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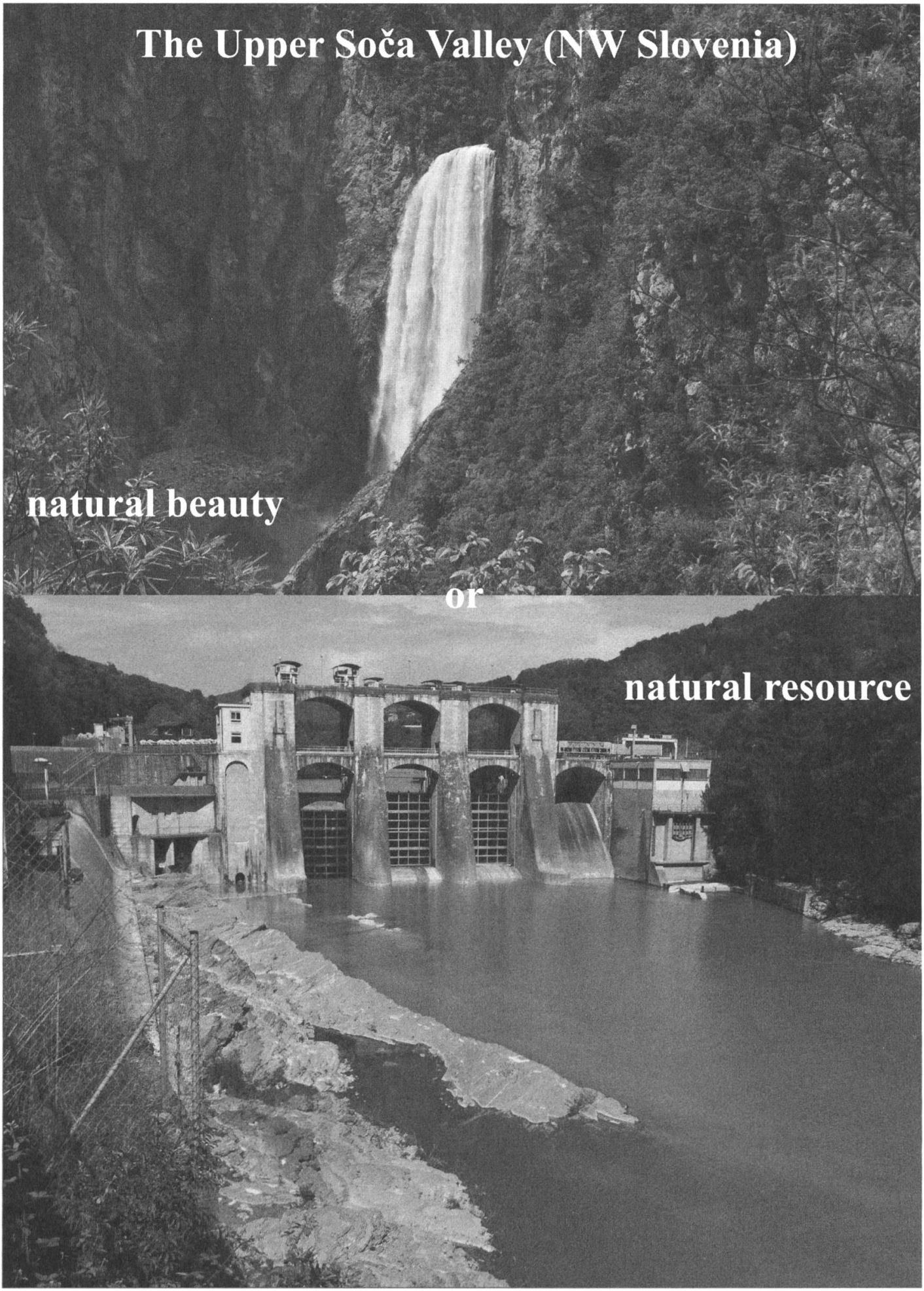
The Upper Soča Valley (NW Slovenia)
natural beauty
or
natural resource

Hydropower Landscape in the Slovenian Alps Pros and Cons for the Construction of Hydropower Plants in the Upper Soča Valley

