Škocjan Caves

2020 Conservation Outlook Assessment

SITE INFORMATION

Country: Slovenia
Inscribed in: 1986
Criteria: (vii) (ix)

This exceptional system of limestone caves comprises collapsed dolines, some 6 km of underground passages with a total depth of more than 200 m, many waterfalls and one of the largest known underground chambers. The site, located in the Kras region (literally meaning Karst), is one of the most famous in the world for the study of karstic phenomena. © UNESCO

SUMMARY

2020 Conservation Outlook

Finalised on 02 Dec 2020

GOOD WITH SOME CONCERNS

The management of the World Heritage site itself is effective, with good management personnel and a good management system in place. A combination of different designations and protection regimes covers most of the Reka River watershed and helps ensure conservation of the site’s values, although water quality and potential change in flow are of some concern. Given the small size of the site with a very narrow buffer zone near the western boundary, urban encroachment and intensification of development in the vicinity is a serious problem. It is not clear if legal statutes and political will can, in practice, confront and effectively contain the threats. Global climatic changes (temperature rise, changes in water regime) might affect the site in the long-term and several monitoring sites have been established to monitor the cave climate. The recent increase in tourism and its impact on the cave system is another factor that need to be closely monitored.
FULL ASSESSMENT

Description of values

Values

World Heritage values

▶ Exceptional natural karst phenomenon

This exceptional blind valley and cave system comprises over 6 km of underground passages with a total depth of about 250 m, many waterfalls and one of the largest known underground chambers (Blatnik et al., 2020). The site is located in the Kras region (Karst in German) and is one of the most famous districts in the world for the study of karst phenomena, arguably part of the cradle of karstology (World Heritage Committee, 2014). The Reka River, with an average flow of 8.2 m³/s and flood flows to 387 m³/s, suddenly disappears underground into a canyon passage averaging 20-30 m wide and 30-110 m high. The river roars down cascades and over waterfalls passing through the huge Martel Chamber, 2.55 million cubic metres in volume (Walters and Hajna, 2020), beyond which exploration is limited by the river flowing into a sump where the ceiling descends to river level. The halls and chambers are profusely decorated by speleothem formations (World Heritage Committee, 2014). Upper level cave passages provide evidence of stages in the development of the cave network.

▶ On-going geological karst processes

An impressive array of exceptional karst manifestations, the result of past and present geological, geomorphological, speleological and hydrological processes, are clearly at display for scientists and visitors alike within a relatively small area. The heart of the site, the main cave system with the underground stretches of the Reka River, has been formed in a thick layer of cretaceous limestone. The constantly dynamic system is an outstanding textbook example of contact Karst with well-developed features, such as a blind valley, collapsed dolines, openings, chasms and caves (World Heritage Committee, 2014).

▶ History of cave exploration

Ever since the first explorations and scientific studies were carried out in the 19th century, the cave system has been considered one of the most important karst features in Europe. Since then, all organisations responsible for it have maintained the cave system in good condition. The caves were first explored by Svetina in 1839, who descended 100 m into the Reka. Speleological research began in 1851 (and continues to date), and was followed by visits in 1893 and in 1894 by the famous speleologist Martel, who published accounts in the book ‘Les Abimes’. The most important cave exploration was undertaken in the period 1884-1921 by the German-Austrian Mountaineering Society (DÖAV) and locals (IUCN Consultation, 2020a). The explored cave system is 6.2 km long and 250 m deep (Blatnik et al., 2020). A new entrance has been recently discovered (IUCN Consultation, 2020b).

Other important biodiversity values

▶ Combination of alpine and Mediterranean ecosystems and species

A mixture of habitats is represented corresponding to the floras of Central Europe, the Mediterranean, Submediterranean, Ilyrian and Alpine, all of which are present side by side. Some endemic, rare and threatened species including Orobanche hederae, Lamium wettsteinii, Campanula justiniana, Primula Auricula and Adiantum capillus-veneris, are found in the site (Mulec, 2018).
Underground fauna with endemic species

