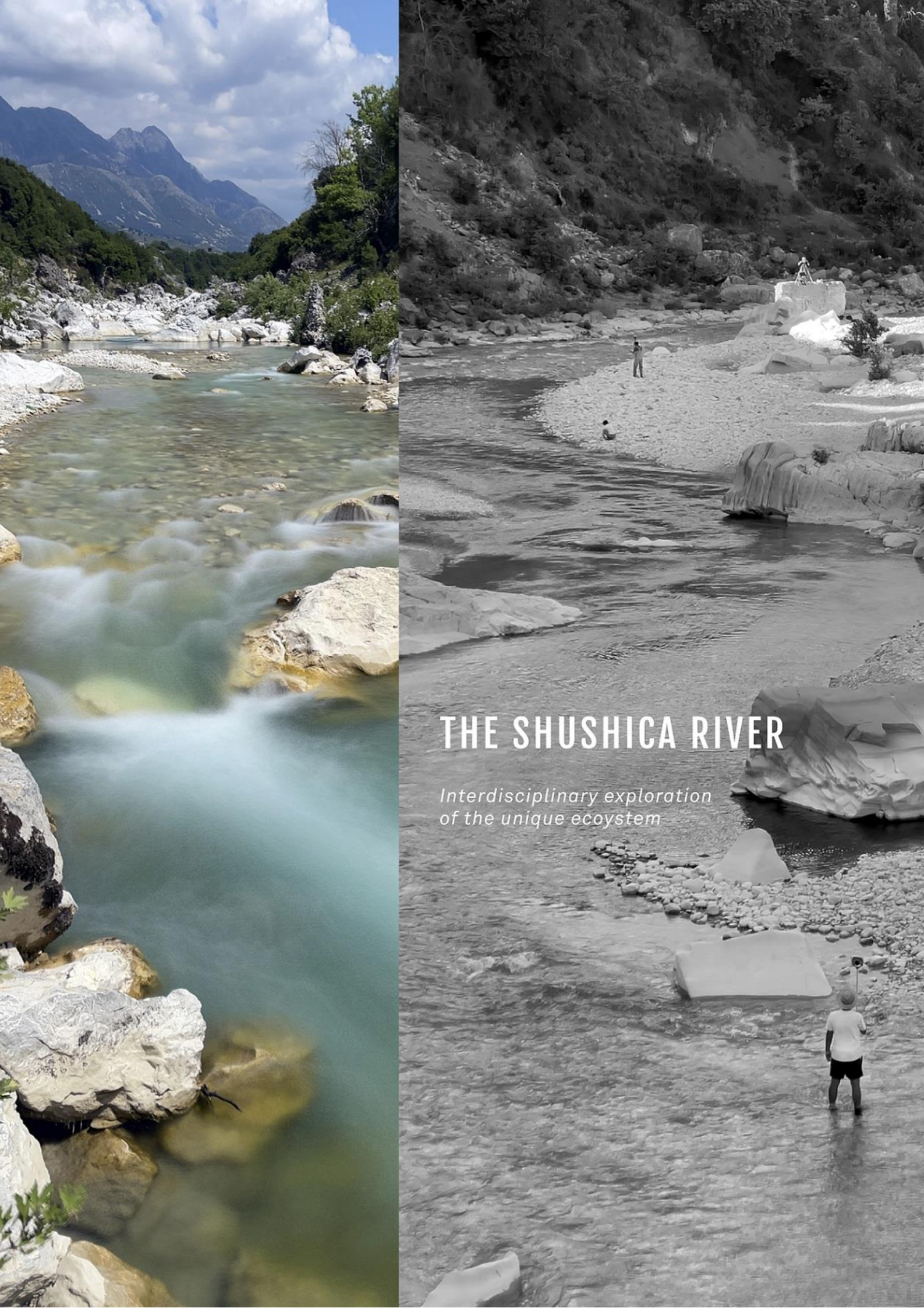

THE SHUSHICA RIVER

Interdisciplinary exploration of the unique ecoystem

Report on an interdisciplinary exploratory study of the Shushica River ecosystem in May/June2021

Scope

Recent studies (Schiemer *et al.* 2020, Meulenbroek *et al*., 2021 Hauer *et al*. 2021) underscored the conservation value of the Vjosa-Aoos river system, as one of the few remaining reference sites for dynamic floodplains in Europe. The Shushica River - 80 km long and with a catchment of 715 km^2 - is a major tributary, with a minimally impaired hydrogeomorphological structure and a mostly unimpeded dynamic flow along its longitudinal, vertical, and lateral dimensions. As such, the Shushica ecosystem represents a major and critical component of the Vjosa catchment.

The planned cascade of hydropower plants clearly contradicts the concept of sustainable development for the area. The Environmental Impact Assessment (EIA) submitted does not contain a sufficient assessment of the current state of relevant aspects of the environment and an outline of their likely evolution in the event of project implementation. The impact on nature and people has not been properly assessed (see our Critical Review attached)!