Blaž Komac, Matija Zorn

Riassunto – Il paesaggio idroelettrico nelle Alpi slovene. Pro e contro per la costruzione di centrali idroelettriche nell'alta valle dell'Isonzo

Prima e dopo la Seconda guerra mondiale, sul fiume Isonzo (Slovenia) furono costruite quattro grandi centrali idroelettriche. Negli anni Sessanta, il regime autocratico autorizzò la creazione di uno sbarramento nei pressi di Bovec, malgrado l'opposizione della popolazione locale e dell'emergente movimento ambientalista. Un decennio più tardi, il movimento d'opposizione al progetto di Kobarid sfociò nell'approvazione della legge di tutela sull'Isonzo. Anche negli anni Ottanta, il progetto di sbarramento del fiume Idrijca si scontrò con una forte opposizione. Attualmente, si progettano nuove centrali idroelettriche, in quanto il suo sfruttamento è ritenuto al di sotto del suo potenziale. In questo articolo, presentiamo lo sviluppo dello sfruttamento idroelettrico di questo paesaggio alpino, analizzandone le ragioni a suo favore e gli argomenti contrari.

Introduction

The Alps are an important source of water[1] for power generation,[2] which has been opposed on account of its environmental and socio-economic consequences.[3] Werner Bätzing[4] identified six phases in the development of hydropower (hereafter, HP) use in the Alps:
– Phase 1 (1890–1920): the first hydroelectric power plants (hereafter, HPP) met the needs of the local economy;
– Phase 2 (1920–1940): the electricity produced in the Alps could feed large industrial centers outside the Alps; in the Alps more than 200 artificial dams were built;

– Phase 3 (1940/55–1970): a further 100 dams or more were built;
– Phase 4 (1970–1990): this period is characterized by the emergence of the environmental movement;
– Phase 5 (1990–2011): aspirations for the use of renewable energy sources led to the construction of pumped storage HPPs;
– Phase 6 (from March 2011/nuclear accident at the Fukushima power plant): new HP initiatives emerged as a result of the phasing out of nuclear energy in some Alpine countries.[5]

Altogether more than 550 large HP structures have been built in the Alps, with a total installed capacity of about 46 GW, most of them in Italy (14.4 GW) and the fewest in Slovenia (0.5 GW).[6] Their large reservoirs are capable of storing about 5 percent of the annual Alpine runoff.[7]

A similar development is observed in the Soča River catchment, Julian Alps (Slovenia), where HPPs currently have an average annual production of 1,100 GWh (the estimated potential is 1,800 GWh).[8]

This article presents the plans for building large HPPs on the Soča River in the period from the 1960s onwards. So far, this topic has not been treated comprehensively in the literature. To fill this gap, we analyzed the contents of virtually all accessible literature on this topic in Slovenia, such as daily newspapers, magazines, professional and scientific publications. We analyzed 185 articles, 93 of which published in the daily newspaper *Delo* (founded in 1959), to identify historical patterns in the changing arguments for the construction of HPPs, and the increased awareness of nature conservation that emerged very early also from a global perspective.

Based on detailed content analysis, we outline the development of HP use and analyze the reasons for and arguments against it, represented by the Ladder of Citizen Participation.

Hydropower in the Soča Valley

The Soča is a 138 km long alpine river that originates in a karst spring in the Julian Alps. It first flows 96 km through western Slovenia before reaching Italy and finally the Adriatic Sea. Its upper reaches are characterized by an alpine snow-rain regime with a spring peak discharge and a 150-fold difference between the minimum and maximum discharge.[9]

The first two HPPs were built in phase 1 (according to Bätzing) when the area belonged to Austria-Hungary.[10] They provided electricity to the Idrija mercury mine (1893, HPP Mesto) and the Cave del Predil lead and zinc mine (1898, HPP Možnica). Both are still in operation.[11] In 1921 (phase 2),[12] when

Fig. 1. Existing and planned HP facilities in the Soča River catchment. Sources: Radinja (see note 8). *Geografski informacijski sistem za področje obnovljivih virov energije*, www.engis.si/portal.html, 7 June 2021. *Soške elektrarne*, www.seng.si/en/hydropower-plants, 5 June 2021.