The geological diversity of the site supports an equally fascinating biological diversity, which has important implications for land and water management (World Heritage Committee, 2014). Subterranean habitats are available in narrow fissures and voluminous cave passages and rivers. The wider region has more than 200 species of troglobitic animals specialised for subterranean environments. Up to date, 30 troglobionic species have been found in the Škocjan Caves, 16 stygobionts (fauna living within groundwater systems) and 14 terrestrial troglobionts (Blatnik et al., 2020). Cave beetles are especially common. In the surrounding park area there is a highly diverse bat population with, so far, 25 known species. Škocjan Caves host one of the biggest population of Schreibers's long-fingered bat (Miniopterus scheibersii), exceeding 8,000 individuals (Blatnik et al., 2020), as well as large colonies of the Long-fingered bat (Myotis capaccinii). Other species that can be found in the caves during hibernation or in maternity colonies are the greater horseshoe bat (Rhinolophus ferrumequinum), the lesser horseshoe bat (Rhinolophus hipposideros), the barbastelle (Barbastella barbastellus) and the common noctule (Nyctalus noctula) (Škocjan Caves Management Plan, 2019-2023). The surface flora and fauna are also rich, because of the diverse landscape and special microclimatic conditions associated with enclosed depressions in karst terrain.

Assessment information

Threats

Current Threats

Current threats to the World Heritage values come mostly from outside (urbanisation, infrastructure development and water quality). Water use in the Reka River catchment, affecting discharge into the cave, is currently not having a major impact on the existing water regime. However, this could change if new reservoirs were to be constructed, and especially in combination with changes to the local water regime caused by ongoing global climate change. Some minor threats also come from an increasing tourism pressure. The natural beauty and natural phenomena of the site are at present hardly affected, but very noticeable changes in land development, such as construction of windmills, are occurring around the park.

Dams/ Water Management or Use

(Water level and water flow, impact on natural processes, impact on aesthetic value)

The underground river canyon of Škocjan Caves was cut into the limestone bedrock by the Reka River (World Heritage Committee, 2014). In the early 1980s, two reservoirs - Klivnik and Mola - were built in the upper Reka catchment (IUCN, 1986). Apart from drinking water supply, water permits in the Reka catchment have also been issued for hydro powered flour- and sawmills, and for abstraction for irrigation of agricultural land. The current use of water is not having a major impact on the existing water regime and water quality of the Reka River and has not posed any risk or danger to the environment (Škocjan Caves Management Plan, 2019-2023). However, the construction of a new dam and creation of a water reservoir (for drinking water) on a tributary of the River Reka, the Padež, has been discussed for decades. If it were constructed, then river discharge into Škocjan Cave would be directly affected (World Heritage Committee, 1996). At present, there are some new ongoing discussions on the issue, but no information is currently available (IUCN Consultation, 2020a). For a more precise assessment of the situation, further analyses should be carried out. Prior research on possible risks and consequences, as well as available water quantities in the Reka River should be made before issuing any further water permits (Škocjan Caves Management Plan, 2019-2023).

Renewable Energy

(Windmills)

Wind farm construction in the area of the Vremscica ridge has not progressed, the negotiation process
for construction at the Volovja Reber ridge is still ongoing (World Heritage Committee, 1996). There are a few new proposals for wind farms in the vicinity of village of Volce, but these have not been accepted yet (IUCN Consultation, 2020a).

▶ **Tourism/ visitors/ recreation**

(Tourism)

There has been a significant increase of visitors to the cave. In the last decade, visitor numbers have doubled, from 100,000 per year in 2008 to 200,000 in 2019 (Škocjan Caves Management Plan, 2019-2023; IUCN Consultation, 2020a). Although the management of tourist traffic is efficient, the impact of increased visitation on the cave ecosystem should be evaluated (IUCN Consultation, 2020a and b). Studies have shown a significant impact of tourism on airborne particles in the cave, including increased concentrations of bacteria and microbial load (Mulec et al., 2017), and problems with “lampenflora”, growing around artificial lights in the cave (Škocjan Caves Management Plan, 2019-2023). There has also been an expansion of airport facilities north of the park that adds to traffic and noise (IUCN Consultation, 2017).

▶ **Habitat Shifting/ Alteration, Temperature extremes**

(Climate change)

Ongoing global climate change will bring changes to the local water regime (IUCN, 1995). The underground system might face even bigger oscillations in the future, prolonged periods of low water regime, and extreme floods. A big flood in 2019 destroyed some of the tourist infrastructure in the cave (IUCN Consultation, 2020b). As air and water temperatures rise, surface flora and underground fauna will be forced to adjust (World Heritage Committee, 1995). This may impact on relict Alpine plant species that grow together with Mediterranean species thanks to particular local climatic conditions.

