper forests	223.6
D.2.1./B.1.	Subalpine juniper forests/Rocky terrain with no or slight vegetation growth	10.9
D.2.1./B.1./B.2.	Subalpine juniper forests/Rocky terrain with no or slight vegetation growth/Gullies	4.2
D.2.1./C.3.5.	Subalpine juniper forests/Sub-Mediterranean and epi-Mediterranean dry grasslands	10.0
D.2.1./C.4.1.	Subalpine juniper forests/Mountain turfs	366.0
D.2.1./E.6.1.	Subalpine juniper forests/Subalpine beech forests	103.8
E.3.5.	Littoral thermophilous Dalmatian white oak forests and underbrush	770.0
E.3.5./B.1.	Littoral thermophilous Dalmatian white oak forests and underbrush/Rocky terrain with no or slight vegetation growth	16.1
E.3.5./B.2.	Littoral thermophilous Dalmatian white oak forests and underbrush/Gullies	9.9

NHC code	NHC description	Surface (ha)
E.3.5/B.2/B.1.	Littoral thermophilous Dalmatian white oak forests and underbrush/Gullies/Rocky terrain with no or slight vegetation growth	3.5
E.3.5/C.3.5.	Littoral thermophilous Dalmatian white oak forests and underbrush/Sub-Mediterranean and epi-Mediterranean dry grasslands	657.4
E.3.5/C.3.5/B.1.	Littoral thermophilous Dalmatian white oak forests and underbrush/Sub-Mediterranean and epi-Mediterranean dry grasslands/Rocky terrain with no or slight vegetation growth	137.1
E.3.5/C.3.5/D.2.1.	Littoral thermophilous Dalmatian white oak forests and underbrush/Sub-Mediterranean and epi-Mediterranean dry grasslands/Subalpine juniper forests	17.5
E.3.5/D.3.1.	Littoral thermophilous Dalmatian white oak forests and underbrush/Jerusalem thorn groves	77.6
E.3.5/E.4.6.	Littoral thermophilous Dalmatian white oak forests and underbrush/Southeast alpine/Illyrian thermophilous beech forests	37.3
E.3.5/E.4.6/C.3.5.	Littoral thermophilous Dalmatian white oak forests and underbrush/Southeast alpine/Illyrian thermophilous beech forests/Sub-Mediterranean and epi-Mediterranean dry grasslands	6.2
E.3.5/E.7.4.	Littoral thermophilous Dalmatian white oak forests and underbrush/Scots and black pine forests on dolomites	125.8
E.4.2.	Central European acidophilous beech forests	125.3
E.4.6.	Southeast alpine/Illyrian thermophilous beech forests	852.6
E.4.6/B.1.	Southeast alpine/Illyrian thermophilous beech forests/Rocky terrain with no or slight vegetation growth	102.2
E.4.6/C.3.5.	Southeast alpine/Illyrian thermophilous beech forests/Sub-Mediterranean and epi-Mediterranean dry grasslands	72.4
E.4.6/E.7.4.	Southeast alpine/Illyrian thermophilous beech forests/Scots and black pine forests on dolomites	201.9
E.4.6/E.7.4/B.1.	Southeast alpine/Illyrian thermophilous beech forests/Scots and black pine forests on dolomites/Rocky terrain with no or slight vegetation growth	43.4
E.6.1.	Subalpine beech forests	1,176.9
E.6.1/B.1.	Subalpine beech forests/Rocky terrain with no or slight vegetation growth	6.7
E.6.1/C.3.5.	Subalpine beech forests/Sub-Mediterranean and epi-Mediterranean dry grasslands	28.4
E.6.1/C.4.1.	Subalpine beech forests/Mountain turfs	160.4
E.6.1/D.2.1.	Subalpine beech forests/Subalpine juniper forests	2.6
E.6.1/E.7.4.	Subalpine beech forests/Scots and black pine forests on dolomites	24.6
E.7.4.	Scots and black pine forests on dolomites	421.8
E.7.4/B.1.	Scots and black pine forests on dolomites/Rocky terrain with no or slight vegetation growth	12.7
E.7.4/C.3.5.	Scots and black pine forests on dolomites/Sub-Mediterranean and epi-Mediterranean dry grasslands	12.1
E.7.4/C.3.5/B.2.	Scots and black pine forests on dolomites/Sub-Mediterranean and epi-Mediterranean dry grasslands/Gullies	5.2

6.3. Appendix 3: Endangered status of plants and animals in Paklenica National Park

Table 15. Status of bird species according to the Red Book of Endangered Birds in Croatia (RADOVIĆ et al., 2003). Only birds recorded in the boundaries of Paklenica National Park are listed.

English name	Latin name	Fly-over	Nesting	Rare species	Wintering	Status in Croatia
1. Black stork	<i>Ciconia nigra</i>	+				VU
2. Honey buzzard	<i>Pernis apivorus</i>	+	+			VU
3. Egyptian vulture	<i>Neophron percnopterus</i>					RE
4. Griffon vulture	<i>Gyps fulvus</i>					RE
5. Black vulture	<i>Aegypius monachus</i>			+		RE
6. Short-toed eagle	<i>Circaetus gallicus</i>		+			VU
7. Marsh harrier	<i>Circus aeruginosus</i>	+				EN
8. Montagu's harrier	<i>C. pygargus</i>	+				EN
9. Lesser spotted eagle	<i>Aquila pomarina</i>	+				EN
10. Golden eagle	<i>A. chrysaetos</i>		+			EN
11. Bonelli's eagle	<i>A. fasciata</i>			+		CR
12. Lesser kestrel	<i>Falco naumanni</i>			+		RE
13. Saker falcon	<i>F. cherrug</i>	+				CR
14. Peregrine falcon	<i>F. peregrinus</i>		+			VU
15. Eurasian woodcock	<i>Scolopax rusticola</i>	+				DD
16. Common snipe	<i>Gallinago gallinago</i>	+				CR
17. Stock pigeon	<i>Columba oenas</i>	+				DD
18. Fieldfare	<i>Turdus pilaris</i>				+	CR
19. Olive-tree warbler	<i>Hippolais olivetorum</i>					DD
20. Icterine warbler	<i>H. icterina</i>	+				DD
21. Willow warbler	<i>Phylloscopus trochilus</i>	+				EN

Table 16. Status of bird species supplemented according to the status specified in the Bird List of Croatia (LUKAČ, to be released).

English name	Latin name	Fly-over	Nesting	Rare species	Wintering	Status in Croatia
22. Hobby	<i>Falco subbuteo</i>	+				VU
23. Grouse	<i>Bonasa bonasia</i>		?+			VU
24. Crane	<i>Grus grus</i>	+				VU
25. Barn owl	<i>Tyto alba</i>	+				VU
26. White-backed woodpecker	<i>Picoides leucotos</i>		+			VU
27. Water pipet	<i>Anthus spinoletta</i>		+			VU
28. White-throated dipper	<i>Cinclus cinclus</i>		+			VU
29. Alpine accentor	<i>Prunella collaris</i>		+			VU
30. Woodchat shrike	<i>Lanius senator</i>		+			VU
31. Spotted nutcracker	<i>Nucifraga caryocatactes</i>				+	VU
32. Yellow-billed cough	<i>Pyrhhorax graculus</i>		+			VU

Table 17. Status of vascular plants of Paklenica National Park according to the Red Book of Vascular Plants of Croatia (NIKOLIĆ & TOPIĆ 2005).

Latin species name	English species name	Status
1. <i>Blackstonia perfoliata</i> (L.) Huds.	Yellow-wort	EN
2. <i>Carex divisa</i> Huds.	Divided sedge	EN
3. <i>Cypripedium calceolus</i> L.	Lady's slipper	EN
4. <i>Daphne cneorum</i> L.	Red narrow-leave laurel	EN
5. <i>Gentiana lutea</i> L. subsp. <i>symphyandra</i> (Murb.) Hayek	Yellow gentian	EN
6. <i>Ophrys apifera</i> Huds.	Bee orchid	EN
7. <i>Arctostaphylos uva-ursi</i> (L.) Spreng.	Bearberry	VU
8. <i>Campanula cochlearifolia</i> Lam.	Earleaf bellflower	VU
9. <i>Ilex aquifolium</i> L.	Holly	VU
10. <i>Leontopodium alpinum</i> Cass.	Edelweiss	VU
11. <i>Lilium bosniacum</i> (Beck) Beck ex Fritsch	Bosnian lilly	VU
12. <i>Lilium carniolicum</i> Bernh. ex Koch	Carniolan lilly	VU
13. <i>Lilium martagon</i> L.	Martagon's lilly	VU
14. <i>Orchis purpurea</i> Huds.	Lady orchid	VU
15. <i>O. tridentata</i> Scop.	Three-toothed orchid	VU
16. <i>O. ustulata</i> L.	Burnt orchid	VU
17. <i>Taxus baccata</i> L.	Common yew	VU
18. <i>Achillea clavenae</i> L.	Silvery yarrow	Nt
19. <i>Anacamptis pyramidalis</i> (L.) Rich.	Pyramidal orchid	Nt
20. <i>Aquilegia kitaibelii</i> Schott	Kitaibel's columbine	Nt
21. <i>Asparagus tenuifolius</i> Lam.	Narrow-leaved asparagus	Nt
22. <i>Campanula fenestrellata</i> Feer	Window bellflower	Nt
23. <i>C. waldsteiniana</i> Schult.	Waldstein's bellflower	Nt
24. <i>C. velebitica</i> Borbas	Velebit bellflower	Nt
25. <i>Cardamine maritima</i> Port. Ex. DC.	Maritime bittercress	Nt
26. <i>Centaurea spinosociolata</i> Seenus	Centaury	Nt
27. <i>Cephalanthera damasonium</i> (Mill.) Druce	White helleborine	Nt
28. <i>C. longifolia</i> (L.) Fritsch	Narrow-leaved helleborine	Nt
29. <i>C. rubra</i> (L.) Rich.	Red helleborine	Nt
30. <i>Corydalis acaulis</i> (Wulfen) Pers.	Littoral corydalis	Nt
31. <i>Cyclamen repandum</i> Sibth. Et. Sm.	Littoral cyclamen	Nt
32. <i>Daphne laureola</i> L.	Spurge-laurel	Nt
33. <i>D. mezereum</i> L.	Mezereon	Nt
34. <i>Dianthus velebiticus</i> Borbas op. Kulcz	Velebit carnation	Nt
35. <i>Digitalis grandiflora</i> Mill.	Yellow foxglove	Nt
36. <i>Ephedra fragilis</i> Desf. Ssp. <i>campylopoda</i> (C.A.Mayer) Asch. Et Graeb.	Ephedra shrub	Nt
37. <i>Gentiana clusii</i> Perr. Et Song.	Clusius gentian	Nt
38. <i>Heracleum sphondylium</i> L. ssp. <i>orsinii</i> (Guss.) H. Neumayer	Cow parsnip (sub-species)	Nt
39. <i>Iberis pruitii</i> Tineo	Pruit's candytuft	Nt
40. <i>Inula salicina</i> L.	Willowleaft yellowhead	Nt
41. <i>Iris variegata</i> L.	Hungarian iris	Nt
42. <i>Narcissus tazetta</i> L.	Joss flower	Nt
43. <i>Orchis morio</i> L.	Green-winged orchid	Nt

Latin species name	English species name	Status
44. <i>Paeonia mascula</i> (L.) Miller	Balkan peony	Nt
45. <i>Peltaria alliacea</i> Jacq.	Garlic cress	Nt
46. <i>Pinus nigra</i> Arnold subsp. <i>dalmatica</i> (Vis.) Franco	Dalmatian black pine	Nt
47. <i>Polygala chamaebuxus</i> L.	Shrubby milkwort	Nt
48. <i>Primula kitaibeliana</i> Schott	Kitaibel's primrose	Nt
49. <i>Primula veris</i> L. subsp. <i>columnae</i> (Ten.) Luedi	Cowslip	Nt
50. <i>Pulsatilla alpina</i> (L.) Delarbre	Alpine pasqueflower	Nt
51. <i>Rhamnus intermedius</i> Steud. Et Hohst.	Buckthorn (local variety)	Nt
52. <i>Seseli malyi</i> A. Kern.	Moon-carrot (endemic variety)	Nt
53. <i>Sternbergia lutea</i> (L.) Ker Gawl. Ex Spreng.	Yellow autumn crocus	Nt
54. <i>Tulipa sylvestris</i> L.	Wild tulip	Nt

Table 18. Status of amphibians and reptiles in Paklenica National Park according to Red Book of Amphibians and Reptiles of Croatia (TVRTKOVIĆ 2006).

Latin species name	English species name	Status
1. <i>Hyla arborea</i> L.	Tree frog	Nt
2. <i>Vipera ursinii macrops</i> Mehely, 1911	Meadow viper	EN
3. <i>Zamenis situla</i> (Linnaeus 1758)	Leopard snake	DD
4. <i>Testudo hermanni</i> Gmelin, 1789	Hermann's tortoise	DD

Table 19. Status of mammals in Paklenica National Park according to Red Book of Mammals of Croatia (TVRTKOVIĆ 2006).

Latin species name	English species name	Status
1. <i>Lynx lynx</i> (Linnaeus, 1758)	Lynx	Nt
2. <i>Rupicapra rupicapra</i> Linnaeus, 1758	Chamois	Nt
3. <i>Miniopterus schreibersii</i> (Kuhl, 1817)	Large bent-wing bat	EN
4. <i>Rhinolophus euryale</i> Blasius, 1853	Mediterranean horseshoe bat	VU
5. <i>Plecotus macrobullaris</i> Kuzjakin, 1965	Alpine long-eared bat	DD
6. <i>Rhinolophus ferrumequinum</i> (Schreber, 1744)	Greater horseshoe bat	Nt
7. <i>Rhinolophus hipposideros</i> (Bechstein, 1800)	Lesser horseshoe bat	Nt
8. <i>Myotis emarginatus</i> (E. Geoffroy)	Geoffrey's bat	Nt
9. <i>Myotis myotis</i> (Borkhausen, 1797)	Greater mouse-eared bat	Nt
10. <i>Nyctalus leisleri</i> (Kuhl, 1817)	Lesser noctule	Nt
11. <i>Dinaromys bogdanovi</i> (Martino 1992)	Martino's vole	Nt
12. <i>Sciurus vulgaris</i> Linnaeus, 1758	Red squirrel	Nt
13. <i>Chionomys nivalis</i> (Martins, 1842)	Snow vole	Nt
14. <i>Dryomys nitedula</i> (Pallas, 1778)	Forest dormouse	Nt
15. <i>Eliomys quercinus</i> (Linnaeus, 1766)	Garden dormouse	Nt
16. <i>Muscardinus avellanarius</i> (Linnaeus, 1758)	Common dormouse	Nt
17. <i>Canis lupus</i> Linnaeus, 1758	Wolf	Nt
18. <i>Ursus arctos</i> Linnaeus, 1758	Brown bear	Nt
19. <i>Lepus europaeus</i> Pallas, 1778	Brown hare	Nt
20. <i>Glis glis</i> (Linnaeus, 1766)	Edible dormouse	Nt

6.4. Appendix 4: Important areas for wild taxa and habitat types and birds in the Ecological Network within the boundaries of Paklenica National park

Table 20. Important areas for wild taxa and habitat types and birds in the Ecological Network within the boundaries of Paklenica National park. *- priority habitats; # - internationally important areas = potential Natura 2000 areas.