Tab. 1. Installed capacity and mean annual energy production currently managed by the company Soške elektrarne, with reference to the development phases of the HP network in the Alps. The phases in the table do not add up cumulatively, but indicate new facilities in individual phases (except in the last row)

Phase of HP development in the Alps according to Bätzing	Country at the time	Installed capacity – existing (MW)	Share (%)	Installed capacity – additionally planned (MW)	Mean annual production – existing (GWh)	Share (%)	Mean annual production – additionally planned (GWh)
1 (1890–1920)	Austria-Hungary (till 1918)	0.73	0.22		3.00	0.26	
2 (1920–1940)	Kingdom of Italy	51.44	15.26	49.37*	253.55	21.95	
3 (1940/55–1970)	Yugoslavia			267.60			1,219.00
4 (1970–1990)	Yugoslavia	42.14	12.50	233.00	145.88	12.63	503.00
5 (1990–2011)	Slovenia (after 1991)	241.97	71.77		749.40	64.88	
6 (2011–)	Slovenia	0.85	0.25		3.30	0.29	
TOTAL		337.13	100	549.97	1,155.13	100	1,722.00

* For the year 1921. The plans were changed several times during the Italian period.
Source: Soške elektrarne (www.weng.si/en/hydropowerplants, 5 june 2021).

the catchment was part of the Kingdom of Italy, plans were submitted for the construction of nine HPPs, of which the HPPs Plužna and Log were built. In 1929, a string of five HPPs were planned, of which the HPPs Doblar and Plave were built (Fig. 1). A HPP was planned near Kobarid and one near Tolmin. There were plans to exploit the high-alpine lake Krnsko jezero (1,394 m), now part of the Triglav National Park. At present, the capacity of the HPPs from this period exceeds 51 MW (Tab. 1), with a total electricity production of over 250 GWh a year.[13]

After World War II (phases 3 and 4)[14] initiatives for the HP exploitation of the Soča River emerged approximately every ten years. In the early 1950s, a plan was prepared to build a chain of seven HPPs: Kršovec, Žaga, Trnovo, Gabrje, Solkan and Trebuša, as well as a run-of-river HPP between Lake Bohinj and Tolmin.[15] It was argued that, if the river potential was fully exploited, the Soča

«would provide more electricity than could be generated by all the power plants in pre-war Yugoslavia».[16] In 1952, HPPs on the Soča produced 25 percent of Slovenia's electricity, in 1964 they produced 9 percent and only about 4 percent in the mid-1970s.[17] Although the plans were modified there were heated polemics in the 1960s associated with the construction of the HPP Trnovo, the construction of the HPP Kobarid in the 1970s, and the construction of the HPP Trebuša in the 1980s. Several small HPPs were built in the 1980s, and of the large plants planned, the HPP Solkan (phase 4) and the pump-storage HPP Avče (phase 5) were built (Tab. 1).[18]

The 1960s – the HPP Trnovo

Its construction would create a 80-metre-high dam near Bovec with a reservoir 10 km long and 2 km wide (Fig. 2), and would submerge the Čezsoča village of 300 inhabitants. The capacity was to be 140 MW with an average annual production of 470 GWh.[19] When the plans were presented in 1964, the construction of the HPP «stirred the public like no other similar initiative before».[20]

The government set up a commission, which concluded that the construction was necessary and reasonable, but it would spoil the beauty of the landscape and the river discharge regime.[21] One of its members wrote:[22] «The Commission met at the time of the energy crisis ... [which] ... had a significant impact on the work.» He added that they «had worked for a mere two months, while the HPP had been planned since 1955». A public discussion followed, which was accompanied by reactions from experts with opinion articles and the public with roadblocks and rallies,[23] «a level of resistance never seen [...] before then».[24] The government commissioned the Urban Planning Office to organize a symposium, which took place from 24 to 26 November 1965.[25] Participants spent the first day on-site with the proponents «explaining the plan not in the conditional mode but in the future tense».[26] On the second day, 20 lectures were given, and on the third day, the topic was discussed by more than 40 panelists. The statements were supported by radio and television.[27] According to the minutes,[28] the «problem discussed here is probably one of the most delicate, and has caused such an uproar that we have come to the conclusion that a certain intolerance is to be feared.» The event was an important step toward greater participation in decision-making.[29]