▶ **Water Pollution**

(Water quality)

Up until the 1990s, the Reka River was one of the most heavily polluted rivers in Slovenia, mainly due to the organic acids and fibreboard factories in Ilirska Bistrica, a settlement in the buffer zone and in the catchment of the Reka River. Pollution prevention works were initiated with the construction of wastewater treatment plants and reservoirs for low flow recharge. In the nineties, the industrial production decreased and so did the pollution levels (IUCN, 1986; Šraj et al., 2008; WWF, 2011). However, continuing regional development, including an expanding wood industry, adds an unknown continuing threat (IUCN Consultation, 2017), as industrial wastewater is not collected and treated appropriately (Škocjan Caves Management Plan, 2019-2023).

The water quality of the Reka has considerably improved in recent years due to the river’s self-cleaning capability; nevertheless, some organic pollution events are occasionally detected flowing into the cave system (Blatnik et al., 2020; IUCN Consultation, 2020b; WWF, 2011; Škocjan Caves Management Plan, 2019-2023). Wastewater is still a major issue in the catchment, as most of the villages in the buffer zone still do not have any organised municipal wastewater collection or treatment systems. Leaks from cesspits, or direct discharge into the river, affects the water quality in the Park and might pollute the cave system. Agriculture might also contribute to pollution, especially from pesticides, fertilisers and improperly managed manure storage (IUCN Consultation, 2020a; Škocjan Caves Management Plan, 2019-2023).

Another significant danger is traffic accidents and leakages from trucks that transport petroleum products and hazardous materials. A considerable number of illegal waste dumps still exists in the Park’s surroundings, and the rehabilitation of the Globovnik industrial waste dump that was used by the organic acids factory in Ilirska Bistrica remains an unresolved issue. Micro-plastic in the river, as well as plastic waste floating into the cave during heavy rainfall, are also of increasing concern (Škocjan Caves Management Plan, 2019-2023).

Although the current chemical water quality is assessed as good, there still are several threats that require ongoing monitoring.
Commercial/ Industrial Areas
(Urban development)

There is limited development in the World Heritage site, but ongoing developments in the buffer zone, as well as encroaching urban and commercial development nearby. Given the small size of the site (401 ha), urban expansion and intensification in the vicinity are a serious problem, especially because the western boundary of the core zone abuts a motorway corridor at Divača. Two industrial zones have been constructed close to the World Heritage site. Plans for setting up the third such zone have temporarily been abandoned, mainly for commercial reasons (low success of the previous two zones) (World Heritage Committee, 1996). However, increasing activities in industrial zones might affect the underground ecosystems (IUCN Consultation, 2020b). There are also plans to reopen a limestone quarry in the buffer zone (IUCN Consultation, 2020a).

Potential Threats

Various developments outside the World Heritage site have serious potential to negatively affect the World Heritage values by impacting severely on aesthetics (visual impacts and noise up to the park boundary), by damaging the quality of natural processes (water flow, water pollution) and by reducing the resilience of the natural ecosystem, including its flora and fauna (terrestrial and aquatic), because of habitat destruction in the buffer zone and adjacent areas. Global climate changes might also affect the biological values of the site, but more gradually.

Roads/ Railroads
(Motorway)

New motorways have been constructed adjacent to the core zone of the World Heritage site and a national spatial plan is being prepared for the Postojna/Divača-Jelšane motorway section in the transitional area (Škocjan Caves Management Plan, 2019-2023). A second railroad track of the Divača-Koper railway line is also under construction (IUCN Consultation, 2020a). Expansion of other corridors may be under consideration, as well as continuing expansion of urban and commercial zones (World Heritage Committee, 1996).

Renewable Energy
(Hydropower and water captation)

There is potential for construction of further freshwater reservoirs in the Reka basin because of interest in further freshwater supplies. Construction of a dam with a water reservoir on the Padež River, which would directly affect river discharge into Škocjan Cave, has been discussed for decades (World Heritage Committee, 1996). At present, there are some new ongoing discussions on the issue, but no information is currently available (IUCN Consultation, 2020a).