Area code	HR2000052 #			
Area designation	Pit-cave under Bojin crest			
Conservation objectives	wild taxa			
	Species		English name	
	Leptodirus hochewarti		Narrow-necked blind cave beetle	
	endemic taxa			
	habitat types	NHC habitat	Natura 2000 code	Habitat type
	H.1.	Karst caves and pit-caves	8310	
Area code	HR2000082 #			
Area designation	Manita Peč Cave			
Conservation objectives	wild taxa			
	Species		English name	
	Leptodirus hochewarti		Narrow-necked blind cave beetle	
	endemic taxa			
	habitat types			
	NHC code	NHC habitat	Natura 2000 code	Habitat type
H.1.	Karst caves and pit-caves	8310		
Area code	HR2000122 #			
Area designation	Sniježnica near Babin Vrh			
Conservation objectives	wild taxa			
	species		English name	
			endemic taxa	
	habitat types			
	NHC code	NHC habitat	Natura 2000 code	Habitat type
	H.1.	Karst caves and pit-caves	8310	
Area code	HR2000756 #			
Area designation	Pit-cave under Buljma cliffs			
Conservation objectives	wild taxa			
	species		English name	
	Leptodirus hochewarti		Narrow-necked blind cave beetle	
	habitat types			
	NHC code	NHC habitat	Natura 2000 code	Habitat type
	H.1.	Karst caves and pit-caves	8310	
Area code	HR2000757 #			
Area designation	Pit-cave at Buljma spur			
Conservation objectives	wild taxa			
	species		English name	
	Leptodirus hochewarti		Narrow-necked blind cave beetle	
	habitat types			
	NHC code	NHC habitat	Natura 2000 code	Habitat type
	H.1.	Karst caves and pit-caves	8310	
Area code	HR2000871 #			
Area designation	Paklenica National Park			
Conservation objectives	wild taxa			
	species		English name	
	Myotis emarginatus		Geoffrey's bat	
			All petrophilous bird species	
			All lizards	
	Zamenis situla		Leopard snake	
	Astacus astacus		Crayfish	
	Erebia gorge vagana		Vagana silky ringlet	
	Erebia medusa		Woodland ringlet	
	Parnassius apollo		Apollo	
	Rosalia alpina		Rosalia longicorn	

Conservation objectives	<i>Scolitantides orion</i>		Checkered blue	
	<i>Zerynthia polyxena</i>		Southern festoon	
	<i>Aquilegia kitaibelii</i>		Kitaibel's columbine	
	<i>Eryngium alpinum</i>		Alpine sea holly	
	<i>Genista holopetala</i>		Entire-petalled gorse	
	<i>Lilium jankae ssp. bosniacum</i>		Bosnian lilly	
			other wild taxa endangered at the European or national level	
	habitat types			
	NHC code	NHC habitat	Natura 2000 code	Habitat type
				Canyon vegetation
			8120	Carbonate gullies <i>Thlaspietea rotundifolii</i>
			8210	Carbonate rock with chasmophyte vegetation
	B.1.4.1.3.	Meadow-rue and bellflower community		
	E.3.5.9.	Mixed black pine and hop hornbeam forest	9530*	
	E.4.6.	Southern alpine-Illyrian thermophilous beech forests	91K0	
	E.6.1.	Subalpine beech forests	91K0	
E.6.1.1.	Subalpine beech forests with alpine buttercup	91K0		
E.7.4.4.	Black pine and cotoneaster forest	9530*		
H.1.	Karst caves and pit-caves	8310		
Area code	HR2000961 #			
Area designation	Babino Lake			
Conservation objectives	habitat types			
	NHC code	NHC habitat	Natura 2000 code	Habitat type
				<i>Deschampsietum subalpinum</i>
	A.1.1.1.	Permanent ponds		
Area code	HR5000022 #			
Area designation	Velebit Nature Park			
Conservation objectives	wild taxa			
	species		English name	
	<i>Barbastella barbastellus</i>		Barbastelle bat	
	<i>Canis lupus</i>		Wolf	
	<i>Dinaromys bogdanovi</i>		Martino's vole	
	<i>Lynx lynx</i>		Lynx	
	<i>Myotis myotis</i>		Greater mouse-eared bat	
	<i>Nyctalus leisleri</i>		Lesser noctule	
	<i>Plecotus macrobullaris</i>		Alpine long-eared bat	
	<i>Rhinolophus ferrumequinum</i>		Greater horseshoe bat	
	<i>Rhinolophus hipposideros</i>		Lesser horseshoe bat	
	<i>Ursus arctos</i>		Brown bear	
	<i>Vipera ursinii macrops</i>		Meadow viper	
	<i>Telestes (Phoxinellus) croaticus</i>		Croatian ray-finned fish	
	<i>Erebia medusa</i>		Woodland ringlet	
	<i>Maculinea arion</i>		Large blue	
	<i>Parnassius apollo</i>		Apollo	
	<i>Thymelicus acteon</i>		Lulworth skipper	
	<i>Aquilegia kitaibelii</i>		Kitaibel's columbine	
	<i>Arabis scopoliana</i>		Scopoli's rock cress	
	<i>Cerastium dinaricum</i>		Dinaric chickweed	
	<i>Cypripedium calceolus</i>		Lady's slipper	
	<i>Degenia velebitica</i>		Velebit degenia	
	<i>Eleocharis carniolica</i>		Carniolan spike rush	
	<i>Eryngium alpinum</i>		Alpine sea holly	
			other wild taxa endangered at the European or national level	

Conservation objectives	habitat types			
	NHC code	NHC habitat	Natura 2000 code	Habitat type
Conservation objectives			4060	Alpine and boreal heaths
			5210	Mediterranean maquis dominated by juniper (<i>Juniperus spp.</i>)
			6110*	Open xerothermophilous pioneer communities on carbonate rocky soil
			6170	Alpine and subalpine limestone meadows
			62A0	Eastern sub-Mediterranean dry meadows (<i>Scorzonera villosae</i>)
			8210	Carbonate rock with chasmophyte vegetation
	B.2.1.	Mountain, sub-alpine and alpine gullies	8120	
	B.2.2.	Illyrian/Adriatic littoral gullies	8120	
	C.3.4.2.1.	Mat-grass meadows	6230*	
	C.4.1.	Mountain turfs		
	D.2.1.	Sub-alpine dwarf pine brush		
	D.2.1.1.1.	Dwarf pine and honeysuckle community		
	E.4.6.3.	Illyrian coastal beech forests forest with autumnal moor grass	91K0	
	E.5.2.1.	Dinaric beech-fir forest	91K0	
	E.6.1.1.	Subalpine beech forests with alpine buttercup	91K0	
	E.7.3.3.	Subalpine spruce forest with <i>Adenostyles</i>	9410	
	E.7.4.	Scots and black pine forest on dolomites	91R0	
	H.1.	Karst caves and pit-caves	8310	

Tab. 21. Internationally important areas for birds in the National Ecological Network in Paklenica National Park.

Area code	HR1000022 #	
Area designation	Velebit	
Conservation objectives	wild taxa	
	species	English name
	<i>Aegolius funereus</i>	Boreal owl
	<i>Alectoris graeca</i>	Rock partridge
	<i>Anthus campestris</i>	Tawny pipit
	<i>Aquila chrysaetos</i>	Golden eagle
	<i>Bonasa bonasia</i>	Grouse
	<i>Bubo bubo</i>	Eagle owl
	<i>Circaetus gallicus</i>	Short-toed eagle
	<i>Dendrocopos leucotos</i>	White-backed woodpecker
	<i>Dryocopus martius</i>	Black woodpecker
	<i>Emberiza hortulana</i>	Ortolan's bunting
	<i>Falco peregrinus</i>	Peregrine falcon
	<i>Glaucidium passerinum</i>	Pygmy owl
	<i>Lanius collurio</i>	Red-backed shrike
	<i>Pernis apivorus</i>	Honey buzzard
	<i>Phylloscopus bonelli</i>	Bonelli's warbler
	<i>Picoides tridactylus</i>	Three-toed woodpecker
	<i>Strix uralensis</i>	Ural owl
	<i>Tetrao urogallus</i>	Capercaillie

6.5. Appendix 5: Results of consultations with stakeholders

Three groups of topics or suggestions have been identified:

1. can be incorporated into Management Plan
2. requires additional study
3. cannot be incorporated into Management Plan but the responsible authority will be informed

Stakeholder	Issue or proposal	Management Actions	Responsible authorities	Stakeholder
ECO-Zadar, NGO	Local partner for green telephone (illegal logging inside the Park, although it was actually outside; illegal waste dumps, outside the Park)	1	Improve and institutionalize future cooperation	Paklenica NP Public Institution, NGOs
	Joint educational activities in local and regional schools	1,2	Foresee possibilities of joint educational activities	Paklenica NP Public Institution, NGOs, local and regional schools
	Promotion of environmental products (tied more to Velebit Nature Park)	2	Sale of local products in shops and information points in the Park	Paklenica National Park and Velebit Nature Park Public Institutions, NGOs
	Complaints that they pay fees when entering the Park.	3	Local residents admitted free of charge; NGO is based in Zadar. Do not pay fees when entering on business	
Paklenica Mountain Club, Zadar	Sound cooperation with Park, use of pack horses to supply the mountain lodge, etc.	1	Improve and institutionalize future cooperation	Paklenica NP Public Institution
	Educated mountain guides can be used for the needs of the Park and visitors	1	Study potential and offer it to visitors	Paklenica NP Public Institution, Paklenica Mountain Club
	Renovation plan for mountain lodge	2, 3	Park does not own the building and cannot legally invest in the property of others. Assistance in securing funds is possible.	Paklenica NP Public Institution, Paklenica Mountain Club
	Maintenance of trails and paths	1	Trails already well marked and maintained in joint actions. These activities continue every year	Paklenica NP Public Institution, Paklenica Mountain Club
Zadar County Nature Protection Institution	Existing bird-watching posts on Pag should be joined in a single package for birdwatchers together with Paklenica National Park	1, 2	Improve and institutionalize future cooperation, "birdwatchers" are largely already aware of existing package	Paklenica NP Public Institution, Tourism sector

Stakeholder	Issue or proposal	Management Actions	Responsible authorities	Stakeholder
Zadar County Physical Planning Department	Physical Plan already valid to 2011	1	Needs with reference to the Physical Plan must be incorporated into the Management Plan, regular information and proposal for amendments to the Physical Plan	Paklenica NP Public Institution, Zadar County Physical Planning Department
	Road construction criticized but accepted by everyone after a wildfire	1,3	Formally legalize the existing road through Starigrad-Paklenica Municipality Physical Plan	Paklenica NP Public Institution, Zadar County Physical Planning Department, Starigrad-Paklenica Municipality
	Quality data on the cultural heritage were not available during development of Paklenica National Park Physical Plan	1, 2	Continue and enhance research into the cultural heritage	Paklenica NP Public Institution, Zadar County Physical Planning Department, Zadar Museum
Local tourism boards	Manita Peć should be opened longer	1	A management plan for Manita Peć is already being developed which will determine the maximum carrying capacity and working hours	Paklenica NP Public Institution
	Local population not sensitive to existing natural and cultural value. Require education on tourism package	1	Organize lectures, information days and excursions, generally during winter	Paklenica NP Public Institution, Tourism boards, municipalities, local schools
	No climbing school or equipment rental	3	There is a shop with limited equipment rentals. Park will support activities in this line but will not take the lead.	Private businesses
	Ethno-settlement a good pilot project	1	The Center should be opened in 2007 and continually grow	Paklenica NP Public Institution
	Area around Park lacks comprehensive image. The Park should have joint marketing activities with the surrounding region	1	The Park is now already a recognizable driver of the region's tourism, joint activities in the vein are continuing	Paklenica NP Public Institution, Tourism boards
Hotel Alan (450 beds + camp)	Sound cooperation with the Park	1	Improve and institutionalize future cooperation	Paklenica NP Public Institution, Hotel management
	Complaints from guests on the quality of the mountain lodge	3	The Park will, in cooperation with mountain clubs, attempt to improve services and help in finding potential sponsors for the lodge	Paklenica NP Public Institution, Mountain Club
	Lectures on the Park for hotel guests	1	Already operational since 2006	Paklenica NP Public Institution, Hotel management
	Wastewater treatment installation for the hotel will be complete in 2007. The Park may include its camp but only with financial assistance in construction	2	The Park will look into legal and financial possibilities	Paklenica NP Public Institution

Stakeholder	Issue or proposal	Management Actions	Responsible authorities	Stakeholder
Hotel Vicko	More notifications from the Park on its plans	1	Improve and institutionalize future cooperation	Paklenica NP Public Institution, Hotel management
	Low level of quality sanitary services in the Park	1, 2	Improve the Park's environmentally-friendly sanitary services	Paklenica NP Public Institution
	Poor information points and deficient information materials	1, 2	Improve information in the Park and its environs	Paklenica NP Public Institution
	Contract with U.S. travel agency to bring 150 buses of elderly tourists for lunch each year. The Park has no adequate package for short visits by these type of tourists, so after lunch they move on.	1	Difficult access in the Park for the elderly and disabled will be addressed by an action plan. The new visitor center at the "bunkers" will have disabled access and will be usable by such visitors	Paklenica NP Public Institution
	Inadequate package for school field-trips	1	Develop and conduct specific programs for schools for various ages based on existing school curricula	Paklenica NP Public Institution
Starigrad-Paklenica Municipality	Local population is under impression that the National Park impedes development	1	Organize lectures, information days and excursions, generally during winter	Paklenica NP Public Institution
	The Park should be the driver of development	3	As a Public Institution, the Park cannot initiate nor conduct developmental activities outside of its regular activities. Any form of cooperation will be endorsed	
	The Park should work on raising general environmental awareness among the local population	1	Organize lectures, information days and excursions, generally during winter	Paklenica NP Public Institution, Tourism boards, municipalities, local schools
	Joint projects involving the Park, municipalities, tourism boards, etc., organization of additional seasonal medical assistance	1	The Park is already one of the region's leading factors and joint activities will continue	Paklenica NP Public Institution, Tourism boards, municipalities,
Lovinac Municipality	Development of ski slopes at Dušica, possible entry location for Paklenica National Park	2	Dušica is outside the Park, but development of this type may impact the Park. A quality environmental impact study is needed	Paklenica NP Public Institution, Velebit Nature Park, state institutions
Surrounding hunting zones	Poaching reduced as a result of enhanced supervision by all stakeholders	1	Introduction of joint supervision of poaching with parks (Paklenica National Park and Velebit Nature Park)	Paklenica NP Public Institution, Velebit Nature Park, hunting associations and hunting concessionaires
	Pond maintained by local hunters used as watering areas for sheep	3	Intense discussions with individuals and users of the area. Watering sites are outside of the Park's boundaries.	Velebit Nature Park Public Institution, landowners and livestock breeders
	Possibility of organizing alternative programs, e.g. photo-safaris, bear-watching, song-birds living on cliffsides	1	Jointly develop and conduct programs for various interested visitor groups	Paklenica NP Public Institution, Velebit Nature Park, hunting associations and hunting concessionaires

The peaks of Paklenica National Park.



N a t i o n a l P a r k

Paklenica

A C T I O N P L A N S



Starigrad-Paklenica, August 2007



The first chamber in Manita Peć Cave.

Manita Peć Cave

NATIONAL PARK

Paklenica

ACTION PLAN



Starigrad-Paklenica, August 2007



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1. Introduction

1.1. Subterranean karst phenomena in Paklenica National Park

Paklenica National Parks is one of the oldest national parks in Croatia. It is located in an exceptionally karst coastal area, functioning as a natural link between the most beautiful Croatian mountain, Velebit, and the Adriatic Sea. It is notable for its attractive surface forms, ranging from numerous tiny details covered with karrens and solution pans to the grandiose Velika Paklenica and Mala Paklenica Canyons and wooded highlands. The Park's typical karst geomorphological traits, formed by millennia of interaction between water and rocks, are reflected in its subterranean zone as well, with its numerous cavities, i.e. caves and pit-caves.

79 speleological sites (Kuhta, Gužvica & Jalžić, 2002; Kuhta, 2004, 2006) were recorded in the territory of the Paklenica National Park through systematic analysis of existing documentation and detailed field explorations over the past fifteen years. All the gathered data were systematically processed and organized in a speleological site database which constitutes the foundation of speleological GIS of Paklenica National Park (Kuhta & Singer, 2004). The completed speleological and IT processing has currently generated the most complete outline of speleological problems in any area of the Republic of Croatia. Besides their direct contribution to better knowledge of the Park's fundamental values and opening possibilities for their presentation under the highest standards, the completed research constitutes a contribution to management of the entire protected natural system and an exceptionally valuable platform for all future research.

Given the type of speleological sites, it can be said that caves and pit-caves are equally represented in the Park. Out of the aforementioned number, 42, or 53%, are pit-caves, and the remaining 37, i.e. 47%, are caves or mostly horizontal phenomena. Considering their dimensions, smaller sites prevail, i.e. those shallower and shorter than 50 m. There are 55 of such phenomena, i.e. 70% of those explored. 23 (29%) are mid-sized sites, with depths or lengths ranging from 50 m to 500 m. Among these, pit-caves predominate: there are 16 of them (70%). There is only one sites in the group of large speleological phenomena, those longer or deeper than 500 m: *Ponor na Bunjevcu* ('Bunjevac Abyss'), explored to a depth of 534 m, which is also the deepest speleological sites in the central and southern part of Velebit (Čepelak, 1980).

Based on a preliminary evaluation of researched speleological sites (Kuhta, Gužvica & Jalžić 2002), it can be concluded that some are extremely valuable from the archaeological, paleontological, biospeleological, tourism and ethnographic standpoints, and that they certainly increase the National Park's basic value.

- In archaeological terms, the Pećina u Pazjanicama ('Cave in Pazjanice') stands out, as fragments of Nakovanj and Ljubljana culture pottery dating to the Eneolithic and Early Bronze Age were found there. This cave is the first established prehistoric site in the area.
- Cave bear skulls taken from pit-cave Jama u Zubu Buljme can be deemed a valuable paleontological discovery. However, in this aspect the cave Špilja u Zubu Buljme certainly has even greater potential. Preliminary test digs conducted during explorations in 2001 showed this to be a very prospective paleontological site.
- A wealth of subterranean animal species live in a considerable number of these explored speleological sites. According to research conducted so far, there are 60 taxa in the Park's caves, including 28 taxa adapted to subterranean habitats. It is worth noting that that 6 taxa have been described precisely based on discoveries made in the Park.



- Some of the smaller sites like caves Babunjuša, Špilja kod Kneževića, Mokraća, Krumpirova špilja, Marasovića špilja and Škiljića stan are ethnographically significant. In the past these caves were used as shelters for livestock and to store goods. They also testify to centuries of connections between people and the karst environment in which they once lived.
- Although there are several locations in the National Park which may be very interesting as tourist attractions (Jama Vodarica, Sklop IV), the only sites used for this purpose is Manita Peć cave.