Proponents of construction argued that the HPP would «save» the energy sector, the reservoir would flood areas of «poor quality» and that the lake would be attractive to swimmers.[30] They brought «fans who loudly applauded some speakers and opposed, heckled and booed others».[31]

Opponents emphasized that the area «is considered to be a real national park of Europe».[32] They mentioned «a huge mud-filled depression», the fog, the impossibility of fishing and river erosion.[33] They pointed out concerns about bedrock instability,[34] recalling the catastrophic events in Vajont (Italy),[35] and the negative impact of the HPP on tourism,[36] as the water level would be lowered by 25 meters to 60 meters in September and October.[37] During this period the country was plagued by a «general shortage of electricity»[38] and power outages that caused billions of dollars of damage.[39] The opponents «were branded romantics and sentimentalists, and during the symposium one of the fans «turned off the lights and loudly demanded that the opposing side provide electricity with their romanticism if they could.»[40]

The government then ordered the investor (*Soške elektrarne Nova Gorica – SENG*) to produce an environmental report,[41] which documented so many natural and cultural assets that consent could not be granted. In 1966, the national Assembly postponed the decision for 20 years.[42] The advocates pointed to the necessity of the construction of HPPs on several later occasions.[43]

The 1970s – the HPP Kobarid

In the 1970s, a plan was put forward for a 65-metre-high concrete dam above Kobarid, behind which a 4.5-km-long lake would emerge. A HPP with a capacity 63 MW would produce 183 GWh of electricity annually.[44] As the State faced electricity shortages, emphasis was placed on the economic importance of the HPP.[45] If a decade ago one of the main arguments for construction was to regulate the river regime, in the 1970s it was to reduce flood risk.[46] Local political organizations unanimously supported the project, while the Urban Planning Institute, the Institute for the Protection of Cultural Heritage, and the Society for Environmental Protection were opposed.[47] They were concerned that the HPP[48] «is merely a Trojan horse that would later open the door to full exploitation of the Soča Valley, and argued that it is economically unreasonable to stop halfway.» Despite the opposition, the national Assembly voted in favor of construction in February 1971.

A heated debate was sparked off by the open letter of the Society for Environmental Protection of June 10, 1972, claiming that «the inhabitants of Tolmin are being coaxed, cajoled and given promises».[49] Several public associations demanded that the area be declared a «natural attraction of particular importance.»[50] After the 1976 earthquakes in Friuli, attention was also drawn to this hazard.[51] In October 1978, the magazine *Planinski vestnik* (Mountain Bulletin) published a letter penned by Slovenian communist leader Edvard