Housing/ Urban Areas
(Urban development)

Development pressure from neighbouring Trieste, Divača and other areas has been high over the last few decades (housing, industrial and commercial areas, motorways, etc.) and will inevitably continue into the future. National spatial plans are currently being prepared for the Postojna/Divača-Jelšane motorway section and the M8 Kalce-Jelšane transportable gas pipeline in the transitional area. Plans are also in preparation for the construction of two wind farms in the municipality of Divača (Škocjan Cave Management Plan, 2019-2023).

The World Heritage site is very vulnerable because it is small (4.1 km2), has no effective buffer zone on its western boundary, and has an actively occupied buffer zone with increasing development on its eastern (upstream) boundary. Hence, urban expansion and encroachment cannot be sustained without seriously damaging World Heritage values: there is almost no margin for further encroachment (IUCN Consultation, 2017).
Overall assessment of threats

High Threat

Threats to the World Heritage values of the site are still contained, but the site is small and surrounded by encroaching development that impacts the aesthetics by visual intrusion and noise, and affects the quality and quantity of water infiltrating underground. Urban encroachment and intensification of development in the vicinity is a serious problem, especially if it occurs in the upstream Reka catchment.

Global changes (temperature rise, changes in water regime) are beyond the control of management authorities, but might also affect the site in the long term, although the rate of change is slow.

Protection and management

Assessing Protection and Management

Management system

Mostly Effective

The Škocjan Caves World Heritage site has a good and efficient management system in place (World Heritage Committee, 1996; World Heritage Committee, 1995). Responsibility for overseeing the implementation of the management plan and monitoring its effectiveness lies with the Slovenian Ministry of Environment and Spatial Planning and the Council of the Škocjan Caves Park Public Service Agency (IUCN, 1995). In 1999, the Agency took over the management of the entire cave system and the related infrastructure. It plays an important role in developing and promoting sustainable tourism and providing educational programmes for the local population and the local community in the Park. The Agency also performs several activities, for instance it prepares the management plan for the Park, supervises maintenance and protection, monitors the status of natural assets and cultural heritage in the Park, coordinates research, participates in international projects and manages the Information Centre. A new management plan for the period 2019-2023 has been adopted. It has six management objectives, which are subdivided into operational objectives that are further broken down into tasks and activities. Each task has an estimated cost and an evaluation method outlined (Škocjan Caves Management Plan, 2019-2023).

Effectiveness of management system

Highly Effective

The Park has very competent and dedicated staff who implement the Management plan (World Heritage Committee, 1995). As of December 2017, the agency had 23 permanently employed workers and two fixed-term employees, including the Director (IUCN Consultation, 2020a; Škocjan Caves Management Plan, 2019-2023). The site has access to adequate professional staff across conservation, promotion, interpretation and particularly education. In the last years the visitor management has improved through e.g. activities for spreading the visitors over the year and limitation of number of visitors (IUCN Consultation, 2020a), but the increasing number of visitors is putting some pressure on the staff. The site is involved in research and international projects and also benefits from a substantially large group of volunteers, derived from the local community and conservation specialists.

The management plan 2019-2023 was drawn up on the basis of status analyses carried out by the managing authority of the site. An analysis of strengths, weaknesses, opportunities and threats (SWOT) showed that good management of nature protection is one of the strength of the site. More than 90% of the objectives laid down in the Decree on the Programme for Protection and Development of the Škocjan Caves Park for the 2013-2017 period were evaluated as successfully realised. The effectiveness of the implementation of the current management plan will be monitored through annual programmes and reports prepared on the basis of the five-year programme. At the end of the plan period in 2023, an analysis of the implementation of planned activities and the realisation of individual long-term goals will be conducted (Škocjan Caves Management Plan, 2019-2023).

The Škocjan Caves Park, despite limitations in staffing and funding, is still achieving its conservation
objectives at a high level (IUCN Consultation, 2017; World Heritage Committee, 1996).

▶ **Boundaries**

The core boundary of the World Heritage site is adequate, but the buffer zone, established by the Regional Park law in 1996, is inadequate along the western border near the motorway and Divača, although there is little scope for its improvement (IUCN Consultation, 2017).

▶ **Integration into regional and national planning systems**

There is reportedly good planning at state level (World Heritage Committee, 1995). The management plan must be taken into account by the municipalities located within the Park and its buffer zone when preparing their municipal spatial plans. The guidelines for planning other activities in the Park such as agriculture, forestry, water management, fishing, hunting, mineral extraction, industry, crafts and entrepreneurship must be based on services responsible for individual areas (Škocjan Caves Management Plan, 2019-2023).