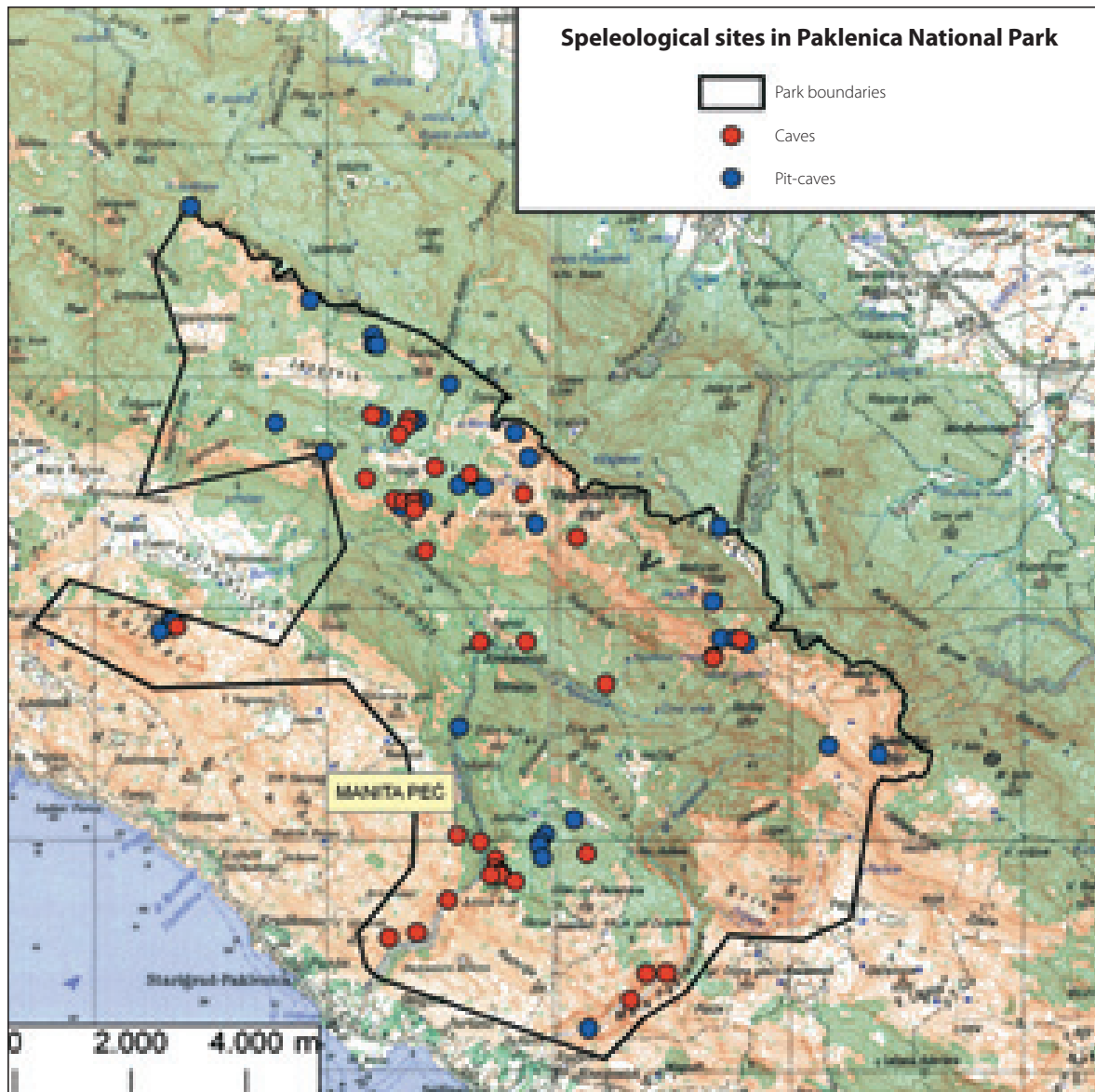


Fig. 1: Known speleological sites in Paklenica National Park

1.2. Manita Peć as a part of Paklenica National Park

Speleological phenomena are among the peculiarities of karst areas, including Paklenica National Park. Hidden in deep rock massifs, they are specific aesthetic and morphological environments, thus arousing great interest among nature lovers. These subterranean places facilitate a direct view into the fundamental processes involved in the formation of the karst relief, and they are therefore extremely educational in addition to providing an emotional and aesthetic experience.

Even though its length of 175 m places Manita Peć in the group of shorter speleological sites, the shape of its underground chambers and the sheer number and variety of cave decorations have long aroused public interest. The first tours under acetylene torches were organized as early as in 1937. It is unquestionable that Manita Peć is one of the more significant natural treasures of Paklenica National Park, since it significantly contributes to its geomorphological and biological diversity. Situated in the recreation and tourism infrastructure zone, the cave attracts a large number of visitors.

Since it is usually impossible to go underground without knowledge of special skills and additional equipment, accessibility to the visitors is facilitated through technical interventions which usually mean the construction of paths and installation of artificial lights. On the other hand, speleological sites are specific and very sensitive habitats. Their inappropriate use could reduce the number and variety of the subterranean species.

1.3. A vision for Manita Peć

The framework for defining the vision of Manita Peć cave as the fundamental guideline for defining objectives, protection, development and management of this valuable natural phenomenon is definitely the vision of Paklenica National Park as a whole is defined in the Management Plan. Besides coordination with the guidelines set forth in the National Park's vision statement, all management activities pertaining to the cave must comply with the following facts:

- Manita Peć is a unique representative of the wealth of subterranean karst phenomena in the Park, and its fundamental attributes are subterranean geomorphology and the number, dimensions and diversity of cave decorations (speleothems);
- The cave has an important tourism-recreational and educational function and it also contributes to the variety of the Park tourism product;
- Manita Peć is an extremely valuable habitat in which numerous species of subterranean fauna have been registered. The cave is a type location for 4 taxa which are all Croatian endemic species.

Manita Peć is a cave set up for tourism. The priority in its use must be accorded to protection of its geomorphological value and species diversity.

The vision statement represents the fundamental framework for management and developmental decision-making tied to the cave and all activities must lead to its achievement. In order to bring this vision to fruition, the following long-term objectives have been ascertained concerning cave management:



- Protection and preservation of a subterranean habitat and enabling undisturbed development of natural processes;
- Ensuring access to an authentic experience of the natural value of the cave to visitors;
- Collection of the data necessary to determine the cave's carrying capacity and further study and monitoring of microclimatic conditions and processes of its genesis, as well as biospeleological research;
- Improving the cave's infrastructure with minimum interventions in the natural environment;
- Improving the educational and recreational aspect of visits to the cave.

2. History of the Cave

Some of the caves in the territory of Paklenica National Park have been known to local people for a long time. Pottery and bone fragments found in Pečina u Pazjanicama (Forenbaher and Vranjican, 1982) indicate occasional stays by people as early as the Eneolithic and Bronze Age. The remains of a supporting wall and farm buildings at the entrances to several caves clearly indicate the use of caves as occasional shelters for agricultural goods and livestock until a few decades ago. Furthermore, it is known that accumulations of seepage water in some caves like Jama Vodarica or Kapljarka were precious sources of potable water during summer droughts. One can also assume that long before the first explorers entered them; some caves were entered by bolder individuals trying to satisfy their curiosity. However, their tours usually led to the wrong conclusions on the length and features of subterranean areas. Such individual probably visited Manita Peć, though there are no written records of this.

According to written records, biologists were the first to explore Manita Peć and many other sites in the Park as well. The first person to visit the cave was A. Gobanz in 1900. On that occasion, he collected beetle of the species *Typhlotrechus bilimeki likanensis*. After him, the cave was visited in 1906 by entomologists from Zadar, first Müller, and then Petar Novak, the members of the then Liburnija Mountaineering Tourism Club from Zadar (Golf, 1929). In subsequent years, Manita Peć was visited by other explorers, such as Deeleman, Freude, Drioli, Drovenik, Redenšek, Pretner, Bole and others, who collected biological materials.

The first classical, documented speleological exploration of Manita Peć was performed in April 1929 by Đuro Ružić and a certain Mr. Parović from the Velebit Croatian Mountaineering Club at Sušak. It is interesting that they were encouraged to do so by information from a German tourist guide of Dalmatia published in 1928, in which it states that this cave is 10 km long. They published the results of their exploration in the journal *Hrvatski planinar* (Ružić, 1929). During their tour they took several very successful photos and the cave's length was estimated at 300 meters.

Only a few months after this, caves in the Velika Paklenica area were explored by geologist J. Poljak with the cooperation of F. Šuklje. On this occasion, the first topographic draft of Manita Peć (Fig. 2) and some other caves were made. The results of these explorations were published in scholarly and popular periodicals (Poljak, 1929 a,b,c,d). Besides detailed descriptions of the morphology of these sites, their basic geological, hydrogeological and microclimatic features were also shown. Furthermore, based on terrain observations, the author discussed the age of these sites and their genesis as well.

Since the aforementioned works were accompanied by a series of successful photographs and published in frequently-consulted sources, they surely contributed to increased public interest in these sites. Thus, in 1935 a hike was made all the way to the entrance to Manita Peć (Premužić), while in 1937 stairs and path

were made in the cave as well as a new (artificial) entrance. There were plans to introducing electrical lighting even in then to enable visitors to see the entire cave area, since this was not possible with the acetylene torches used by the first guides. For this purpose, a concrete base was made in the entrance chamber on its left side, intended for an electrical generator that was never installed. The interventions made then still constitute the cave's basic infrastructure to this day.

Visits to the cave mainly organized by mountaineers from Zadar ceased during World War II and the postwar period. In its prewar condition, the cave "witnessed" the establishment of Paklenica National Park, and was thus placed under legal protection on October 19, 1949. In order to protect the cave from unconscientious visitors, in 1970 the National Park's management protected the main south entrance with a gate and the northern entrance with a metal grid.

Subsequent speleological research was conducted in the 1950s for the needs of the Croatian Conservation Institute. In 1954, V. Redenšek explored the Park. While gathering subterranean animal species, he also visited Manita Peć. Three years later, i.e. in 1957, the Velika Paklenica area was explored by members of the Speleology Section of the Velebit University Mountaineering Club headed by S. Božičević. On this occasion, they produced a new topographic outline of the cave (Fig. 3) which is still in use today. The results of this research were published in several scholarly and popular works (Božičević, 1957, 1958 a, b, 1965).



Fig. 2: The first topographic outline of Manita Peč, the best known speleological site in Paklenica National Park. (Taken from Poljak, 1929 b).

Since 1960s, interest in Paklenica has grown, particularly with the growth of alpine climbing. The cliff known as Anića Kuk became famous even outside the country. The number of Park visitors grew rapidly with the development of tourism in general. Since a growing number of visitors started expressing their wish to visit Manita Peć, the management organized occasional guided tours through the cave using acetylene torches and also flashlights. Visitors could admire its beauty, and photos of Manita Peć became a mandatory part of all promotional materials for Paklenica National Park. The number of visitors is still growing.

In 1988, Paklenica National Park's Governing Board decided to illuminate the cave. Thus, a technical solution was commissioned on the basis of the cave infrastructure's existing condition and 4 kW diesel generator to power the lighting.

In 1990, the Željezničar Speleology Club from Zagreb was contracted to install fixed lighting based on the Technical Solution (Fantov, 1988), and to undertake the necessary conservation works in compliance with the protection required by a geomorphological natural monument.

During the audit of the Technical Solution (Posarić and Borovec, 1990) all in accordance with principles of ecologic engineering (Cigna and Forti 1989; Posarić 1990, 1992), the investor was suggested to measure the found cave state, budget of ecologically endurable capacity, the corrosion type and the project of ecologic-protective and exploitation measures. However, finances did not allow this to happen. The solution implemented was cheaper but less precise. Thus, based on experience from earlier works (Posarić et al., 1988; Posarić, 1988, 1989) and with previously determined parameters, the estimate of crypto-climatic and luminous traits, the corrosion type and ecologic tolerances of the object was made.

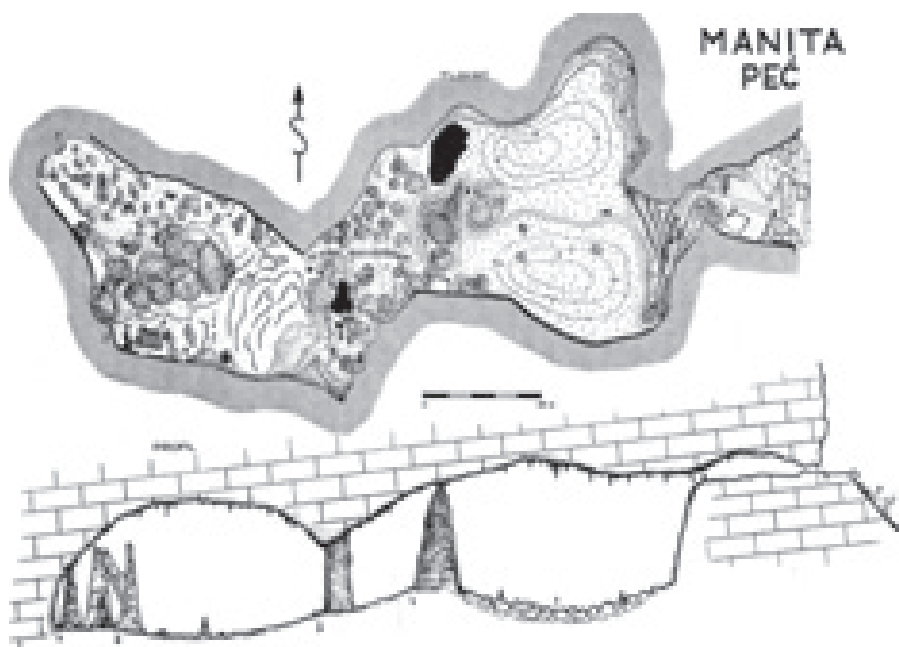


Fig. 3: Topographic outline of Manita Peć drafted during research in 1957 (Taken from Božičević, 1965).

During an audit of the Technical Solution (Posarić & Borovec, 1990), the investor was advised, in compliance with the principles of environmental engineering (Cigna and Forti 1989; Posarić 1990, 1992), to measure the cave's existing condition, estimate the environmental carrying capacity and corrosion type and draft a project of eco-protective and exploitation measures, but the funds to do so were lacking at the time. Instead, a less expensive but also less precise solution was adopted, based on experiences gained in previous work (Posarić et al., 1988; Posarić, 1988, 1989) and on previously determined parameters, and the crypto-climatic and illumination features, corrosion type and ecological tolerance of the site were estimated.

The second part of the terms of reference pertained to the energy facility at the cave's entrance, which was supposed to meet the power conditions of a generator, aesthetic/location requirements and site protection. The design was developed by Ivan Borovec (construction and power supply project) and Juraj Posarić (accommodation and protection). The National Park's staff built a small house and fuel magazine in November and December 1990. At the same time, certain insufficiencies along the tourist trail were corrected and fences and handrails were fixed up to particular sections.

In January 1991, the members of the Željezničar Speleology Club installed permanent electrical lights in Manita Peć, conducted power supply tests, electrical and illumination measurements and turned the facility over to client. The war in Croatia prevented monitoring of events and additional works on use and protection support in Manita Peć. Once the danger of direct hostilities passed, the cave was put into function.

In July 2007, electrical installations in the cave were fully reconstructed, and sunlight was used as the principal energy source. Photovoltaic panels were installed north of the cave's entrance, while a diesel generator is used as a reserve energy source. Solar lighting produced exemplary results already in the first season, because there was no need to even resort to the reserve option (diesel generator).

3. Current status and value

3.1. Location and access

Manita Peć is situated northwest of Anića Luka on the western side of Velika Paklenica Canyon. The cave is inscribed in the topographic map M 1:25 000, Velika Paklenica sheet. The entry coordinates are the following:

x 4 908 090

y 5 538 230

z 570 m n.m.

Access to the cave runs along an approximately 2.2 km long paved road from the National Park entrance to the parking lot. From that point, visitors hike on a trail to Borisov dom. In its first part, the trail passes along the bed of a torrent gully, pressed between immense rocks, some as high as 400 meters. This is the most magnificent part of Velika Paklenica Canyon. Reaching an altitude of 250 m above sea level below Anića Kuk, the biggest cliff on Velebit, the ravine widens into a small level field called Anića Luka. It is a roughly ten minute walk to the diverging path for Manita Peć. In a number of bends, the trail ascends to the tower called Zub od Manite peći and continues to the viewpoint and entrance to cave Manita Peć at an elevation of approximately 570.



Fig. 4: Location of Manita Peć

The trail going from the parking lot to the cave's entrance is about 3 km long, and the hike takes approximately an hour and a half due to an ascent of almost 500 m.

According to the zoning of the National Park under the Management Plan, Manita Peć is in the recreation and tourism infrastructure zone.

3.2. Climate

Sub-Mediterranean, continental and alpine climatic conditions meet in the territory of Paklenica National Park, and a diversity of microclimatic conditions exist here due to its complex relief, i.e. differing elevations, gradients and exposures.

Climatic measurements in the Park are currently not conducted, but up to 1991 there was a rain-gauge station in Parići. Based on measurements from the closest weather station in Starigrad-Paklenica, the warmest month is August, with an average temperature of 27.2 °C, while February is the coldest with an average temperature of 7.46°C. Temperature values drop as one moves away from the coast, so the average monthly temperature at Velebit's peak zones can be even 15° C lower than temperatures at the sea.

Due to the exposure of the southern part of Velebit to southwestern moist air flows from the sea, abundant orographic precipitation is created. The smallest quantity of precipitation on the coast is approximately 1,200 mm/year, while as the altitude increases the quantity of precipitation grows as well – to 2,000 mm at 900 m and 3,500 mm at highest elevations (e.g. Vaganski vrh). In the peak zones, snow is a significant constituent of precipitation.

Due to the relatively low elevation of Manita Peć, snow is rare around the cave and on its access trails, and does not stay on the ground long, thus enabling access to the cave throughout the year. Since it is situated on the canyon's flank, the area around the cave is frequently exposed to wind and particularly strong gusts of bora winds. Wind, as precipitation, is more frequent during winters.