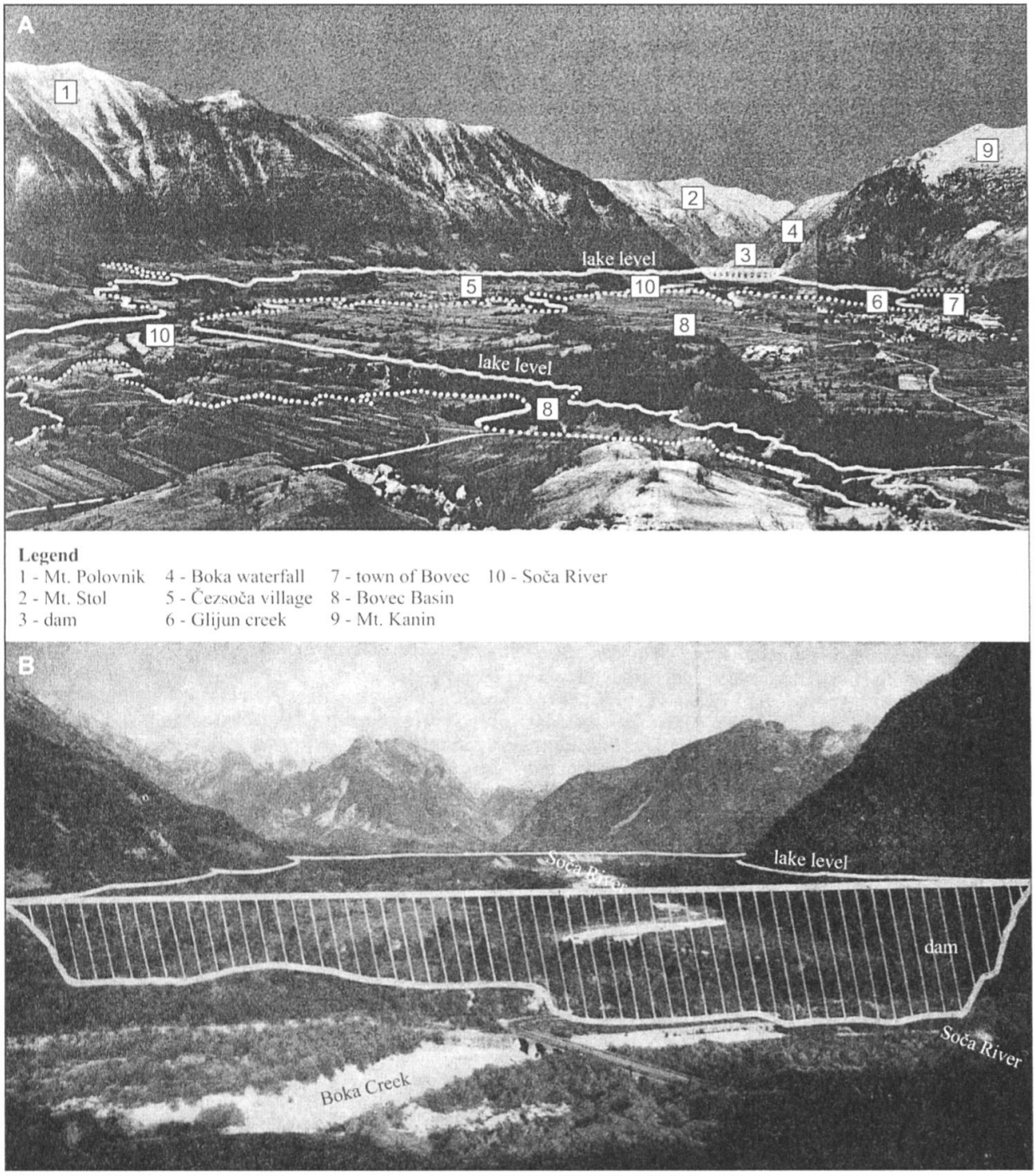

Fig. 2. The reservoir «Bovško jezero» (Bovec Lake); A) that would emerge behind an 80-metre-high dam (B) for the HPP Trnovo. Peterlin (see note 20), p. 139.

Kardelj, claiming that: «unplanned, reckless and irresponsible activities affecting nature, supported by commercialism, consumer mentality, short-sightedness and selfishness of individuals and some groups often cause irreversible

damage.»[52] The Society for Environmental Protection published a memorandum for the protection of the rivers Soča and Idrijca.[53]

These public outcries against the construction can be seen as the background of the growing environmental awareness[54] while local residents, too, were «increasingly opting for the protection of natural beauty».[55] In the 1970s, new laws were passed to protect the environment. The Protected Area of the River Soča and Its Tributaries Act was adopted in 1976 and can be considered the first regulation for safeguarding natural rivers in Europe.[56] In 1980, the construction of the Kobarid, Kamno, and Radovna HPPs was postponed for two decades.[57]

The 1980s – the HPP Trebuša

In the 1980s, a 14 km² lake was to be created behind a 120-metre-high dam on the Idrijca River,[58] and the HPP with a capacity of 170 MW was to generate 320 GWh per year (Fig. 1).[59] Since three villages with 700 inhabitants would be flooded, concerns were raised immediately.[60] Opponents pointed to the changes in the cultural landscape and climate, loss of habitats, and contamination with sediments from the Idrija mercury mine.[61] It was also pointed out that the dam would be located in the area of the active Idrija Fault.[62]