Spatial planning in the Park's protected area is based on the Ordinance amending the spatial components of the long-term and social plan for the Divača Municipality and the Ordinance on spatial management conditions for the Divača Municipality. The Divača Municipality is currently preparing the municipal spatial plan pursuant to the Spatial Planning Act. Some concern exist regarding urban, infrastructure and commercial development in the vicinity of the site, such as the Postojna/Divača-Jelšane motorway section, the second track of the Divača-Koper railway line, and the M8 Kalce-Jelšane transportable gas pipeline in the transitional area, as well as wind farms in the municipality of Divača. A sound spatial plan of the Municipality of Divača for the Park would enable the Park to better achieve its management objectives. Particular attention should be given to solving important infrastructural issues in the area of the Municipality of Divača, which should be adapted to the rise in the number of visitors to Škocjan Caves that has been noted in recent years. Another matter of key importance is the involvement of the Škocjan Caves Park Public Service Agency in the planning of regional and national activities in the Park's area of influence and transitional area (Škocjan Caves Management Plan, 2019-2023).

▶ **Relationships with local people**

There is good integration of local villages in the planning and operation (UNESCO, 1993; World Heritage Committee, 1995). The management of the site has stimulated an effective collaboration with the local community and excellent collaboration between the site authorities and the communities should be highlighted (World Heritage Committee, 1996). Representatives from the municipality of Divača and other local communities also formally take part in the park’s activities through the Škocjan Caves Public Service Agency and selected boards and events (IUCN, 1995).

The involvement of local people took on a new dimension in 2014 with the establishment of committees aimed specifically at involving local communities in the participation process and work of the Park. All the committees take part in professional training courses, thematic walks and public awareness campaigns. Members of the Nature Protection Committee have also actively participated in the monitoring of bats. Since 2007, the Belajtnga cave festival has been organized every year in the context of the Škocjan Caves Park Day together with the local population and stakeholders. This festival is an opportunity to present selected producers of traditional and sustainable products and services as well as educational and cultural activities (Debevec and Kranjc, 2019).

However, communication with local residents within the Park could be improved and one of the operational objectives of the management plan is to actively involve the local population, who has been traditionally connected with the caves, in the activities of the Park’s managing authority concerning the protected area in order to strengthen their identity and a sense of belonging (Škocjan Caves Management Plan, 2019-2023).

▶ **Legal framework**

A good legal framework exists, but land and water resources limitations may influence effective implementation (IUCN, 1995; World Heritage Committee, 1995). The region of the Škocjan Caves was declared the Škocjan Caves Regional Park by the Parliament of the Republic of Slovenia in 1996.
(Debevec and Kranjc, 2019). The site is protected under the Nature Conservation Act since 1999 (amended in 2014) and the Cultural Heritage Protection Act (Novak and Stupar, 2018). Other key regulations governing the protection and management of the Škocjan Caves Regional Park are the Škocjan Caves Regional Park Act Decision on the Establishment of the Škocjan Caves Park Public Service Agency and Natura 2000 (IUCN, 1995; Škocjan Caves Management Plan, 2019-2023).

**Law enforcement**

Data Deficient

No data were available.

**Implementation of Committee decisions and recommendations**

Mostly Effective

Improvement of the legal framework in the 1990s has taken place according to the World Heritage Committee’s recommendation (IUCN, 1995); environmental threats are taken into consideration (World Heritage Committee 1996; IUCN, 1995). There have been no recent Committee Decisions since 2014 when the Committee adopted the Retrospective Statement of Outstanding Universal Value for this site (World Heritage Committee, 2014).

**Sustainable use**

Mostly Effective

There is limited scope for sustainable use of natural resources within the World Heritage site, although tourism appears to be managed sustainably the increased visitation in the last years should be evaluated (IUCN Consultation, 2020b). Most activities occur within the surrounding cultural landscape (buffer and transition zones).

**Sustainable finance**

Mostly Effective

During the previous five-year period (2013–2017), the Škocjan Caves Park Public Service Agency received about €12.6 mio of revenue (19 %) from the state budget, 63 % from revenues from the park’s own activities (cave entrance fees, souvenirs and rents), 1 % from the Farmland and Forest Fund of the Republic of Slovenia and 17 % from international financing from EU projects (IUCN Consultation, 2020a; Škocjan Caves Management Plan, 2019-2023). In 2019, the main source of financing was from tourism activities at about 83% of the budget; the rest of the budget was comprised by the state budget (12%) and EU projects funding (5%) (IUCN Consultation, 2020a).