To address the knowledge gap, scientists from several countries have joined forces to carry out a first synoptic assessment of the Shushica during the first week of June 2021. The research program focused on the area from downstream Gjorm to the headwaters upstream Kuc which would be directly affected by the construction of dams.

The aim of this report is to provide a scientific baseline for a valid EIA and support material for demonstrating the potential violations of international laws and agreements by the construction of hydropower dams along the Shushica River.

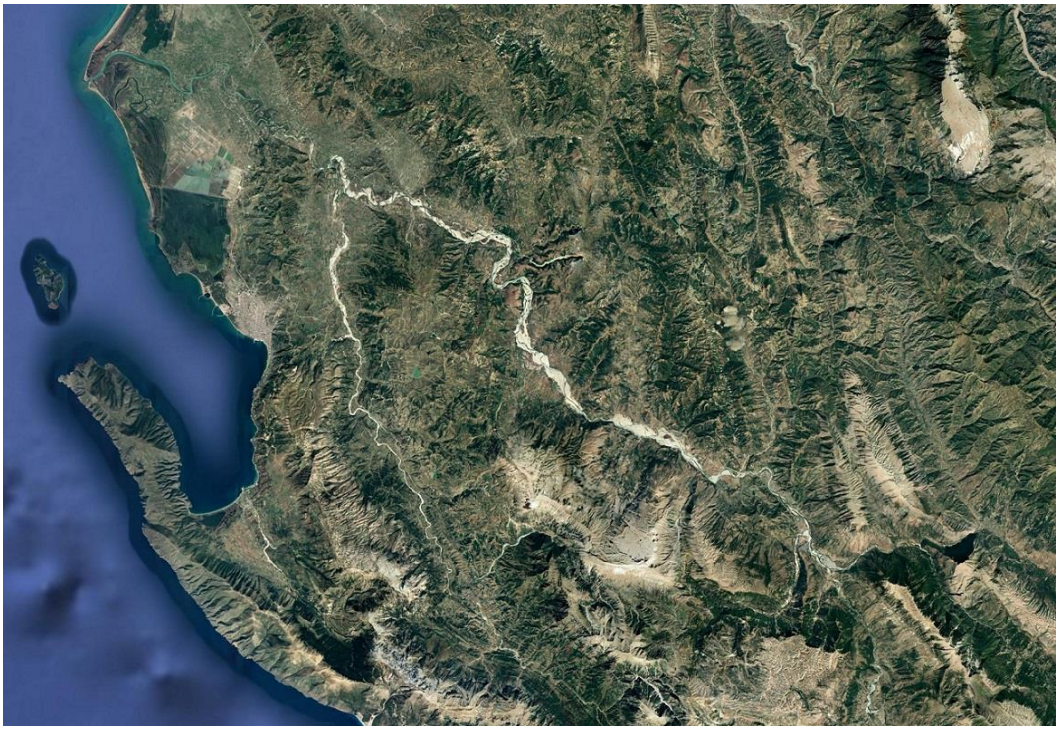

Fig 1. Satellite image of Vjosa and Shushica.

The following three Work Sites of approximately 1000 meters each were studied by the research team. Additional observations and assessments were made at the headwaters of the Shushica upstream Kuc.

Work Site 1: Downstream Gjorm

40°20'3.49"N / 19°38'36.96"E und 40°20'16.48"N / 19°38'26.02"E, 116.4- 118.5 m.a.s.l Upstream new highway bridge. The active channel lies 10-15m below the terrace. The river channel bordered by a narrow band of riparian vegetation and embedded in agricultural land.

Fig. 2 Satellite photo from Work Site 1, downstream Gjorm (Google Earth)

Fig. 3 Work Site 1 Downstream Gjorm. The new highway bridge and behind the former road bridge. Photo © Gregory Egger

Work Site 2, Bratay, Osmanic Bridge (Ottoman)
40°15'46.93"N / 19°40'24.80"E bis 40°16'7.53"N / 19°40'18.61"E

Fig.4. Work site 2, Bratay, Osmanic Bridge
Satellite photo from Work Site 2 near Brataj (@ Google Earth). The Shushica River has incised into the old rock fall area with large boulders remained. In the northwestern corner of the photo the Ottoman bridge.

Fig. 5: Work Site 2, Brataj, Ottoman Bridge.The river incising the rock fall material. Photo © Gregory Egger

Work Site 3, downstream Kallerat
40°14'25.19"N / 19°42'31.30"E to 40°14'20.75"N / 19°42'38.64"E

Fig.6: Satellite photo of Work Site 3 downstream Kallarat (@ Google Earth).