A round table on environmental protection was organized in Idrija.[63] Although the state-organized formal public debate had not yet begun in March 1987, the prognosis for the construction of the HPP was poor because the environmentally aware residents of the valley publicly voiced their opinions.[64] Public demonstrations followed.[65] In a public debate in Idrija, hundreds of participants – among them a «surprising number of young people» – refused to accept «any negotiations».[66] In June 1987, the municipality of Tolmin voted against construction,[67] and the final decision was postponed until 2000.[68] In the early 1990s, investors turned to small HPPs (Fig. 1),[69] a process seen in other parts of the Alps, such as Austria.[70] With the political change in 1990, the reformed communists in Idrija opposed the construction of the HPP Trebuša, and the Slovenian Greens did the same in 1992.[71] In 1990, the Soča River was declared a natural asset of national importance by a decree of the Tolmin Municipality.[72]

Repeated attempts to build dams in the new millennium

In 2011, the Chamber of Commerce and Industry claimed that the National Energy Program proposal to produce high-quality «blue, renewable energy»

made sense in the Soča region, where the power generation «has successfully coexisted with the environment for a century».[73] Later that year, the Energy Act proposed the construction of a 40-metre dam on the Učja River. A feasibility study was conducted, and a public discussion of the plans held in the affected Žaga village, both concluding with a clear ‹no›. Even the plan for the HPP Kobarid was discussed again.[74] The proposed Energy Act contained a provision in Article 565 to simply repeal the 1976 Act that protects the Soča River and its tributaries[75] and stated that even the Nature Protection Act[76] would no longer apply to the Soča River. The Energy Act was the subject of public debate only for a few weeks during the summer. When the Slovenian Academy of Sciences and Arts took a stand against,[77] the Ministry of Environment and Spatial Planning concluded that the construction of HPPs on the Soča «is not allowed».[78] In 2018, this issue culminated in an international campaign *Balkan River Defence*, calling for a halt to plans to build a HPP on the Učja River.[79] In the Balkans, 1,004 HPPs were in operation in 2017, 188 were under construction and 2,796 were being planned.[80]

HP is viewed as environmentally friendly («green», «blue») in energy concepts, although it is acknowledged that it brings more difficulties as its use for energy production «competes» with its uses for drinking and agriculture (irrigation, etc.). It is acknowledged that a technology «relying on large dams» is problematic and that HPPs are unlikely to contribute to decarbonisation to the extent expected.[81] However, SENG stated that it would not withdraw the HPP Učja from its plans.[82] In 2020, the Energy Trading Board concluded that the laws should be amended because the «existing ones do not allow the construction of HPPs».[83] This turned out to be untrue.[84] In mid-May 2020, a letter was published whose author suggests that «the wings of some citizen initiatives should be clipped a little»,[85] complementing one a year older, which stated that by «not using our rivers», we have «forgone the purest renewable water energy».[86]

Discussion and conclusion

We have presented the development of HP use in the Upper Soča Valley in recent decades and shown that it is in line with the development in the Alps.[87] Today, HP is seen as placing considerable pressure on rivers in Europe. In fact, there is on average one barrier per river kilometer,[88] because of which more than 20 percent of freshwater fish species are considered endangered.[89] We have presented the «cascading» attempts to dam the Soča River with tens-of-meters high dams. The first attempt from the 1960s ended with a moratorium

that lasted until the discussion about the HPP Kobarid in the 1970s. In both cases, the arguments against were based on the uniqueness of the river and the limitations of the future development of tourism. In the 1970s, the debate again ended with a moratorium. In the mid-1980s, plans to dam the Idrijca River triggered a heated public debate that led to the formal decision on the project being postponed (again) for 20 years. Later, when the region was used for ski, kayaking and rafting tourism,[90] it was not until the 2010s that new attempts were made to change the legislation and build HPPs on the Učja River.