**Staff capacity, training, and development**

Highly Effective

The Škocjan Caves World Heritage site has well qualified staff in various fields of management and strong participation in international conferences and workshops (World Heritage Committee, 1995), especially those related to the World Heritage, MAB and Ramsar Conventions, as well as EUROPARC, ISCA, Dinaric Parks (IUCN Consultation, 2020a). As of December 2017, the Škocjan Caves Park Public Service Agency had 23 permanent employees and two fixed-term employees, including its Director. The Agency also employs a number of seasonal workers (guides, trainees). The need for additional employees in the Agency has become a constant due to the trend of growing number of visitors in recent years. The employment of three additional workers in the General Affairs Service is planned for the next five years (IUCN Consultation, 2020a; Škocjan Caves Management Plan, 2019-2023).

**Education and interpretation programs**

Mostly Effective

There is adequate awareness of World Heritage among visitors, local communities, businesses and local authorities (IUCN, 1995). Frequent school activities and special events (World Heritage Committee, 1995) are held in the caves and in the surrounding villages. There is an education strategy in place. The Park organises professional and scientific conferences and a number of conferences organise excursions to the park from other parts of Slovenia. There are seasonal and thematic excursions and public events on a regular basis (IUCN, 1995).
Since its establishment, the Škocjan Caves Park Public Service Agency has devoted particular attention to educational programmes. The Park’s international School Network educational programme, launched in 2003, has been awarded for its outstanding achievements in the field of primary school education by the Ministry of Education, Science and Sport of the Republic of Slovenia and commended as a model project by the International Co-ordination Council of the Man and the Biosphere Programme. The Park also encourages students to carry out research for their seminar papers, and undergraduate and Master’s dissertations related to the conservation and development of natural and cultural heritage, and to sustainable development (Debevec and Kranjc, 2019).

The Škocjan Tourist Association was established in 1993 by the inhabitants of the Park to encourage development and protect their interests. The Association also organises various culture workshops and workshops for children from the Park (Škocjan Caves Management Plan, 2019-2023).

**Tourism and visitation management**

There is an efficient management system for the control of visitors and the quality of their experience (World Heritage Committee, 1995). Tičar et al. (2018) showed that the site has a leading geotourism role and that the management of tourist caves via a regional park, as is the case of Škocjan Caves, is an example of good practice. However, there are some aspects which would benefit from regular monitoring and adaptation.

Visitors to Škocjan Caves are mostly seasonal, coming from spring to autumn (the high season). One of the goals is to attract more visitors in colder seasons. In 2008, the number of visitors reached 100,000 per year. In 2016, the number had increased to almost 150,000 and in 2019 it reached 200,000. (Škocjan Caves Management plan, 2019-2023).

There are three museum collections and a tourist information centre. The park has walking and cycling trails, as well as a specialised education trail (IUCN, 1995, World Heritage Committee, 1995). A building with conference room has been purchased and equipped (World Heritage Committee, 1995). Signage to the World Heritage site is adequate and the World Heritage emblem is used on publications (IUCN, 1995).

The infrastructure within the caves has recently been renovated. The restriction of lampenflora growth represents one of the major challenges for cave managers. To address this, the old heat-emitting lamps were replaced by an LED lighting system in 2014, with the possibility of fine-tuning the emission spectrum to minimise growth (IUCN Consultation, 2020b; Škocjan Caves Management Plan, 2019-2023; Mulec 2015). Due to the increased visitation, there is also a risk of alterations of the cave microbiome. In order to preserve the underground ecosystem in the frame of sustainable cave management, the impact of increased visitation on cave ecosystem should be evaluated (Blatnik et al., 2020). Introduction of new tourist infrastructure or its restoration should be carefully planned and an estimation of tourist carrying capacity undertaken (IUCN Consultation, 2020b).

**Monitoring**

A strong formal monitoring programme exists, in particular, for water quality and environmental factors, as well as tourist traffic (IUCN, 1995; World Heritage Committee, 1995), and new technologies have recently been established. It is very important that this monitoring programme is maintained, given the surrounding development pressures and recent increase in tourism.