Crypto-climatic data on the cave itself are extremely meager. Recent measurements show that the interior of the cave has stable climatic conditions. Air temperatures range from 8.6 to 8.8°C. Water temperature in ponds is approximately 1°C lower. The air flow is distinctive only at the cave's entrance as a consequence of a pneumatic link to the site's ceiling through an unknown shaft and external winds. There is no air flow in the deeper parts of the cave.

3.3. Landscape

The territory of Paklenica National Park, with an extreme diversity of geomorphological shapes, is naturally the most attractive and the most valuable part of southern Velebit. The most prominent relief forms in the Park are Velika Paklenica and Mala Paklenica Canyons.

The access trail to Manita Peć allows visitors to see the most attractive part of Velika Paklenica Canyon. In the first part, the trail passes through the narrowest section, pressed between rocks that reach heights of up to 400 meters. Through the most of the year, the experience is greatly intensified by the roar of water next to stream running through Paklenica, which cascades into waterfalls. Upon reaching Anića Luka, there is a magnificent view of Anića Kuk, the highest (400 m) cliff in Croatia.

The trail to the cave passes under the impressive 80 m high rocky tower called Zub od Manite peći ('Tooth of Manita Peć'). The path offers a panoramic view of Anića Kuk, Jurasova glavica, the upper section of the canyon and peaks of Velebit.

Walking along the access trail, visitors can observe this scarcely passable and inaccessible karst area with its many steep cliffs.

3.4. Description of the Cave

Although based on its dimensions and the volume of underground space, Manita Peć is a significant speleological site, it is characterized by a simple morphological structure. The cave has two entrances which are roughly 8 m apart and are situated in the niche of the vertical rock above the cave. The main entrance, which is currently used by visitors, is 2 m high and a meter wide. The northern entrance is 2 m wide and 1.3 m high. There is a small stone hut directly in front of the main entrance, where the generator supplying electricity for the cave's lighting is situated.

The entrance to the cave is 25 m long, from 7 to 18 m wide, with a maximum height of 5 m. This part of the cave is morphologically different than the remaining underground area, which is reflected by its position and the lack of development of more significant dripstone sediments.

The cave continues after an approximately 20 m steep and partly entirely vertical drop. A very likely unique subterranean space in terms of formation is divided into several more or less separate units through additional intense dripstone formation. The first chamber is approximately 40 m long, while its width extends as far as 65 m. With a ceiling reaching heights of 32 m in its central section, this chamber is a very impressive subterranean area, which is very abundantly decorated with cave sediments at places. On its western side, there is a large dripstone column which is surely one of the most impressive views (Photo 1).

The westward leaning steep section of the subterranean channel can be considered the cave's central part. Although approximately 25 m wide, the space is covered by numerous dripstone sediments, some



Photo. 1: A group of tourists at the large column in the cave's central section (photograph by M. Kuhta)

of which are up to 20 m high, forming a labyrinth of smaller passages at their bottom. Descending along mostly dripstone blocks, one reaches the cave's lowest point.

The cave's final area is approximately 60 m long and 40 m wide. In its initial portion, there is a chamber with a diameter of 28 m, ranging from 25 to 30 m in height. The cave's floor is mostly covered with dried rimstone pools up to 75 cm deep, while all of the rock is covered with thick dripstones. Particularly impressive is over 10 m high flowstone called "The Pipe Organ" (*Orgulje* – Photo 2), which covers the eastern part of the rock, and its continuation, approximately 25 m high, on the southwestern rock. The tourist trail through the cave ends in this point.

The formerly unified subterranean space farther on is divided by a group of large stalagmites about 90 m in perimeter into two apparently separate channels. The first continues to the western side of this chamber and is 20 m long and between 5 and 10 m wide. Here there are stalagmites reaching heights of 18 m, and particularly interesting is a broken and leaned dripstone pillar 1.5 m thick. The entrance into the second channel is on the southwestern side of the chamber and is somewhat less than 50 m long, with a maximum width of roughly 20 m. The channel gradually ascends along intense dripstone blocks. At its final section, which is also the end of the cave, there are very interesting stalagmites. Their peaks are almost flat as a consequence of the conditions under which they were formed. At this point, water drips through from a height of almost 20 m, spreading widely in contact with the base, which results in equally fast growth of stalagmites in the entire width of dispersion. Besides these stalagmites, the thin curtains extending from the approximately 20 m high ceiling on the final northwest rock of the channel are particularly beautiful. This part of the cave is not open to visitors.

The cave's length measured along the line of the recorded profile (Fig. 3) is 175 m, while the difference in height between the level of the opening and the lowest point in the cave is approximately 35 m. Its basic fundamental morphological value lies in the dimensions of the underground area and the monumentality, number and diversity of calcite decorations. Although the total length of Manita Peć is relatively small, in speleological circles this cave is considered one of the most beautiful in Croatia. Besides the strong aesthetic impression it leaves on visitors, the cave's interior is an ideal place to explain and demonstrate the process of karst phenomena creation. Education should thus be considered one of the important elements of presentation.

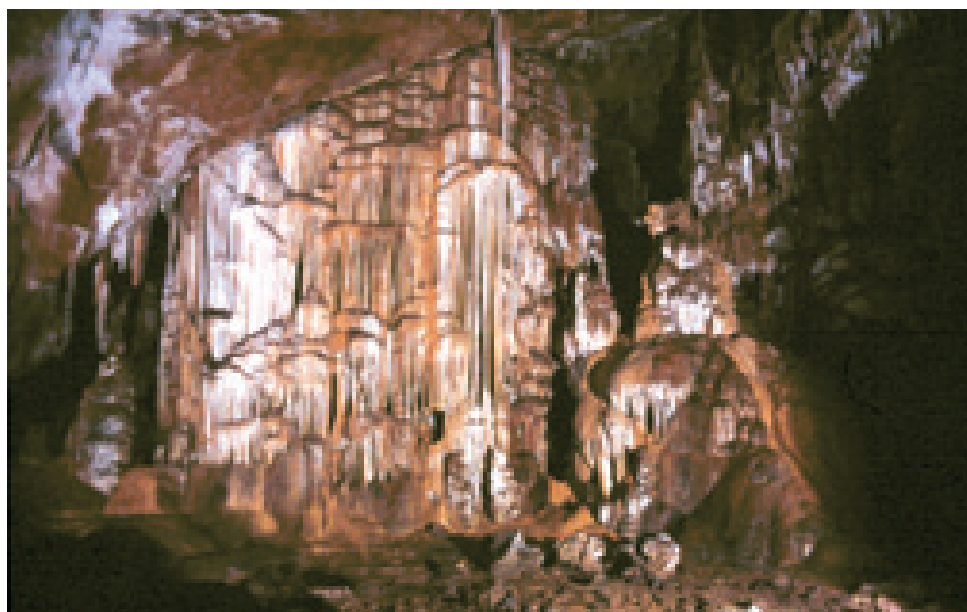


Photo. 2: Calcite flowstone at the end of the tourist section of the cave known as "The Pipe Organ" (photograph by M. Kuhta)

3.5. Geological and hydrological features

Manita Peć is formed in thickly layered, light gray limestone from the Middle Jurassic (Dogger, J_2), alongside their gradual transition to limestone from the Late Jurassic (Malm, J_3). The geological layout map of the wider area of Manita Peć is shown in Fig. 5. Limestone layers lean in a northwesterly direction at an angle of 40° to 50° and are situated on the southwestern wing of the secondary fragmented anticline structure of Velika Paklenica. Tectonic fragmentation of rocks is quite visible in the cave itself. Besides layered surfaces, systems of tectonic crevices that generally extend from northwest/southeast and northeast/southwest, significantly influencing the cave's formation. The floor of the cave is made of enormous, collapsed stone blocks and fragments, as well as calcite sediments that cover the stone blocks. Thinner accumulations of clayey sediments are present in the lowest parts of the cave.

From the hydrogeological standpoint, Manita Peć belongs to the group of dry speleological sites without recent hydrogeological functions. Even so, water constantly seeps into the cave. Although these waters get lost in the blocks and fragments covering the cave floor, the formation of small pools was possible at two by dripstone action. The today completely dried out, large rimstone pools at the end of the tourist section in the bottom of the cave indicate that significantly larger quantities of water drained into the cave in the recent past.

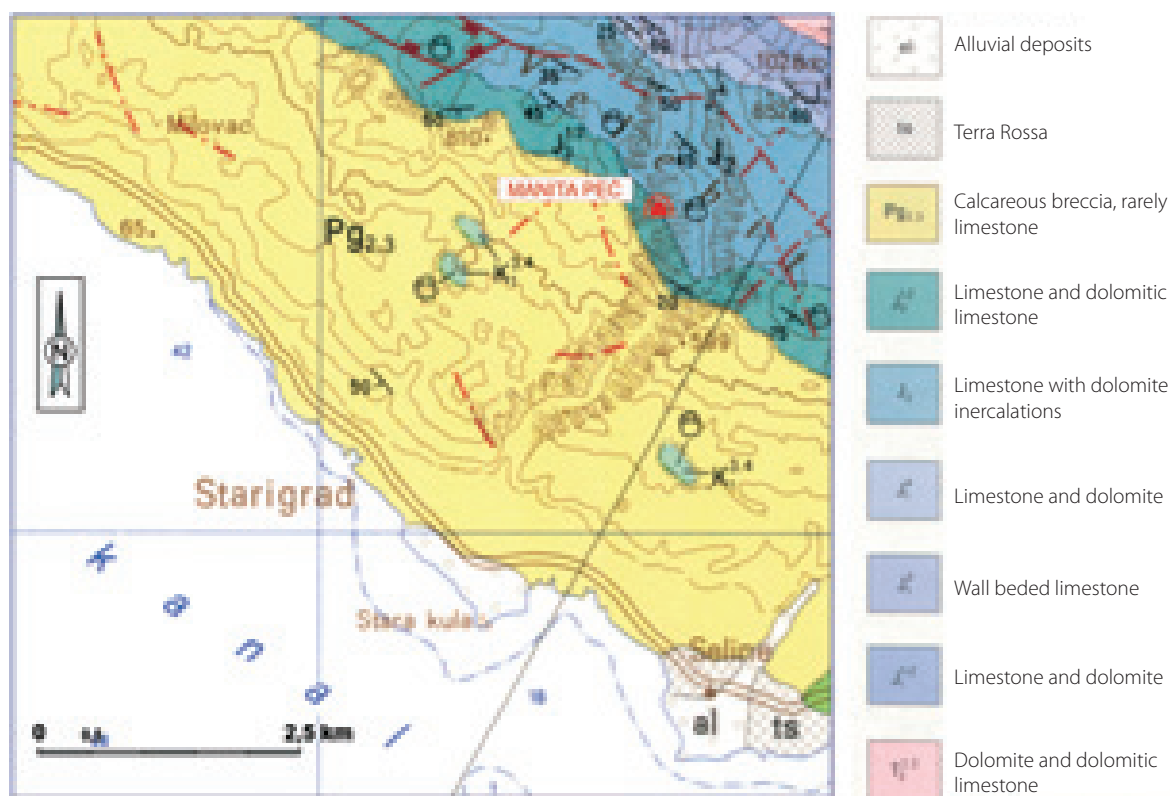


Fig. 5: Geological layout map of the wider Manita Peć area (based on Majcen et al., 1970)

Karstification, which creates and develops speleological phenomena (speleogenesis), is a complex process influenced by many factors, from the geological base and structural-tectonic conditions to climatic, hydrological, hydrogeological and other elements. However, the elementary conditions of speleogenesis are a soluble rock terrain composition, their tectonic fragmentation and water.

In the initial phase, corrosion processes play the most significant role, i.e. the chemical dissolution of rock. The underground action of water is predisposed with tectonic fractures created during endogen movement along which water penetrates from the surface of the terrain. Infiltrated water enriched with carbon monoxide from the air and ground as well as humus and other organic acids, dissolves walls of cracks making them gradually larger. The process is relatively slow, although with time the number and dimensions of certain cracks increases and they also interconnect, thus creating the conditions for slow flow, which encourages dissolving. With the additional widening of initial cracks, the flow becomes more intense and erosion gradually occurs.

In zones more suited or more subject to the advancement of these processes, a concentration of subterranean flows occurs, thus leading to the proper conditions for the main phase of cave creation. Due to the flow of large groundwater quantities, the principal role in subterranean formation is assumed by the process of fluvial erosion, whereby water, through its mechanical action, breaks and carries off fragments of rock, thus accelerating the widening of the underground channel. The final dimensions of the open area are conditioned by the duration of active circulation, water quantity and flow intensity, bedrock features and accompanying factors such as the mechanical effect of dragged deposits, etc. Judging by the dimensions of Manita Peć, the main phase of its development was very intense.

The late developmental phase of caves also occurs gradually with a decline in the water flow. In this phase, rocks settle and blocks collapse and sometimes even small-grained sediments accumulate. Furthermore, when these conditions are met, the late phase is characterized by intensive crystallization of cave decorations, which is clearly visible in Manita Peć. Determining the time of development of these phases with precision requires specialized testing, such as dating the absolute age of cave sediments.

3.6. Overview of fauna

The basic feature of subterranean karst (except the entrances) is a total absence of daylight, stable air temperatures and high humidity. Due to the absence of organic production, the subterranean habitats are rather harsh. However, in underground biotopes, living communities have been created (biocenosis) with numerous relict and endemic species of differing duration and origin. Subterranean habitats are among the least explored, thus enabling the almost daily discovery of new species with the fascinating ability to adjust to subterranean living conditions.

From section on the cave's history above indicated that it was first explored by biologists (A. Gobanz in 1900). 106 years have passed since then, and in this period the cave was visited and examined by other notable Croatian and world researchers. Mueller and Novak in 1906 and 1940 respectively, Deelman-Reinhold in 1963-1978, Freude and Pretner 1965, Jalžić 1973-1980, and lately Ozimec 1998/99, Vujčić-Karlo and Rađa in 1999-2002. Their discoveries indicate that Manita Peć is an extremely important and significant biospeleological site.

In 1963 and 1964, Robert P. Deelman and Crista L. Deelman-Reinhold collected a small aquatic isopod (*Crustacea: Isopoda aquatica: Asellidae*) a drip-water pool in Manita Peć. After a year of analysis, C. L. Deelman-Reinhold described these as the endemic subspecies *Proasellus coxalis lucifugus*. The holotype and other specimens have been stored in the collection of the Rijksmuseum van Natuurlijke Historie in Leiden, Netherlands (Deelman-Reinhold, 1965). In 1983 Crista L. Deelman-Reinhold also described an endemic species of spider, *Histopona egonpretneri*, from the Agelenidae family based on the materials she collected with Robert P. Deelman during several visits to the cave in the period from 1975 to 1978 (Deelman-Reinhold, 1983).

In 1989 Gordan S. Karaman described a new endemic species of a small underground amphipod (*Crustacea: Amphipoda: Bogidiellidae*) called *Bogidiella sketi* (Karaman, 1989). Only one specimen of this 1.9 mm large small crab was collected in the pools of Manita Peć by an unidentified Slovenian explorer, who gave it to biospeleologist Boris Sket in Ljubljana. Today it is not known where the species holotype is, and so far this discovery has not been confirmed.

In 1980, during collection of subterranean beetles, Branko Jalžić collected a specimen of a blind underground pseudoscorpion from the Chthoniidae family, which he stored in the collection of the Croatian Natural History Museum in Zagreb. Based on this specimen, P.M. Ćurčić described the new endemic species *Chthonius radjai* (Ćurčić, 1988). Once described, the holotype has remained in B. Ćurčić's collection in Belgrade and has yet to be returned to Croatia.

One can therefore conclude that Manita Peć is a type locality (*locus typicus*) for four species; the spider *Histopona egonpretneri*, the pseudoscorpion *Chthonius radjai*, the small aquatic isopod *Proasellus coxalis lucifugus* and the small amphypod *Bogidiella sketi*. These are all Velebit endemic species; *Chthonius radjai* was found at only one other site in Paklenica (Pisanica pit-cave), while the *Bogidiella sketi* was not registered anywhere else following the first discovery.

Besides these species, other species were also found in the cave, such as specimens of an endemic beetle (Coleoptera), *Typhlotrechus bilimeki likanensis* and *Leptodirus hochenwarti velebiticus*, as well as the centipedes (*Myriapoda: Diplopoda*) *Hassia likanum* and *Attemisis likana*. The subterranean spiders (*Aranea*) collected in the cave are the species *Stalita pretneri*, *Parastalita stygia* and a taxon of the Philodromidae family. Besides the pseudoscorpion *Chthonius radjai*, another species, *Neobisium stygium stygium*, was found. The species *Grylomorpha dalmatina* and *Troglophilus cavicola* (Jalžić, 1995; Ozimec, 1998, 2004; Vujčić-Karlo & Rađa, 2004) from the Orthoptera order were also discovered.

Based on all previous knowledge, a total of fourteen taxa of subterranean fauna live in Manita Peć. This fact indicates the need for further biospeleological research, organization of systematic monitoring and, most importantly, cave management that will ensure sustainability of these populations in terms of both quality and quantity. Management methods are especially important because subterranean ecosystems have a low ecological capacity and a low tolerance.