The arguments for the construction of dams in the Soča River catchment went from «phase 1» addressing local needs (coinciding with phase 1 after Bätzing),[91] to responding to industrialization needs in «phase 2», development needs in «phase 3»[92] (phases 2 to 4 after Bätzing), and sustainable development needs in «phase 4», with HP as representative of green energy (phase 5 after Bätzing; HP has been questioned as «clean» energy in the last years)[93] and addressing the low-carbon needs in «phase 5» (phase 6 after Bätzing). In the future, we expect a new phase of multipurpose reservoirs,[94] e.g. for HP, flood control and as water reserves during droughts,[95] redefining the hydroelectric landscape.[96] Considering the negative trends of the discharges of alpine rivers,[97] this argument might prove to be the strongest, «as they provide drinking and industrial water and are used for electricity generation.»[98]

In the past 60 years, in line with climate change adaptation, the use of HP has no longer been just a basis for local (1960–1970) and regional (1970–1980) economic development, but has become a component of «pure», «blue», «green» (1980–2000) and «low-carbon» (since 2000) electricity generation. From an environmental perspective, the HP generation in the Soča Valley began as a «local solution to regional energy problems» and the negative impacts were local. Today HP generation is a «local environmentally friendly way of solving global environmental problems» with supposedly no negative impact in terms of carbon emissions.[99] Despite being renewable, HP comes along with severe social and ecological adverse effects.[100]

The Ministry of Environment and Spatial Planning claims that no large-scale HPPs will be built in the Soča and its tributaries[101] but they are positive about the construction of small-scale HPPs.[102] Apparently, building new dams is a global trend[103] and the «solution» to future problems,[104] instead of adapting the existing HPPs to the upcoming changes.

The topic discussed reflects the development of nature conservation in Slovenia.[105] It was precisely the public debate on the protection of the Soča River, which took place in the mid-1960s, that played a role in the «awakening» of civil society, particularly the environmental movement,[106] which grew at the same time as the north-American environmental movement.[107] In Alpine coun-

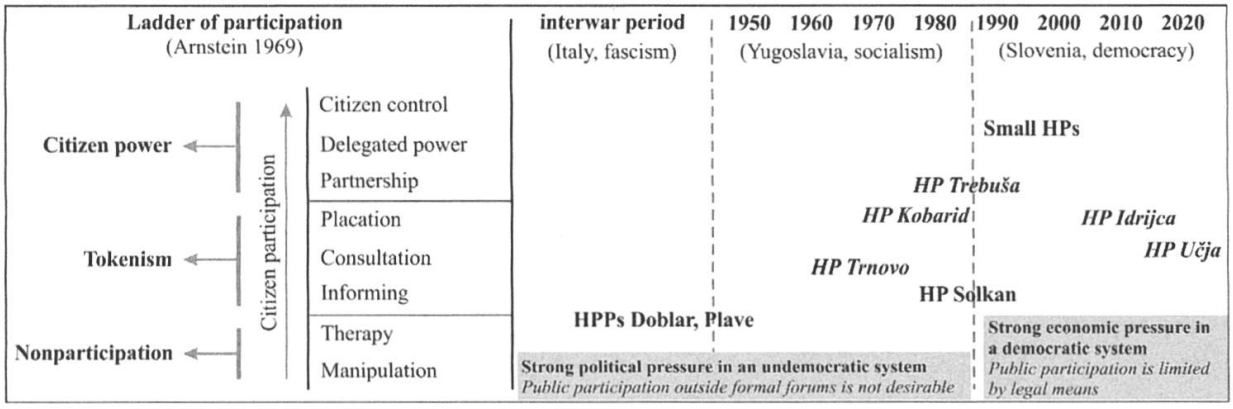

Fig. 3. Construction of HPPs on the Soča River according to the Ladder of Citizen Participation (HPPs in italic were not built). Source: Arnstein (see note 111).

tries (e.g. Austria from the 1970s onward), the emergence of the environmental movement is also linked to «the evolution of the country's energy system».[108] The public debate which was tolerated in Slovenia at that time is rather surprising for an autocratic regime. For example in China,[109] «widespread opposition had little or no effect on the ultimate outcome of a particular dam construction».[110]