The Škocjan Caves Park cooperates with the Environmental Agency of the Republic of Slovenia and the Karst Research Institute ZRC SAZU in the performance of measurements and analyses of a complex system of ecosystems. The Professional Service, which operates within the framework of the park, aims to establish the park’s infrastructure for the performance of measurements and, in combination with national monitoring, prepares more detailed inspections and monitoring of the state of the park.

**Research**

The area has a long tradition of cave research (> 150 years) and there are several ongoing research programmes (IUCN, 1995). These have included risk assessment, studies relating to the value of the site, monitoring exercises, archaeological surveys, visitor management and tourist impact monitoring, rural sociology studies and occupational safety studies. In addition, there are international projects aimed at detailed archaeological, hydrological, sociological and educational research. Some hydrological
measurements were performed under the framework of the Slovene programme of the International Hydrological Programme – UNESCO and International Geoscience Programme. Cave exploration is still in progress and there are ongoing speleological, geodiversity, 3D mapping, cave wildlife and microorganism research (IUCN Consultation, 2020a; Knez et al., 2020; Walters and Hajna 2020; Moldovan et al., 2018; Stepišnik and Trenchovska, 2018).

### Overall assessment of protection and management

The site has a very good management system supported by highly qualified staff, and an active scientific and educational programme in place. However, there is limited ability to influence what occurs in the surrounding area. Statutes provide legal protection, but in practice encroachment of urban, infrastructure and commercial development poses serious threats.

In recent years, there has been a significant increase of visitors to the cave and although tourist management is mostly effective, the impact of increased visitation on the cave ecosystem should be evaluated, and carrying capacity and infrastructure development assessed. This would require some additional funding and staff capacity.

- **Assessment of the effectiveness of protection and management in addressing threats outside the site**

  There is a certain level of legislative protection applied to the whole watershed of the Reka River, including the Biosphere Reserve. Protection within the World Heritage site is effective, but outside and adjacent to the site active land development, infrastructure planning and commercial activities are occurring with apparently little regard to the impacts on World Heritage values. The buffer zone is inadequate along the western border near the motorway and municipality of Divača.

- **Best practice examples**

  In 2003, the international Park’s School Network was established. The School Network has organised numerous workshops, excursions, exhibitions, and similar events. The School Network’s contribution to fostering sustainable development and the protection of natural and cultural heritage is evident in numerous publications and other material. Schools in the School Network include cooperation with the Park in their annual work programmes. In 2016, the Ministry of the Republic of Slovenia of Education, Science and Sport presented the Škocjan Caves Park Public Service Agency with an award for its outstanding achievements in the field of primary education. The programme has also been recommended by the International Co-ordination Council of the Man and the Biosphere Programme as a model for cooperation and networking in the field of sustainable development education (Škocjan Caves Management Plan, 2019-2023).

### State and trend of values

#### Assessing the current state and trend of values

**World Heritage values**

- **Exceptional natural karst phenomenon**

  The natural beauty of the site is hardly affected for the time being, but encroaching development around the World Heritage site (visual and noise intrusions from construction and infrastructure) may seriously affect aesthetic conditions within the core zone of the park (IUCN Consultation, 2017; World Heritage Committee, 1996; World Heritage Committee, 1995). The impacts of increasing visitation and the development of new tourist infrastructure or its restoration should be carefully assessed (IUCN Consultation, 2020b).
On-going geological karst processes

The state of the natural values is assessed as good. Natural processes in caves and collapsed dolines are mostly undisturbed. Entrances to the Škocjan Caves system are closed with doors and video surveillance in order to control visits and prevent possible damage (Škocjan Caves Management Plan, 2019-2023).

Some changes (construction of reservoirs, industry) occurred upstream in the past, which affected the water quality and flow regime (Šraj et al., 2008; WWF, 2011). These problems are now largely resolved. Land use and cover over the cave is largely natural vegetation, so percolation processes into the cave are maintained in an essentially natural state. Global climate changes are likely to affect water balance gradually in the future.

History of cave exploration

Exploration and scientific research are ongoing and are efficiently regulated (IUCN Consultation, 2017; IUCN, 1995; World Heritage Committee, 1995) and a good monitoring programme is in place.