Photo. 3: *Typhlotrechus bilimeki* – an endemic subterranean beetle (Coleoptera) (photograph by R. Ozimec)

3.7. Existing cave infrastructure

3.7.1. Tourist trail

Tourist trail through the cave was made in 1937, when the current visitor entrance was widened by several meters. The total length of the trail is about 150 m - most of a concrete lane up to 1.4 m wide. At steep points in the cave - the vertical drop immediately after the entrance and the steep passage through the dripstones between the first and the second chamber - concrete stairs were made. The trail is adapted to the cave's morphology, made by partial incision into the floor, embanking and erection of small support walls made of stone from the cave itself. Although at the time of construction, too little care was accorded to preserving the natural state, the trail through Manita Peć has had a significantly lesser impact on the environment than a series of trails later made in other tourist caves.

During partial reconstruction of the trail done in 1990, a metal fence and handrails were installed. At the end of the tourist section, at the bottom of the second chamber, there is a metal structure above the floor itself made of galvanized profiles and a grid.

The concrete trail, stairs and handrails are in good condition and they enable easy and safe sightseeing in the cave.

3.7.2. Electrical installations

It was already mentioned that the cave was electrified in 1991. The works were done by the members of the Željezničar Speleology Club from Zagreb and Park employees. The technical solution under which works were implemented was developed by Juraj Posarić and Ivo Borovec (Posarić & Borovec, 1990; Posarić, 1995). The most recent reconstruction of the entire electrical network with lights was rendered in 2007. The project documentation was developed by experts from the Electrical Engineering and Computer Science Faculty in Zagreb, while the actual work was done by the employees of the firm Horvat d.o.o. from Zagreb.

Energy for lighting in Manita Peć is generated by photovoltaic panels installed at the cave's northern entrance, while a 5 kW diesel generator is used as a reserve source. The electricity generated by the photovoltaic panels is stored in a battery station at the very entrance to the cave. Dry batteries are used to prevent any possible pollution of the cave. The cave is thus illuminated in an environmentally friendly manner. The reserve generator is located in a "power hut" built in a niche next to the cave's entrance. It is made of local stone, and besides meeting all technical requirements its aesthetic appearance and position are acceptable. Environmental protection principles were observed by using special plaster and coating that reduce noise and vibrations (Chromofon, Chromosil impregnation, Vibrostop). Exhaust fumes are released cold below the access trails by a system of buried pipes. Fuel for the generator is stored in a natural niche, in a seal container (tank-van).

In order to avoid damaging the cave, electrical cables only installed under the man-made trails. The main principle was to lay cables and other installations on the bottom, out of sight, or in deeper shadows. Where this was not possible, i.e. where cables disturbed the view from the trail, cables were laid through loose sediments in the cave (rock fragments and clay). Although the total length of EPN type cable laid is 430 m, the cave was not damaged anywhere.

In selecting construction and installation materials, a high corrosion class 4 was assumed for the cave, so inert thermoplast and duraplast, silicones and polycarbonates were used, while galvanized bridges were

avoided. Wherever it was possible to do so, galvanic corrosion was halted by interstitial and surface isolation. "Vis" and "Cres" type lamps were used as light fixtures.

Switchboxes and light fixtures were installed on the surface with bolts and plastic anchors. The total 75 holes are 8-10 mm in diameter. If the entire installation was dismantled and the holes filled with clay, the damage done could scarcely be detected.

The works conducted give visitors maximum security; visitors are completely physically separated from power fixtures. The schematic for electrical installations rendered in Manita Peć are shown in Fig. 6.

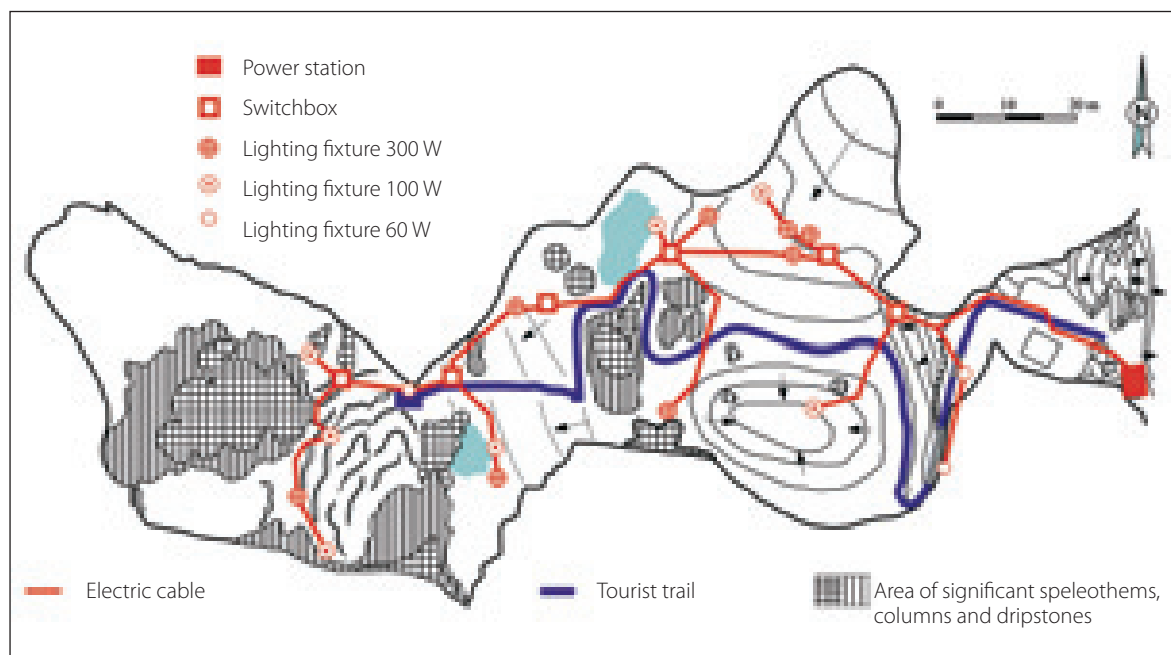


Fig. 6: Schematic for electrical installations in Manita Peć prior to reconstruction (based on Posarić & Borovec, 1990)

3.7.3. Lighting characteristics

Lighting reconstruction involved replacement of classical W-filament vacuum bulbs (efficiency: $\eta = 14$ lm/W) or fluorescent-tube (KFC) halogen lamps ($\eta = 25$ lm/W) with installed or separate electronic devices – EPN ($\eta = 84 - 100$ lm/W).

Lighting in the cave is classified as:

- General lighting at an average of 10 lx
- Scenic lighting of specific features at 80 lx
- Necessary lighting of trail at minimum of 1 lx

This reconstruction has secured better illumination of interesting details in the cave, increased the safety of movement for visitors, and also reduced energy input, thus reducing heat and all unwanted consequences that ensue due to heating of cave rock or air.

3.8. Number of visitors

Once the war in Croatia ended, the number of visitors to Paklenica National Park has grown constantly (Table 7, Fig. 7), so visits to Manita Peć have also grown.

Table 1. Number of visitors in Paklenica National Park, 1996-2005

Year	Total number of visitors to the National Park	Hikers	Climbers
1996	26,025	19,125	6,900
1997	35,550	25,750	9,800
1998	41,999	30,404	11,595
1999	41,851	30,677	11,174
2000	70,363	49,470	20,893
2001	86,737	59,916	26,821
2002	105,017	74,416	29,482
2003	102,183	55,850	33,958
2004	108,414	75,219	33,195
2005	113,920	79,404	34,522

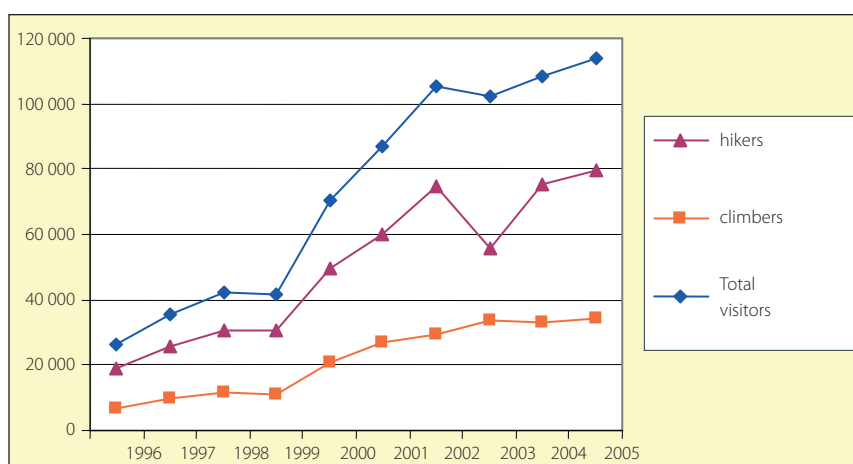


Fig. 7: Trends in the number of visitors to Paklenica National Park, 1996-2005

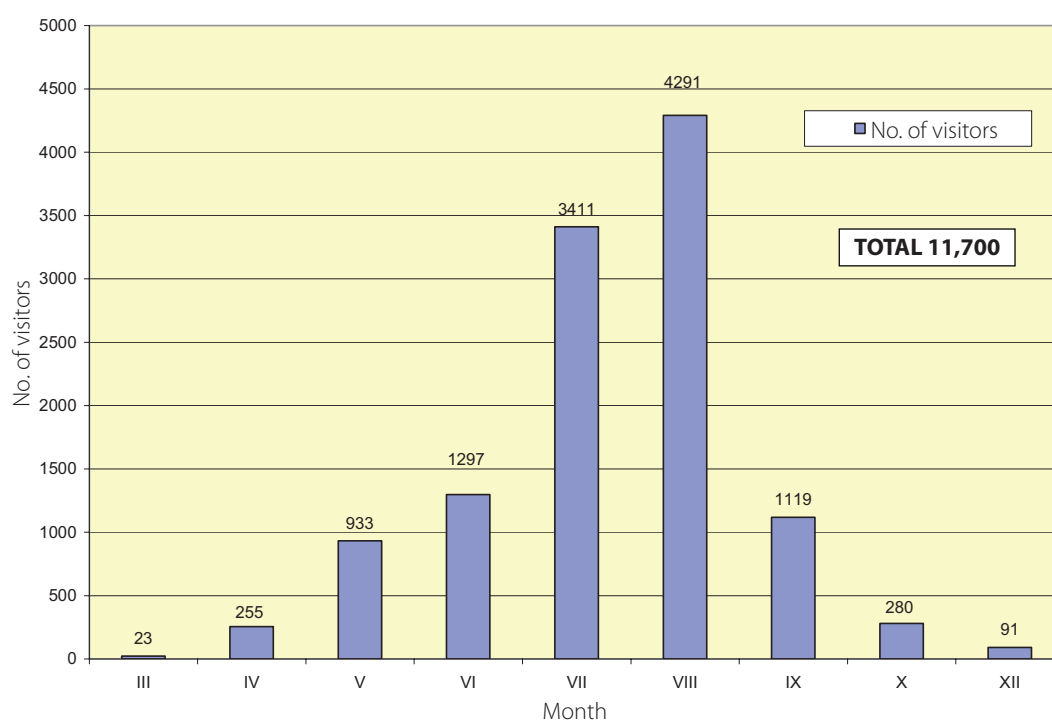
The cave is open to visitors from early April to late October, i.e. seven months a year. The regime of visits is adapted to seasonal variations in the number of Park visitors, as shown in Table 2. Although visits are also possible during the rest of the year if announced in advance, this is rare so it can be concluded that the cave has no tourist load five months per year (November-March).

Table 2: Regular schedule of visits to Manita Peć

APRIL	- Saturdays from 10:00 a.m. to 1:00 p.m.
MAY	- Wednesday and Saturdays from 10:00 a.m. to 1:00 p.m.
JUNE, OCTOBER	- Mondays, Wednesdays and Saturdays from 10:00 a.m. to 1:00 a.m.
JULY, AUGUST, SEPTEMBER	- Every day from 10:00 a.m. to 1:00 p.m.

The cave can only be visited in the company of a guide. Groups number from 25 to 30 people, and the tour lasts up to 30 minutes.

According to the data from the presentation service, 2005 was a record year, with 11,700 visitors in the cave, which was 10.3 % of the total number of Park visitors. The number of visitors to cave by months is shown in Fig. 8. The highest frequency of visits was recorded in July and August. During these two months, 7,702 visitors saw the cave, which is 65.8 % of total annual visits. In 2006, there was a mild drop in visits. Based on data so far processed, by the end of August, the main part of the season, 9,870 visitors came to the cave. This is 340 visitors less than in the same period of 2005.

**Fig. 8:** Number of visitors in Manita Peć by months in 2005

4. Fundamental objectives and conditions underlying management of Manita Peć Cave

4.1. Objectives of Manita Peć Action Plan

Making speleological sites suitable for tourism and their use can damage them, i.e. it can lead to a partial loss of the natural value that makes them interesting to visitors. The basic negative changes are:

- Change of the internal geometry by widening entrances, making trails, constructing stairs and bridges;
- Alteration of crypto-climate (air circulation, energy inputs);
- Chemical change (rock corrosion, filling and equipment);
- Biological change (greenery, assimilation, disappearance of cave fauna);
- Phyto-cenology of superstructure (dealing with plant cover on site's roof structure).

Manita Peć was partially prepared for visits as early as 1937. The most recent interventions, including its electrification, were made in 1991. The cave has been extensively used since 1996.

The cave became a recognizable segment of the Park's tourism product and it is annually visited by up to 11,700 people, i.e. 10.3 % of the total number of visitors to the Park. Its fundamental attractions are:

- Subterranean geomorphology;
- Number and diversity of cave decorations (speleothems);
- Number and diversity of endemic subterranean fauna.

In line with the cave's vision and long-term objectives, and taking into consideration the condition, significance and value of Manita Peć, the **fundamental objectives** of this Action Plan are to:

- enable maximum protection of the site and unimpeded development of natural processes under use conditions for tourism purposes;
- ensure a safe, attractive and educational tour of the subterranean karst for visitors;
- define the conditions for use of the cave in its existing condition;
- define the program and procedures needed to improve the infrastructure and use of the cave based on environmental engineering principles;
- provide guidelines for further study of all aspects of this natural phenomenon with the purpose of increasing the fundamental value of the Park and the educational aspect of visits to the cave;
- establish monitoring of the cave's physical parameters and fauna.

4.2. Cave zoning concept

This Action Plan divides Manita Peć into three zones with differing levels of permitted activities and influence on subterranean biotopes (Fig. 9). The three zones are:

1. Tourism zone. This is the area in which visitors move and exert maximum impact, encompassing the tourist trail and its expansion. It is physically restricted in its largest section (fence, handrails). Visitors are prohibited from moving outside of this area.
2. Restricted movement zone. Authorized personnel can move about in this area to conduct service activities and measurements. This area can also be accessed by researchers with the proper authorization to gather biological materials and samples, and for measurement and monitoring. In this area, visitor impact is manifested in the lights and heat which must be maintained within environmentally acceptable limits.
3. Strict conservation zone. Access and all activities in this area are restricted, with the exception of research, which requires consent from the National Park and the relevant Ministry. Minimum impact – permanent undisturbed biotope zone.

The zoning of this subterranean area constitutes an attempt to ensure maximum protection of this habitat while according consideration to actual circumstances. The tourism zone has already been permanently devastated by the construction of the trail. The second zone is a necessary consequence of tourism, but it is a fact that the level of impact can be controlled and maintained within the limits of environmental tolerance. The strict protection regime of the third zone has as its objective the preservation of an undisturbed natural biotope, which should ensure the preservation of all underground fauna. Although it is assumed that activities in the first part of the cave will not influence the condition of the third zone, it is difficult to estimate the impact of heat and CO₂ emissions, since the key input parameters are not known. The estimate of possible influence and monitoring of the actual condition must be made as a part of the assessment of the cave's carrying capacity.

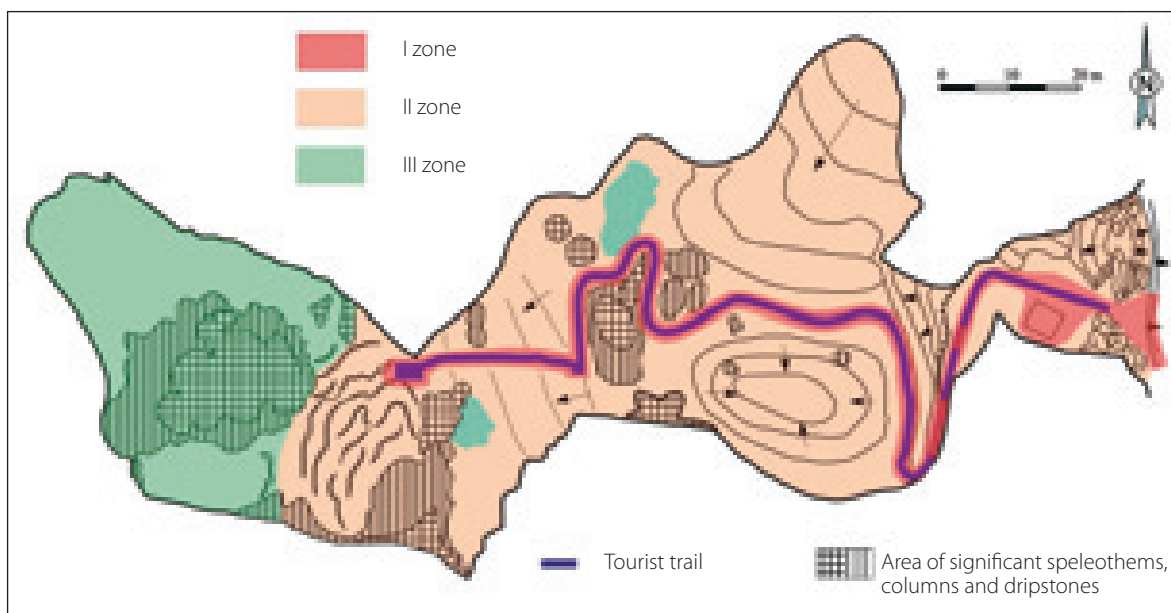


Fig. 9: Zones of permitted activities and impacts

4.3. Construction interventions and site geometry

The existing tourism zone has been well routed to enable sightseeing of the most attractively arranged parts of the cave. In the subsequent period, the construction of new trails and their elements is not planned, nor are there plans to enlarge the existing facilities.