The attempts presented here to build the HPPs mostly fit the categories of tokenism and non-participation, characteristic of the lower levels of the Ladder of Citizen Participation.[111] Figure 3 shows the changes in the degree of public participation in building HPPs from the interwar period to the present. As it was not possible, in the absence of data, to cover the entire period with comparable indicators, the figure was created by the authors, based on our knowledge of the literature analyzed, development of the area, and of the role of the public in nature conservation in Slovenia.[112]

The undemocratic socialist political regime allowed public participation to a fairly high degree, but only within the protocols established by law. Therefore, people were barred from discussing issues in public, «outside» the predetermined framework in the form of «round tables», lectures, and conferences led by the authorities. Conservationists in Slovenia were reprimanded for not adhering to «constitutionally» established or prescribed methods of public debate and decision-making. Therefore, activists developed techniques, skills, and a wide network of informants to reach a broader public.[113] More recently, we have once more been seeing a rather low level of public participation in the democratic system due to ad-hoc changes in legislation that limit NGOs participation in decision-making.[114] This development is not what is described as common in the literature.[115] For example, only NGOs that formally demonstrate a legal interest and have a certain number of members can participate. Public debate is constrained in terms of time and importance to decision-mak-

Tab. 2. Factors influencing public perception of HP projects

Environmental and ecological impacts	*Socio-economic impacts*	*Positive impacts*
Negative changes to the environment	Negative impacts on the economy and livelihoods	Benefits to economic development
Ecological changes	Unequal distribution of benefits	Benefits to social development
Increased hazards	Issues with the process of public participation or consultation	
Destruction of or changing landscapes		

Sources: Mayeda/Boyd (see note 121). Cf. Chala/Ma'Arof/Sharma (see note 117).

ing, reducing democratic control of public provisioning and employing strategies to remove debate from the public sphere.[116] For this reason, the era of «green» and «sustainable» development is characterized by increasing pressure on the Alpine space, nature and rivers, of which the Soča River is a relevant example.

HP is an important economic asset for the Alps. Nevertheless, the construction of dams has had strong and lasting negative impacts on nature, economy and society as green and renewable is not necessarily sustainable.[117] This concern is of great importance, as most of the residents of the nearby Tagliamento River (NE Italy) identified the conservation of the river as a top priority for future management, reflecting the discrepancies between river management and citizens´ values and priorities.[118] This was also expressed by geographer Karel Natek stating:[119] «Since the vast majority of Alpine rivers are regulated or energy-exploited, the natural preservation of the Soča is extremely important for the entire Alpine region.» In modern approaches: 1) environmental and ecological impacts, 2) local socio-economic impacts, and 3) public participation and consultation practices (Tab. 2), also defined as «triple conflicts»,[120] are key factors in the development and deployment of energy systems.[121]

The paper points out that there have been changes over the decades, particularly in the arguments for building HPPs, which follow socio-economic development elsewhere in the Alps,[122] as Bätzing has noted. At first, HP was an essential component of economic development, but was subsequently characterized by growing environmental concerns. Today we face a new era for HP governance[123] as HPPs are an important source of electricity generation in the Alps and contribute to the reduction of CO_2 emissions. Nevertheless, the impact of HPPs on nature and landscape cannot be ignored, so that some rightly ask: «what would sustainable solutions have to look like [...] if all remaining potential for HP production are to be exploited?»[124] Electricity generation through HP is necessary when the «technical, economic, and environmental benefits

of HP make it an important contributor to the future world energy mix, particularly in the developing countries.»[125] However, also in developed Alpine countries, such as Switzerland and Austria, the expansion of reservoirs and the construction of new pumping HPPs «are considered a necessity to master the energy transition.»[126] The «triple conflict» remains unsolved.

In opening: The Boka waterfall in the Soča Valley is more than 100 meters high and its discharge can reach up to 100 m^3/s (upper figure). The Ajba dam was built in 1940 for the HPP Plave to meet Italy's electricity needs in the interwar period (lower figure). Photos by Matija Zorn.

Notes

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