Summary of the Values

Assessment of the current state and trend of World Heritage values

Values like natural physical phenomena and karst processes are very resilient. However, as the development of surface and underground karst features are still evolving, increasing the tourist infrastructure and surfaces, as well as measures impacting the quality and quantity of the river flow should be avoided (IUCN Consultation, 2020b).

Threats to these natural processes within the site are limited and are well managed in the cave, but the general environment is subject to increasing impact on the surface through development in the buffer zone, including in the Reka basin, and visual intrusion and noise introduced by encroaching development, especially along the motorway corridor (IUCN Consultation, 2017). In addition, global climatic changes introduce gradual low level threats that are beyond control of site management.

The trend was one of improvement as the problem of the water quality of the Reka River was addressed, but now urban, commercial and transport development has emerged as a major threat.

Assessment of the current state and trend of other important biodiversity values

The plant and animal populations in the dolines and caves appear to be stable and resilient to natural events (floods, water regime variation). However, global changes might modify the climatic conditions in the dolines, and thus affect the relict plant species, as well as the rare and endemic underground fauna (IUCN, 1995, World Heritage Committee, 1995). Pollution in the Reka River has decreased in recent years, and the situation may be improving in the subterranean environment, although probably not on the surface as development is changing land cover in the region around the park. Factors such as excessive use of pesticides and fertilisers, removal of hedges, discharge of municipal wastewater, introduction of non-native invasive species, sports and leisure activities and urbanisation in the Park are also affecting the biodiversity values (Škocjan Caves Management Plan, 2019-2023).

Special notice should be given to the olm, which is an endemic Dinaric species and the only cave vertebrate in Europe that lives in the underground Reka River flow. It is extremely sensitive to any disturbances and pollution of underground water of the Reka River. Bats are regularly monitored and the state of species that appear in the Škocjan Caves are considered stable. However, some pressures to their habitats have been observed, as wintering colonies of some bat species are located along the tourist paths in the cave and artificial lighting of their roosting places has negative impacts. There is a need for additional adaptation of lighting of the old tourist path during

Additional information

Benefits

Understanding Benefits

► Outdoor recreation and tourism,
   Natural beauty and scenery

Extensive and well maintained walking path network above and below ground, villages with tourist facilities, restaurants, information centres, etc.

An excellent site for both passive and active recreation.

► Direct employment

The Park has generated direct and indirect employment and also contributes a lot to the wider, national economy especially through development of tourism. At the same time, key natural assets are at present well preserved. Some local residents are running accommodation facilities and others are engaged in the production of local products (Škocjan Caves Management Plan, 2019-2023).

► Importance for research,
   Contribution to education

The site has long been important for speleological research, understanding karst processes and the geological history of cave development in the region. The site offers a location where these can be studied and where they can be explained to students and the general public.

Factors negatively affecting provision of this benefit :
- Pollution : Impact level - Low
- Habitat change : Impact level - Moderate, Trend - Increasing

The quality of the cave environment and its ecosystem directly reflects the quality of the external environment to which it is connected.

► Tourism-related income,
   Provision of jobs

With up to about 200,000 visitors coming to the World Heritage site each year, significant income is generated, both directly by the park and indirectly by service providers in the surrounding area. This supports permanent and seasonal jobs in the park and in the surrounding community.

Summary of benefits

The beautiful and awe-inspiring natural scenery and phenomena of the World Heritage site, together with a well-conserved natural environment, lends itself to active and passive recreation and scientific research. Associated tourism provides a sustainable economic benefit to the local community.

Projects

Compilation of active conservation projects

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<th>Organization</th>
<th>Brief description of Active Projects</th>
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<th>Institution/Project Description</th>
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| 1 | Slovenian Environment Agency – ARSO  
Water quality monitoring. |
| 2 | Karst Research Institute, Slovenian Academy of Science and Arts, Meis, storitve za okolje, d.o.o.  
Karst research for sustainable use of Skocjan Caves as world heritage, 2017-2020 |
| 3 | Škocjan Caves Park, Institute of Republic of Slovenia for Nature Conservation, Municipality of Divača, DOPPS-BirdLife Slovenia, Elektro Primorska, Agriculture and Forestry Agency Nova Gorica  
Ensuring appropriate use of Karst dry grasslands and rocky heights to preserve selected habitat types and species in the Natura 2000 'Karst' protected area, 2016-2021 |
# REFERENCES

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