- The existing staircase and trails have to be made coarse through manual stone working in smooth spots, while metal fixtures must be maintained by water-based anti-corrosives (without organic solvents) or even replaced if completely worn. The existing metal fixtures should be replaced with stainless steel if funding is secured.
- Electrical installations must be maintained with construction and installation materials adequate for corrosion category 4. Potentially more extensive reconstruction of electrical installations and lighting must be implemented under plans drawn up and approved in advance.
- All waste created in the course of permitted works or regular maintenance and activities in the cave must be disposed outside of the Park as prescribed by law.
- All human activity is prohibited in the area of the cave's superstructure, except recreational hiking on the hiking trails.

4.4. Electrical installations and lighting

To ensure that the electricity network and lights are always in proper condition, and to offer visitors to the best possible experience of the cave's beauty and to prevent the potentially negative impact of new devices, the following must be done:

- Once annually, not later than 30 March of the current year (beginning of season), the rectitude of protective electrical devices must be tested and grounding resistance has to be verified by a person or company registered to monitor of electrical devices.
- The maximum allowable temperature of the paint on installed sources must not exceed 3200 K; the recommended limit is 3000 K, and the optimum is 2700 K.
- The maximum allowable input light illuminating rocks and dripstone sediments must not exceed 80 lx.
- The minimum light on the trail must exceed 1 lx.
- Although the maximum allowable daily lighting of the cave with currently used power, emitter type and thermal energy dissipation is 7 hours, due to an entire series of assumptions on which it is based and with the aim of safety against harmful impact, in practice it is decreased to 5 hours.

4.5. Heat load and carrying capacity

According to the tenets of environmental engineering for sites used for tourism, it is necessary to define the existing state of all components of the speleological site (morphology, crypto-climatic conditions, fauna etc.), to determine its environmental-protection tolerances and then calculate carrying capacity with imposed pressures (energy) and prescribes measures for protection and monitoring.

Since some of these activities have not been carried out for Manita Peć and since some parameters were estimated based on previous measurements or empirically, in the subsequent period it will be necessary to launch and perform activities to make a new estimate of the cave's carrying capacity. This estimate must also be aligned with the new lighting project.

Since no negative repercussions of tourism use have yet been noted, the previously ascertained conditions must be observed until the aforementioned program is carried out.

- 60 visitors in the cave per hour are permitted.
- The maximum allowable air temperature at the end of the tourist trail (position D), measured 150 cm above the level of the trail, is 9.8°C.
- In case of reaching of the aforementioned air temperature, visits are halted and the lighting is switched off until the air temperature at the measurement point cools to 8.8°C.
- To monitor temperatures in the cave, a thermometer must be installed at the end of the tourist trail with momentary readings and automated registration at 30-minute intervals (reference thermometer).
- Temperature measurements necessary to determine carrying capacity will be conducted under a separate program.
- To establish permanent monitoring of crypto-climatic conditions in the cave, there are plans to equip it with registration thermometers arranged as shown in Fig. 10.

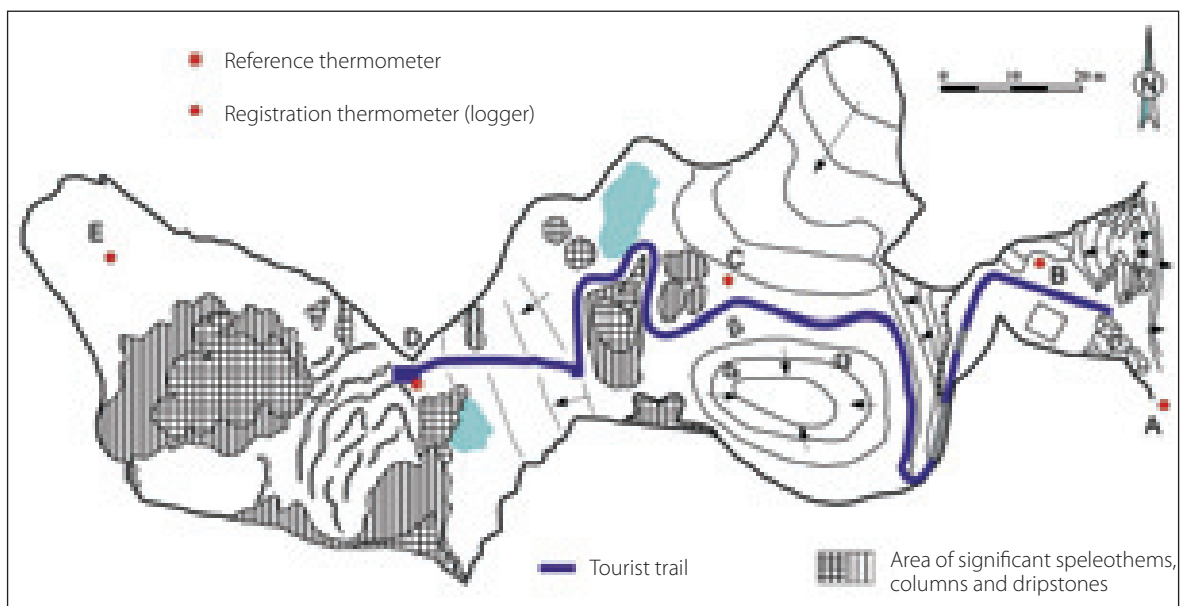


Fig. 10: Location of thermometers for ongoing measurement and registration of air temperature in the cave.

4.6. Atmosphere

The content of gases in the cave has not yet been measured. It is known that CO_2 in the air of well ventilated caves can be up to ten times greater than in the atmosphere. Its presence is the consequence of dripstone creation, when CO_2 is released together with calcite from the water solution. In tourist caves, the increase of CO_2 content is a part of physiological load (with dissipated heat) which is a consequence of visitors breathing. The atmosphere contains 20.94% O_2 and only 0.03 % CO_2 , while the exhaled air contains approximately 16% O_2 and 4% CO_2 . Due to this disproportion, under conditions of intense use of air in the cave, the O_2 content can diminish while CO_2 grows. Weak natural ventilation and ascending extension of subterranean channels are conducive to this phenomenon.

- During maximum load in the cave, the gas content must be measured along the tourist trail.
- Measurements must be conducted by a company authorized to perform work safety and workplace atmosphere assessments.
- The minimum allowed volume of oxygen (O_2) in the cave atmosphere is 18%, measured at the end of the tourist trail (next to point D).
- When the value of oxygen decreases to this level, the entry of visitors is halted until it reaches 20% by means of natural circulation.
- To the control of these conditions during maximum attendance, it is necessary to acquire a measurement instrument to record and warn of insufficient oxygen content.
- Control measurement of gas content in the cave's zone III, closed to visitors, will be performed through occasional measurements of conditions during maximum load in the cave.

4.7. Tour organization and guidance

Manita Peć can only be visited in the company of a guide.

- Inside the cave, visitors can move in groups along the installed and fenced trail if accompanied by a guide.
- The maximum allowable number of visitors in a group is 30; in addition to the guide, an assistant will also accompany the group.
- Pre-school children can enter the cave only if accompanied by a parent or teacher in cases of organized visits from kindergartens.
- Organized groups of school children up to 12 years of age must have at least one adult companion per five children (the guide and assistant are included in this number).
- Two groups of visitors are not allowed to squeeze past one another on staircases on the initial and last parts of the tourist trail.
- Waits for groups to pass each other can be organized in the existing extension and concrete area behind

the actual entrance, where visitors can become familiar with the history of the cave; this time is also used for the eyes to adjust to the ambient light.

- Guides maintain Cave Visit Logs. The Log contains data on the number of visitors who visited the cave on a specific date, the number of visitors in each group; particular attention is accorded to entries free of charge, entry and exit times of a group, and operation of electrical lighting. In the section under the heading "Note," peculiarities should be noted, such as excessive heating of the cave, decreased oxygen, malfunctions, etc.

4.8. Visitor conduct – general code of conduct

- The cave may not be entered individually, nor can anyone move off of the trail.
- Damaging any components of the cave or installed equipment is prohibited.
- No pets are allowed in the cave.
- No food or beverages are allowed in the cave.
- Use of audio equipment or any noise in the cave are prohibited.
- No smoking in the cave.
- Any photographic or recording equipment using flashes are not permitted without permission from the National Park in manner that complies with law.
- This general code of conduct must be visibly posted on the power station or at the cave's entrance.

4.9. Safety precautions

- There must be a first aid kit at the cave's entrance.
- Guides and their assistants, if they do not have valid driver licenses or are not members of the Croatian Mountain Rescue Service, must have first aid certificates.
- The National Park Public Institution, in cooperation with the Mountain Rescue Service, must draw up the Rescue and Emergency Plan and a plan for notifying the relevant agencies.
- An excerpt from the Rescue plan with important telephone numbers must be visibly posted at the power station or at the cave's entrance.
- Staff in the cave must be familiar with the manifestations of and procedures in case of *pseudofobias* (primarily *claustrophobia*).
- A claustrophobic individual must be immediately taken to the cave's entrance, since for most people the symptoms disappear at the first sight of open skies.
- In the reception area there must be at least one GSM phone or other wireless device to contact the National Park's management or the rescue service.



4.10. Scientific research and monitoring

Scientific research increases knowledge of the cave and its value, and at the same time it can generate results vital to the Park as a whole and contribute to the development of Croatian science. The results of scientific research contribute to the educational value of tourist presentation.

Recent explorations have shown the extreme value and diversity of cave fauna, so biospeleological explorations will continue with the aim of find new species and monitoring the status of biotopes.

The National Park will encourage research which can contribute to better knowledge of the cave's formation as well as recent processes, such as dripstone sedimentation, etc.

Monitoring of the cave's condition and crypto-climatic parameters is intended to maintain them within ecologically acceptable limits, and is a significant protective element under conditions of its use for tourism. In this regard, it is necessary to draft a detailed program for these activities and acquire the necessary measuring equipment.

4.11. Public participation

Manita Peć is a component of Paklenica National Park, so public participation complies with the guidelines set forth in the Park's Management Plan.

The cave is presented to the public through tourist brochures, while research results are published in domestic and foreign journals and presented at seminars.

Since visits to the cave have educational value, cooperation with local schools is organized.

During "Open Door Day," the cave is open for free visits, although the number of visitors is limited by the carrying capacity.

5. Implementation of Action Plan

5.1. Links to other planning documents

The Action Plan for Manita Peć has been aligned with the essential components of the Physical Plan, and Paklenica National Park's Rules of Internal Order and Management Plan. The cave's management plan additionally specifies the operative aspects of management of this site, with emphasis on protection and preservation of subterranean biotopes and all of their components.

5.2. Financial aspects and cost estimate

According to the Nature Protection Act, financing conservation and preservation of natural resources of international and national significance is secured through the central state budget. The same applies to financing of protected areas, in compliance with the needs specified in the Annual Conservation, Maintenance, Preservation and Use Program for Paklenica National Park, and the Public Institution's Development Plan and Annual Budget (Article 76 of the Act). Since Manita Peć is a component of Paklenica National Park's protected area, it falls under the same financing system.

Additional funding to finance conservation may be generated by the National Park itself through the sale of admission passes or a concessions system. Even in this segment of financing, Manita Peć has its own place since a fee is charged for visits to the cave.

In coming period, there are plans for increased investment into the cave's research and infrastructure, so the National Park, based on action plans conceived for these activities, is expected to make an attempt to collect additional funds from international organizations and endowments, which should supplement the revenues the National Park secures from the state budget and admission fees or concessions. Each action plan contains a detailed budget of costs for its achievement and will be included in the annual Conservation, Maintenance, Preservation and Use Program for Paklenica National Park, and the Public Institution's Development Plan and Annual Budget (Article 76 of the Act).

5.3. Activities

5.3.1. Purpose

The Nature Protection Act stipulates that the Management Plan is valid for ten years, and that it is reviewed after five years. Action plans are prepared as short-term documents (one year) or as medium-term documents, and they are aligned with management plans to adhere to the defined management vision, objectives and measures (up to five years) in a detailed yet flexible manner.



In compliance with the vision and fundamental objectives of the Manita Peć management plan, there is an acknowledged need to perform a series of activities to contribute to the better scientific appreciation of the cave, secure maximum conservation of nature under conditions of active tourism and improve the attractiveness and educational content of visits to the cave. These activities are the subject of action plans.

5.3.2. Content of activities

Action plans are generally prepared for periods of one to five years. They are developed by the National Park's staff in cooperation with experts for specific fields and potential contractors which may perform the necessary activities.

The activities foreseen by the National Park's Governing Board consist of:

- Definition of objective: What is the action plan's objective?
- Planned activities: What type of activities are planned and how are they justified?
- Timetable: When will the activities be performed?
- Implementation: Who will perform activities?
- Oversight: Who will verify that activities are performed? What are the indicators to monitor implementation?
- Definition of costs and financing sources: What are the costs, how much will be needed and how will financing be secured?
- Monitoring: What are the indicators for action plan monitoring? How will the correspondingly necessary information be gathered and how will it be evaluated?

5.3.3 Overview of priorities

The action plans for Manita Peć may be broken down into four basic categories, in compliance with their objectives and the accompanying problems.

- A) Nature protection
- B) Infrastructure improvement
- C) Improvement of educational impact
- D) Scientific appreciation of the cave

These categories are not strictly isolated, as individual segments overlap; however, they provide a general thematic denominator and sequence for implementation.

A) Nature protection

Nature protection action plans have the priority and are implemented first. Based on previous consideration, this problem is covered by two action plans:

A1 – Carrying capacity. The content of this action plan entails organization and execution of activities needed to calculate the cave's carrying capacity, which requires:

- a detailed topographic survey of the cave to calculate the volume of underground space and rock surface with great precision,
- elaborate the biospeleological aspects of the current protection status and conditions,
- determine the basic physical and chemical parameters of the cave, and its corrosion type and ecological tolerance,
- calculate the cave's carrying capacity.

A2 – Monitoring. An action plan must be developed to establish permanent monitoring with the aim of overseeing the status and preserving the natural conditions of the subterranean biotope. The plan must define:

- the methods and dynamics of biospeleological surveillance,
- parameters and measurement points,
- measurement equipment and dynamics.

B) Infrastructure improvement

To improve the cave's infrastructure, completion of plans B1 and B2 is anticipated. A timetable for implementation of plan B1 has not been defined, and it primarily depends on available funds.

B1 – Replacement of corrosive infrastructure elements with inert elements. This action plan calls for planning and replacement of fences, handrails and other gear liable to corrode with inert substances (stainless steel, construction plastics, etc.)

C) Educational impact

Already at this point, visits to Manita Peć have a significant educational component based on the natural value of karst phenomena. Activities required to increase this component are the subject of action plan C1.

C1 – Education and interpretation. The basic objectives of this action plan are:

- Improving the content and methods for presentation of the cave and its value, in compliance with contemporary presentation principles.
- Installation of educational panels at different, suitable points on the access trail. The topics on these panels should be associated with karst geomorphology; creation of karrens, solution pans, dripstones and the cave, or they should point to interesting details connected to the trail, such as Zub od Manite peći, etc.



D) Scientific appreciation

The number and content (themes) of action plans tied to scientific appreciation of the cave is flexible and dependant on the interests of the scientific community, i.e. those proposing and engaging in activities. Since the Park's funds are limited, their implementation can be financially supported only after implementation of priority action plans A1, A2 and B1. If plan sponsors or executors become involved in securing the funds themselves, implementation can begin independently once the necessary permits and approvals are obtained. Based on recent knowledge, and from the Park's standpoint, interesting action plans are linked to:

- Further biospeleological research at the site
- Study of recent sedimentation conditions of cave decorations
- Collection of data essential to the creation of the cave, such as dating the age of cave sediments, paleo-climatic conditions for their formation, etc.

5.4. Annual programs and plans

According to the Nature Protection Act (as published in Croatia's official journal, *Narodne novine*, no. 70/05), all protected areas in Croatia must prepare an annual Protection, Conservation, Maintenance, Promotion and Use Program, Public Institution Development Plan and Budget for the subsequent year. These are the key and fundamental documents which form the basis for planning and allocation of budgetary funds to various activities in the National Park. In the future, these documents must be aligned with the Management Plan and the action plans which are components of the latter. Since Manita Peć is a component of the National Park, the activities specified in this management plan are incorporated into the aforementioned documents, constituting an integral component thereof.

Given the other available international and domestic sources of financing for the protection and preservation of Croatia's natural and cultural heritage, enhanced cooperation between the National Park and the relevant national institutions can be expected where this concerns securing other sources of financing and preparation of project ideas and bids to finance developmental projects, i.e. the action plans proposed under the management plan.

5.5. Monitoring

This activity entails the continual monitoring of feasible objectives and measures specified by the management plan and specific tasks defined by the action plans. The information gathered by means of monitoring also facilitates assessments of progress and timely improvement of plans. This is a major corrective factor, for each time an activity is repeated, previous experience, linking of information from different sources, results of field activities and specific measurements and verification of results and their adjustment to further activities all impose themselves.

The monitoring system encompasses measurable indicators which are continuously monitored, and which facilitate assessment of plan implementation over time and fulfillment of management objectives. The gathered data (biological, environmental, socio-economic indicators) are stored in the IT system developed under the KEC Project.

A considerable portion of monitoring in Manita Peć will be conducted by the National Park's staff, while research institutions or other qualified organizations and individuals will be engaged for those segments requiring special expertise.

The types of monitoring that will be conducted by the National Park's rangers and guides include:

- Monitoring all visitor data (number of groups visiting the cave on a given day, number of visitors in each group, recording the number of free passes in particular, time of entry and departure of each group, duration of operation of electrical lighting, specific factors such as heating of the cave, reduction of oxygen quantities, malfunctions, etc.),
- Monitoring temperatures and oxygen content during the cave's working hours,
- Monitoring financial data: costs and income,
- Monitoring biological changes not requiring expert knowledge: appearance of vegetation or algal growth, appearance of bats, etc.
- Occasional reading (downloads) of data from automated measuring devices, after suitable training.

Monitoring that requires specific expertise, and for which external contractors will be engaged, may include:

- Analysis of long-term physical parameter monitoring data
- Monitoring of subterranean biotopes,
- Fauna inventories and species identification,
- Monitoring as a component of specialist research, etc.

When monitoring data are gathered and processed, they must be compared with expected results, and in case of discrepancies, activities must be undertaken that will ensure the achievement of the original objectives.



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Climbers on a cliffside.



C l i m b e r s

NATIONAL PARK

Paklenica

A C T I O N P L A N



Starigrad-Paklenica, August 2007

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1. Introduction

The beginnings of mountain-climbing in Velika Paklenica Canyon date back to 1938, when an attempt was made to climb Anića Kuk cliff – and when Dragutin Brahm was killed. This was a time when there was no protection within the framework of a national park. Two years later, Brahm's friends continued along the same ascent and succeeded, thereafter naming the route "Dragutin Brahm." From 1940 to 1970, several routes were ascended along Anića Kuk, among them the today most frequently climbed Mosoraški, Klin and Karabore, all of which were set by Croatian alpine climbers. From 1970 to 1980, Slovenian alpine climbers began coming to Paklenica National Park and slowly took the initiative in setting up new routes. The installation of bolts for intermediate safety led to a decline in alpine climbing in relation to sport climbing, so that today less than 10% of all climbers in Velika Paklenica are alpine climbers. By the end of 2000, approximately 300 routes had been set up in the Park, and in that same year 20,000 climbers, or almost one fourth of all visitors, climbed on these routes. In 1998, the Park's Management introduced the post of climb supervisor. The duty of this person is to oversee the set-up and arrangement of new routes, verify the safety and upkeep of existing routes, supervise climbing activities and, as much as possible, remain at the disposal of climbers with advice or to render assistance in case of emergencies. Thanks to these supervisors, climbing was banned in the area of Debeli Kuk, where griffon vultures nested during the 1998 and 1999 seasons. In 2005, approximately 35,000 climbers were recorded in the Park for the entire year. In 2002, regular monitoring by the Mountain Rescue Service (*Gorska služba spašavanja* – GSS) was introduced; the Service has an on-duty monitor in Klance, at a site where the most climbers visit. In cooperation with Paklenica National Park's technical and ranger services, rescue operations are conducted in case of accidents or falls.

Among the current population of climbers, 10% consists of alpine climbers, 50% consists of sport climbers and 40% consists of climbers on long bolted routes. A worldwide trend is mass climbing on bolted, simple routes, and the National Park should comply with this trend. This can be achieved by setting up an additional number of routes for beginners and for top-flight climbers, upgrading older routes that are no longer safe, providing higher quality online information and notice boards in the Park, and equipping Klance with additional benches, waste baskets, info-points and other designations.

The number of climbers in the Park from 1998 to 2005 can be seen for individual months.

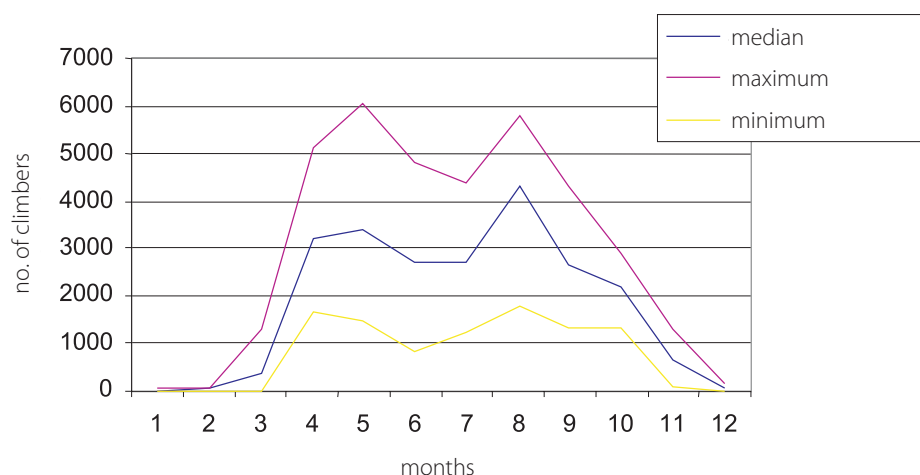


Fig. 1. Number of climbers by individual month in the 1998-2005 period.

Most climbers visit in May and August. The current shortcomings during these months are related to the climate; in May the “Big Wall Speed Climbing” competition is held, and the most frequent problem is poor weather, while in August temperatures are quite high. In order to improve the quality and services at the climbing sites, the addition of new routes is proposed, particularly short, sport-climbing routes – 50 to 60 could be set up in Klance over the next ten years. In this case, the Park could offer a total of 250 sport routes and 400 in all. In the first five years of work on routes, the job of the climb supervisors would entail providing information and conducting repairs and interventions, while climbers would receive all necessary information on routes and necessary equipment, primarily in the field. In the subsequent five-year period, the Park’s website should be upgraded, and a database of all climbing routes should be compiled.

2. Principal objective of Action Plan

The Action Plan is predicated on achievement of the following objective:

Improve climbing possibilities while ensuring protection of animals and vegetation on cliffsides and rock faces, as well as petrophilous birds living in Velika Paklenica Canyon

The accomplishment of the tasks foreseen under the action plan contribute to achievement of the vision set forth in the Park’s Management Plan.

The sub-objectives, activities and measurable results are described in detail in the activity table in Chapter

3. Projected resources to achieve Action Plan

The necessary resources to achieve the objectives of the Action Plan generally include use of existing human resources. During establishment of first aid in the new visitor center, the National Park’s Management will equip facilities for this activity. Completion of the Action Plan will require an additional 386 days annually, which are allocated among the National Park’s staff in the table.

4. Funding sources

Costs pertain mostly to the work of Park staff and are not precisely specified, but the necessary funding should be secured from Paklenica National Park’s own revenues. The annual costs for equipment were not taken into consideration in this action plan.

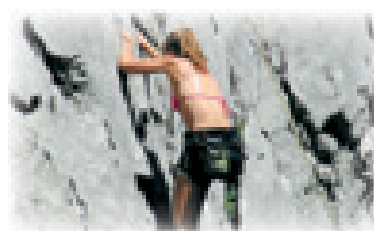
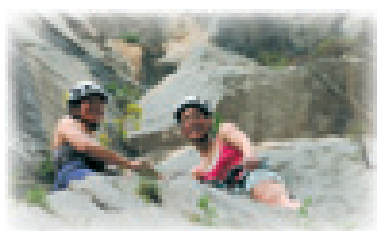
The estimated amount needed to carry forward the activities is HRK 257,240.00 for the 2008-2017 period. The estimated annual costs are HRK 25,725 on average.

5. Action Plan – tabular overview

Objective	Activity	Measurable result	Verification methods	Required inputs	Input costs
Principal objective: Improve climbing possibilities while ensuring protection of animals and vegetation on cliffsides and rock faces, as well as petrophilous birds living in Velika Paklenica Canyon					
Sub-objective 1.1. Set up new climbing routes and improve climber safety					
Increase the number of routes for sport climbing with an additional 10 routes annually	1.1.1. Define the number and position of new routes, budgets and timetables	Equipment plan for 5-6 new sport climbing routes	New route plan	Climb supervisor, 1-15 days	Paklenica National Park's own revenues
	1.1.2. Find assistant	Employment of new climbing assistant	Employment contract	Climb supervisor, Park's chief ranger, director general, conservation manager, total 5 days	Paklenica National Park's own revenues
	1.1.3. Purchase materials for new routes	Purchase of supplies	Invoice	Accounting manager 1 day	Paklenica National Park's own revenues
	1.1.4. Define and staff 10 new routes annually	Define and install bolts and clear new routes	Set-up of new routes	Climb supervisor and assistant total 60 days x 5	Paklenica National Park's own revenues
	1.1.5. Document new routes for climbers	Draft documentation for each sector	Posting of new routes online and at National Park entrance	Climb supervisor 10 days x 5	Paklenica National Park's own revenues
Improve climber safety	1.1.6. Verify sport climbing routes at beginning of season	Entry of reports and data in database	Route data base	Climb supervisor, assistant 120 persons/day annually	Paklenica National Park's own revenues
	1.1.7. Periodically verify long bolted routes (intense annual use, every 3 years at a minimum)	Entry of reports and data in database	Route data base	Climb supervisor, assistant 100 persons/day annually	Paklenica National Park's own revenues
	1.1.8. Verify climber reports	Entry of reports and data in database	Route data base	Climb supervisor, assistant, 45 persons/days annually	Paklenica National Park's own revenues
	1.1.9. Increase number of bolts on sport routes	Number of newly-established bolts	Route data base	Climb supervisor, assistant 10 persons/day	Paklenica National Park's own revenues
	1.1.10. Equip premises for first aid in new visitor center	First aid room equipped	First aid supplies	Technical services manager	Paklenica National Park's own revenues
	1.1.11. First aid training at beginning for each season for all new field staff	Training held for new National Park staff	Number of lectures held and training participants	Conservation manager	Paklenica National Park's own revenues

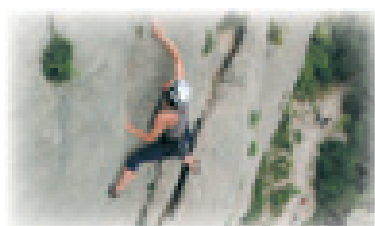
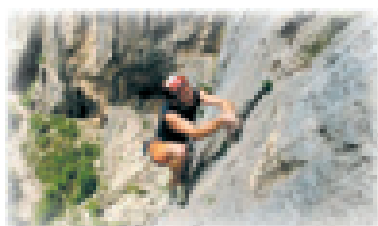
Objective	Activity	Measurable result	Verification methods	Required inputs	Input costs
Improve climber safety	1.1.12. Design and development of panels intended for climbers at the entrance to the National Park and visitor center, with possibility of notification of dangers on climbing routes	Installation of boards, climber impressions log	Number of panels installed	Climb supervisor, conservation manager, presentation manager 10 persons/day	Paklenica National Park's own revenues
	1.1.13. Information for climbers on existing websites (same information as on information panels)	Periodic posting of information on website	Amount of climbing information posted online	Climb supervisor	Paklenica National Park's own revenues
	1.1.14. Upgrading of website so that Park staff can edit and add information from climber forum	Climber reports at forums	New website completed, number of hits on website	Climb supervisor, conservation manager, presentation manager 10 persons/day	Paklenica National Park's own revenues
	1.1.15. Creation of database on climbing routes with data on all completed jobs	Existing route data base	Existing route data base	Expert advisor	Paklenica National Park's own revenues
Sub-objective 1.2.: Monitoring of petrophilous animals and plants in climbing zones					
Protection of plants and animals in the climbing zone in Velika Paklenica Canyon	1.2.1. Supervision of climbing routes in climbing zone to preserve rare and threatened birds and plants	Number of completed field supervisions	Park ranger reports	Climb supervisor, assistant, conservation manager, Park rangers, 3 high-quality binoculars	Paklenica National Park's own revenues
	1.2.2. Closure of routes where rare or threatened species reside during mating season	Number of closed routes	Park ranger reports	Climb supervisor, assistant, conservation manager, Park rangers	Paklenica National Park's own revenues
	1.2.3. Inform visitors of restrictions due to preservation efforts by means of fliers, notices at Park entrance and at starting points of climbing routes, and on website	Informative materials for climbers	Park ranger reports	Climb supervisor, assistant, conservation manager, Park rangers	Paklenica National Park's own revenues
Sub-objective 1.3.: Survey of climbers					
Quality climbing sites and visitor satisfaction over quality of climbing sites tested through regular climber surveys	1.3.1. Survey of climbers implemented every other year	Conducted survey	Analyzed survey results	Climb supervisor, assistant, conservation manager, Park rangers	Paklenica National Park's own revenues
	1.3.2. Inform climbers of survey results	Informative materials for climbers on survey results	Park ranger reports	Climb supervisor, assistant, conservation manager, Park rangers	Paklenica National Park's own revenues

Objective	Activity	Measurable result	Verification methods	Required inputs	Input costs
Sub-objective 1.4.: Education of visitors to National Park and familiarization of all interested visitors with climbing activities					
Engender familiarity with climbing activities through the appropriate information and education to all interested visitors	1.4.1. Climbing education and familiarization by means of appropriate information to all interested visitors	1 or 2 day education per week with climbing lectures	Number of courses held and number of participants	Climb supervisor, assistant, Park rangers	Paklenica National Park's own revenues
	1.4.2. Display of equipment at a simple route and climbing demonstration	Lectures on equipment and climbing methods	Number of lectures held and number of participants	Climb supervisor, assistant, conservation manager, Park rangers	Paklenica National Park's own revenues
	1.4.3. Appropriate panels and posters with climbing instructions as a special form of amenity in the National Park, and include Tourism Board in this activity	Development of panels and boards on climbing in Paklenica National Park	Number of panels installed	Climb supervisor, assistant	Paklenica National Park's own revenues
Sub-objective 1.5.: Hold Big Wall Speed Climbing competition					
Organize speed-climbing competitions every year with exclusive and top-flight international climbers	1.5.1. Organization of speed-climbing competitions	Regular annual event for May Day	Competition held	Presentation service, climb supervisors, Park rangers	Paklenica National Park's own revenues
	1.5.2. Invitation of top world climbers	Lectures, film screenings	Number of lecture participants and film screenings	Presentation service, climb supervisors, Park rangers	Paklenica National Park's own revenues
	1.5.3. Appropriate information in media on competition activities	Ads in newspaper, media information	Number of press clippings	Presentation service, climb supervisors, Park rangers	Paklenica National Park's own revenues



[illegible]

Activity	2008.	2009.	2010.	2011.	2012.	2013.	2014.	2015.	2016.	2017.	2018.
Supervision of climbing routes in climbing zone to preserve rare and threatened birds and plants											
Closure of routes where rare or threatened species reside during mating season											
Inform visitors of restrictions due to preservation efforts by means of fliers, notices at Park entrance and at starting points of climbing routes, and on website											
Climbing education and familiarization by means of appropriate information to all interested visitors											
Display of equipment at a simple route and climbing demonstration											
Appropriate panels and posters with climbing instructions as a special form of amenity in the National Park, and include Tourism Board in this activity											
Organization of speed-climbing competitions											
Invitation of top world climbers											
Appropriate information in media on competition activities											





Black pine forest after a fire in the summer of 2007.

Forest Conservation

NATIONAL PARK

Paklenica

ACTION PLAN



Starigrad-Paklenica, August 2007

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1. Introduction

1.1. Exploitation of forests and protection of forest habitats

The primary reason for proclamation of the National Park and for protection of the Paklenica area in 1949 was the wealth and diversity of its forest vegetation. However, due to logging and heavy pasturing, some of the forests had already been degraded by the time of proclamation. After the area was placed under protection and grazing by goats was banned, the vegetation in individual parts of the National Park was completely restored after sixty years.

Traces of forest exploitation go back to the distant past, since 1669, when this area was returned by the Ottomans to Venice under the Peace of Carlowitz. Over the past centuries, the forests were mercilessly destroyed due to irrational exploitation. At the beginning of the nineteenth century, the Dalmatian authorities attempted to renew the forests which were municipal property and open for exploitation by the population. In 1929, forests became a public resource, and their use was supposed to be managed by an institution in Zadar. At that time pine forests were the most widespread. Many tracts were covered by dwarf pine. Sparse alpine vegetation, grazed upon by sheep and goats, grew in these areas. The areas of Velika Paklenica and Mala Močila contained a considerable amount of pines, and local residents extracted resin in a very crude manner. After 1945, forests at Paklenica were logged to reconstruct homes destroyed by the war. There are no records on how much was logged, but the forests were not destroyed, and in 1949 the entire area was proclaimed a National Park and placed under the management of the Zadar Forestry Office. This formally abolished the usage rights which the residents of Starigrad and Seline exercised based on a regulation dating back to 1861. The forest management program in the Park was adopted in 1980.

1.2. Diversity of forest habitats and plant communities

Today the territory of Paklenica National Park is characterized by the diversity of its forest communities and it is a lush forest oasis on the rocky coastal slopes of the southern portion of the Velebit massif. The distribution of various forest communities is the result of complex climatic and geological conditions, as well as human impact.

An estimated 55% of the National Park's surface is covered with forests and meadow habitats, while 45% is covered with karrens, rock, cliffs and scree.

Dalmatian white oak and hornbeam forests and underbrush (*As. Querco-Carpinetum orientalis*) E.3.5.1., grow at the lowest elevations. These forests were most exposed to human impact, and along the National Park's southern boundary, where grazing was most intense, they were devastated. The most frequent degradation phase involves thorn patches (*Paliuretum adriaticum*) – a specific type of vegetation which emerged with the logging of Dalmatian white oak and hornbeam. Other forms of degradation are occasional pure associations of prickly juniper (*Juniperus oxycedrus*), which are nicely developed in the National Park's southeastern areas. The ban on grazing, primarily by goats, has ushered in the gradual restoration of these forests in their original form. Above this community, hop hornbeam forests and underbrush with autumn moor grass (*As. Seslerio autumnalis-Ostryetum*) E.3.5.6. are widespread. At places in the Velika Paklenica and Mala Paklenica Canyons, these forests descend to lower elevations. Illyrian



coastal beech forests with autumnal moor grass (*As. Seslerio autumnalis-Fagetum*) E.4.6.3. develop at elevations of 500-900 m and they are the most common beech community in Paklenica. The extremely shallow and skeletal dry soils of jutting ridges and crests of the central portion of the National Park, along the sites Golić-Grabar-Orlov kuk-Crni vrh-Veliki kom, host the relict azonal community of black pine and cotoneaster forests (*As. Cotoneastro-Pinetum nigrae*) E.7.4.4., which naturally develops on ridges and steep slopes at elevations of 400-1,200 m. A part of the black pine forests emerged due to planting efforts during the Austro-Hungarian era. Mediterranean vegetation mixes with the traditional vegetation of pine stands in these forests. Sub-alpine beech forests with coltsfoot (*Homogyno-Fagetum*) form the upper boundary of forest vegetation at elevations of 1,000-1,450 m. Due to the long-lasting snow cover, the lower sections of the tree trunks are bent, knotted and often unusually shaped. In its uppermost parts, these community consists of juniper and beech. There is no shrubbery in these forests, rather the soil is covered with moss, giving them a thinned appearance. The moss also ensures moisture for the wealth of soil-dwelling animal life. Beech forests with giant deadnettle (*As. Lamio orvalae-Fagetum*) E.4.5.1. grow near waterways. This is a typical continental community. Beech forests with giant deadnettle develop on dolomites with fresher soils near the streams in both Velika Paklenica and Mala Paklenica Canyons. Individual beech trees in this community have trunk diameters exceeding 1 m. Dwarf pine and honeysuckle forests (*As. Lonicero borbasianae-Pinetum mugii*) D.2.1.1.1. occupy the peak zone of Velebit. This is the large and most compact surface of dwarf pine anywhere in Croatia. After clearing of Illyrian coastal beech forests, this community also expanded to these habitats.

1.3. Planted pine forest

Forests of Aleppo pine (*Pinus halepensis*) and black pine (*Pinus nigra*) were planted at the entrances to Velika Paklenica and Mala Paklenica Canyons. At places in these stands there are occasional examples of maritime pine (*Pinus pinaster*). These associations cover a small area at the entrances to the canyons. In Velika Paklenica, this is a surface of approximately 30 ha, while in Mala Paklenica the surface is even smaller, approximately 15 ha.

1.4. Extra-zonal holm oak (*Quercus ilex*) associations

Holm oak trees are sporadically distributed Velika Paklenica Canyon, as both shrubs and trees. There are somewhat larger associations on the southern slopes:

1. at Jurasova glavica, ca 0.5 ha;
2. on the right side of Velika Paklenica Canyon on the southern cliffs above Pločice, 0.2 ha;
3. above Sklopina as thick shrubbery covering 0.4 ha, at an elevation of 550m.

1.5. Extra-zonal yew tree (*Taxus baccata*) associations

The only larger and thicker association of yew trees developed as scattered bushes on the northern slopes of Anića kuk on the canyon's left side. Here there are 30-50 examples of yew trees scattered along slopes covering a surface roughly 1 ha.

2. Principal objective of Action Plan

The Action Plan is predicated on achievement of the following objective:

Management of privately and publicly-owned forests in the territory of
Paklenica National Park

The accomplishment of the activities foreseen under the action plan contribute to achievement of the Paklenica National Park Management Plan and the vision statement specified therein.

The achievement of the action plan contributes to achievement of the objective of conservation and advancement of the ecological and social functions of forests. The action plan upholds the measures calling for specific activities for selected forests and forest communities.

1. Publicly-owned forests

1.1. Forests

1.1.1. The first measurement surface is situated at Perina greda at an elevation of 820 m. This is a beech association on limestone, on well-developed brown soil. The second surface is situated in a beech forest in Suva draga at an elevation of 850 m. This surface is periodically inspected, and only floristic samples are collected. The second surface is situated at Buterinuša, at an elevation of 750 m, consisting of black pine, and collection of floristic samples is also planned.

1.1.2. In surface no. 1 a precipitation gauge, lysimeter and pedological profile were installed. There are plans to take water samples once monthly and conduct a detailed measurement of the surface every five years, and collect plant sample. In surfaces no. 2 and 3, floristic research and plant sample collection twice annually will continue.

1.1.3. Monitoring plant succession on fire-burned surfaces at Golići was conducted in 2004 and 2005. This research will continue in the following five-year period. The objective is to ascertain the course of succession, growth intensity and plant diversity. Sampling on the surface is conducted twice annually.

1.1.4. Monitoring the development of forest edges will be performed on meadows along black pine stands in the Ogradica area, on the meadows at Struge along the edge of the dwarf pine association twice annually, and during these years plant sampling will be conducted twice annually.

1.1.5. Removal of saplings on established meadows at various phases of successions should proceed every other year on each meadow.

1.1.6. Monitoring of woodpeckers and cavity nesting birds should be performed in beech forests twice annually, along the route 1 from the Martinovo mirilo mountain lodge to Velika Močila.



1.2. Activities in forests in the recreation zone

1.2.1. Potentially hazardous dry trees should be removed along trails and paths in the recreation zone in general in a 15 m belt on each side to ensure visitor safety during each season.

1.2.2. Counter-erosion measures and repair of the most critical areas near flood gullies must be conducted, such as the area at the mouth of the Kusača at the entrance to Mala Paklenica Canyon, the trail to Stražbenica, and Strmac. These activities should be conducted every four years or earlier if necessary.

1.2.3. Undergrowth and bushes need to be removed on most trails and paths to ensure that they are passable, and also as fire prevention measures. These activities are every year in the winter.

1.2.4. Removal of individual trees or shrubs at individual viewpoints or other facilities serving as visitor sites. These activities are to be conducted every four years.

1.2.5. Maintenance of helipads at Anića luka, Anića kuk, Ivine vodice, Velika Močila and Mala Močila, above the Paklenica mountain lodge, Struge, Vlaški grad and Oglavinovac must be done every year for the sake of fire prevention and visitor safety.

1.3. Relict communities

1.3.1. Preservation of old and valuable relict black pine communities is a priority in the National Park – all subordinated to the natural development of this association without outside intervention. These communities will be best preserved without human impact, except in the Ogradica area, along the edges of meadow associations which must be maintained due to their great biodiversity.

1.3.2. Continual monitoring of the development of relict communities will be performed in the associations at Ogradica, Kliment and Velika Močila.

1.3.3. In the black pine associations in Kliment, Velika Močila and Ogradica, woodpeckers and cavity-nesting birds as bioindicators of ecosystem quality in these relict pine associations will be monitored twice annually.

1.4. Forest cultures

1.4.1. Natural processes in all forest cultures will be subordinated to succession in climazonal communities, in this case beech, black pine, and mixed forests, and at lower elevations sub-Mediterranean Dalmatian white oak and hornbeam forests. Monitoring of the development of forests cultures will keep track of overgrowth and the presence of individual species every four years.

1.4.2. In individual associations, particularly at the reception area in Velika Paklenica in the planted Aleppo and black pine cultures, dry vegetation will be removed for fire prevention.

2. Privately-owned forests

2.1. Forests in strict conservation zones (1a and 1b)

2.1.1. Settlement of property rights pertaining to forest plots, to determine the precise percentage and spatial layout of privately-owned forests in strict conservation zones. These activities are to be conducted in the first five-year period due to their priority status.

2.1.2. Exercise pre-emptive purchase rights to individual forest plots inasmuch as they have floristic significance and contribute to local biodiversity. Do so every five years due to priority status.

2.1.3. Possibility of offering compensatory firewood to forest owners if they hold plots in strict conservation zones.

2.2. Forests in other zones (2 active conservation zones and 3 usage zones)

2.2.1. Settlement of property rights involving forest plots, to determine the precise percentage and physical layout of privately-owned forests in strict conservation zones. These activities are to be conducted in the first five-year period due to their priority status.

2.2.2. Establish cooperation with forestry advisory service in the remittance of firewood.

3. Projected resources to achieve Action Plan

The necessary resources to achieve the objectives of the Action Plan include the additional engagement of human resources in the National Park. Periodic monitoring of the condition and development of ecosystems at existing permanent surfaces will require the hiring of four additional staff members who will work periodically for two days. The existing equipment in the National Park will be used, which should be supplemented with new measurement devices and an altimeter.

4. Funding sources

All planned activities will be financed from the revenues of the Paklenica National Park Public Institution, the central state budget and other funding sources. The total planned funds to implement all activities under the action plan are HRK 735,000.00, which over a period of 10 years (from 2008 to 2017) is an average of HRK 73,500 annually.



5. Action Plan – tabular overview

Objective	Activity	Measurable result	Verification methods	Required inputs	Input costs
PRINCIPAL OBJECTIVE: Management of privately and publicly-owned forests in Paklenica National Park					
1. Publicly-owned forests					
1.1. Forests					
Secure natural and unimpeded growth of forest ecosystems where this does not threaten other vital ecosystems	1.1.1. Periodic monitoring of condition and development of forest ecosystems on existing permanent surfaces (3 surfaces, detailed measurements every 5 years)	Key structural data, no. of species, coverage, vegetation layers	Comparative analysis with help of database	4 staff members, 2 days each, equipment must be supplemented with new measurement tools and one altimeter Cooperation with Forestry Faculty in Zagreb	Part of regular operations of Paklenica National Park Public Institution
	1.1.2. Collection of precipitation and water samples from permanent surfaces (1 surface, 1 x monthly)	Results of analysis of gathered water samples.	Comparison with previous results obtained on same surface and with data from other parks.	1 national Park employee, Project leader Boris Vrbek, Ph.D.	Costs of National Park employees within regular operations and costs of project leader and sample analysis
	1.1.3. Collection of floristic samples on fire-burned surfaces (1 surface, 1 x monthly in vegetation period)	Essential structural data on surface, no. of species, coverage, layers, soil condition. Development of herbarium	Comparison with associations of the same phytocenological type within the National Park where no wildfires occurred and data from the literature.	1 Employee Cooperation with Botany Department at Faculty of Natural Science and Mathematics, Zagreb.	Part of regular operations of Paklenica National Park Public Institution
	1.1.4. Monitoring development of forest edges in dwarf pine and black pine associations spreading toward meadows	Surfaces of these associations based on habitat map. Expansion of association in specific time unit.	Change in surface association. Comparison with archival data.	1 Employee Cooperation with Botany Department at Faculty of Natural Science and Mathematics, Zagreb.	Part of regular operations of Paklenica National Park Public Institution
	1.1.5. Removal of saplings on specified meadows undergoing succession	Surface and number of cleared meadows, and their spatial arrangement.	Plant and animal scanning of these meadows and comparison with data prior to activity.	5 Park employees Cooperation with Botany Department at Faculty of Natural Science and Mathematics, Zagreb.	Part of regular operations of Paklenica National Park Public Institution
	1.1.6. Monitoring of woodpeckers and cavity-nesting birds at transects twice annually	Establishment of wealth of species and numbers in forest associations	Comparison with existing data, trend in species numbers and numbers of individual species	1 employee of conservation service	Part of regular operations of Paklenica National Park Public Institution

Objective	Activity	Measurable result	Verification methods	Required inputs	Input costs
1.2. Forests in recreation zone					
Visitor safety	1.2.1. Clearing of dry and potential hazardous tree in 15 m belt from trails and paths	Number, type and mass of logged trees.	Comparison of data on cut trees through the year.	National Park conservation and technical service staff. Existing National Park equipment	Part of regular operations of Paklenica National Park Public Institution
	1.2.2. Counter-erosion measures in flood gully areas	Volume of newly-established and maintenance of existing counter-erosion walls and barriers.	condition of flood gullies prior to and after counter-erosion measures, and depth of erosion gully.	National Park conservation and technical service staff. Existing National Park equipment	Part of regular operations of Paklenica National Park Public Institution
Passable trails and paths and scenic experience	1.2.3. Removal of overgrowth on main hiking routes	Mass of removed undergrowth, surface cleared of overgrowth.	Aesthetic experience of forest after action.	National Park conservation and technical service staff. Existing National Park equipment	Part of regular operations of Paklenica National Park Public Institution
	1.2.4. Removal of individual trees around viewpoints and other facilities for visitors	Mass of removed tree, and number of cleared viewpoints.	Visibility from cleared viewpoints	National Park conservation and technical service staff. Existing National Park equipment	Part of regular operations of Paklenica National Park Public Institution
	1.2.5. Maintenance of helipad at Anića luka, Jurasove glavice, Ivine vodice and Velika Močila, Mala močila	Lumber removed from helipads, number of actions at helipads through the years.	Condition of helipad within National Park.	Existing National Park equipment	Part of regular operations of Paklenica National Park Public Institution
1.3. Relict communities					
Preserve old and rare relict black pine communities and facilitation of natural processes	1.3.1. Enable natural processes and natural growth of forest ecosystems without human intervention	Plan no action in relict community areas except their protection from wildfires. Plan trails farther from these associations to prevent any threats to them.	Verification of condition of relict associations every 5 years.	1 employee of conservation service	Part of regular operations of Paklenica National Park Public Institution
	1.3.2. Permanent monitoring of growth of relict communities	Monitoring growth of relict communities through structural parameters (no. of species, presence of individual species, layers, surfaces)	Comparison with previous data on the status of relict communities in the Park	1 employee of conservation service	Part of regular operations of Paklenica National Park Public Institution

Objective	Activity	Measurable result	Verification methods	Required inputs	Input costs
1.4. Forest cultures					
Conveyance of forest cultures in high climazonal communities through natural development	1.4.1. Permanent monitoring of forest culture growth	Monitoring growth of cultures through structural parameters (no. of species, overgrowth, presence of individual species, layers, surfaces)	Comparison with previous data on forest cultures in the Park	1 employee of conservation service	Part of regular operations of Paklenica National Park Public Institution
	1.4.2. Removal of dry growth for fire prevention	Quantity of cleared plant matter from forest cultures.	Soil coverage in forest cultures, quantity of combustibles on soil. Percentage of dry trees and branches inside the cultures	National Park conservation and technical service staff. Existing National Park equipment	Part of regular operations of Paklenica National Park Public Institution
2. Privately-owned forests					
2.1. Forests in strict conservation zones (1a and 1b)					
Transformation of private forest plots to public property	2.1.1. Settle property rights issues involving forest plots	Settlement of property rights to determine exact percentage and spatial arrangement of private forests within strict conservation zones	Settlement of property rights to gain footing on title to all plots within the Park.	National Park services. Relevant ministry. Zadar County zoning planners. Zadar County courts. Zadar County cadastre.	Part of regular operations of Paklenica National Park Public Institution, central budget funds and funds from other sources.
	2.1.2 Exercise pre-emptive purchase rights to forest plots	Surface area of purchased plots from private owners	Comparison with prior data on percentage of ownership of forests.	National Park services. Relevant ministry.	Paklenica National Park's own revenues, budgetary funds.
	2.1.3. Offer compensatory quantities of firewood to forest owners	Quantity of lumber (m ³) offered to forest owners as compensation for lumber they possess in their own forests within the strict conservation zone.	Comparison of lumber offered by years with lumber within the strict conservation zone under private ownership.	National Park services. Relevant ministry.	Part of regular operations of Paklenica National Park Public Institution

Objective	Activity	Measurable result	Verification methods	Required inputs	Input costs
2.2. Forests in other zones (2 active conservation zones and 3 usage zones)					
Securing essential living needs of forest owners and users pertaining to wood	2.2.1. Settle property rights involving forest plots	Settlement of property rights to determine exact percentage and spatial arrangement of private forests outside of strict conservation zones	Settlement of property rights to gain footing on title to all plots within the Park.	National Park services. Zadar County zoning planners Zadar County courts. Zadar County cadastre.	Part of regular operations of Paklenica National Park Public Institution, central budget funds and funds from other sources.
	2.2.2. Cooperation with forestry advisory service in remittance of firewood	Annually remitted lumber (m ³)	Comparison of remitted lumber by years	National Park services. Relevant ministry.	Part of regular operations of Paklenica National Park Public Institution



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Horses at Mali Štirovac, below the peak of Sveto Brdo.







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Vision of Paklenica National Park:

Paklenica National Park remains the most intense expression of Velebit as the largest Croatian mountain, revered in the national mythology, with exceptional value in terms of its plant and animal diversity and geomorphological features. The Park has significant tourism and recreational functions, organized on the principles of sustainability and education at all levels.





Zoning map of Paklenica National Park