Fig.7: Work Site 3, downstream Kallerat Photo © Gregory Egger

Research focus

- a hydro-geomorphological assessment (Annex 1 & 2)
- assessments of the riparian vegetation (Annex 3)
- a baseline survey on biodiversity, focusing on aquatic macroinvertebrates of international interest (Annex 4, 5, 6), and the groundwater biota (report not finished yet)
- a survey of the fish fauna (Annex 7)
- an assessment of the riparian terrestrial fauna (Annex 8 ,9 & 10)

The reports of the individual work packages are presented in Annex 1-10

Summary:

1. The study supported the high conservation value of the Shushica as an essential branch of the Vjosa river system:

   The detailed geomorphological assessment of the Shushica riverine landscapes at Work Site 1 –downstream Gjorm (see Fig.)- and upstream Bratay illustrated the high geomorphological dynamics creating a specific habitat diversity. The Shushica in its upstream section, thus complements the habitat diversity which has been documented for the Vjosa main stem (Schiemer et al. 2018, 2020, Hauer et al. 2021).

   It represents a significant expansion and amplification of the conservation value of the whole river system in the light of the creation of a Vjosa National Park.

   A critical evaluation of potential impacts of the planned hydropower dams from a technical, hydrological and geomorphological point of view is provided in the critiqueof the ESIA and additionally in a report by C. Hauer, see Annex 2.

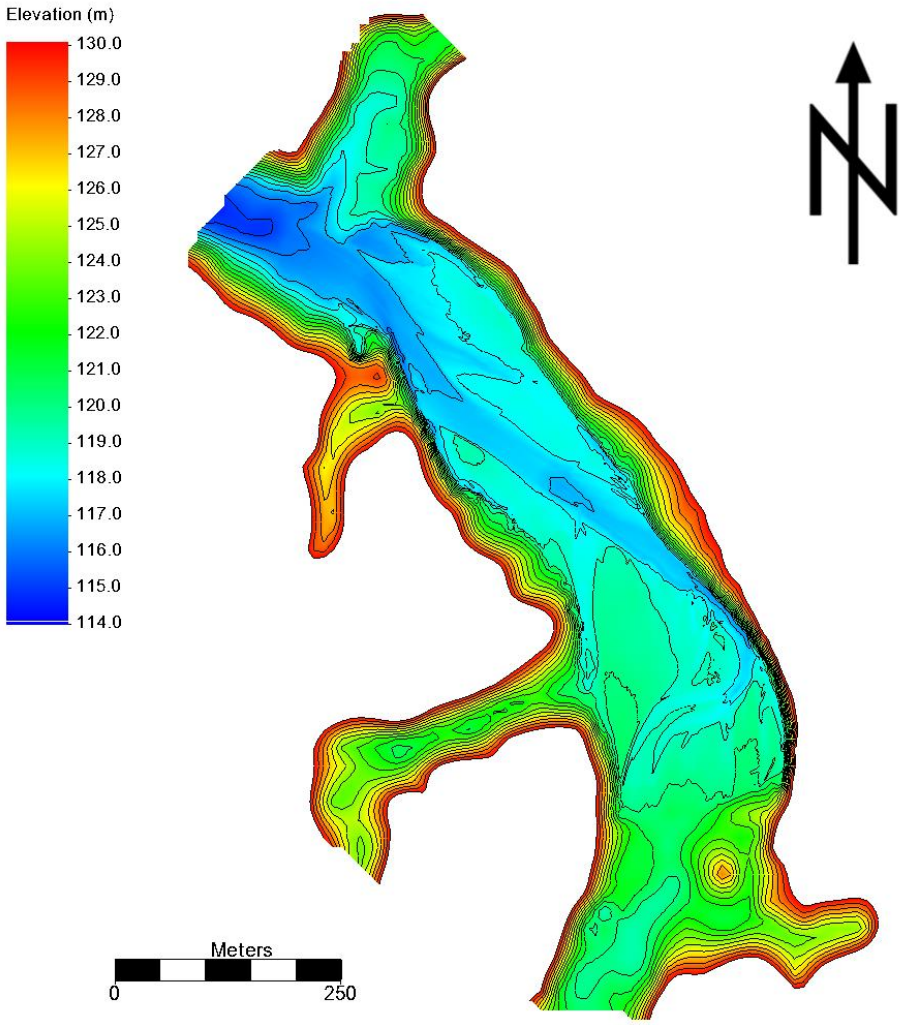

Fig. 8. Digital Terrain Model of Shushica Work Site 1

2. The survey on the vegetation exhibits a highly mosaic vegetation structure at the river banks between active channel and fluvial terraces. The habitat types and their vegetation are listed in Annex 1 of the European Union Habitats Directive (92/43/EEC, amended

document from June 10th, 2013). The whole active channel is essentially represented by FFH-habitat type 3220 (Alpine rivers and herbaceous vegetation along their banks), listed in the European Red list of habitats as “Vulnerable”(Janssen J.A.M. et al. 2016. European Red List of Habitats, 2. Terrestrial and freshwater habitats. Publications Office of the European Union. https://doi.org/10.2779/091,372, Keith et al. 2013). River banks are partially covered with fragments of 92C0 habitat elements (*Platanus orientalis* and *Liquidambar orientalis* woods (*Platanion orientalis*).

3. The assessment of the aquatic MZB fauna (insects and molluscs) within the active channel and the terrestrial fauna encountered within the alluvial channel and the steep river banks provides a flashlight in a diverse, highly specific fauna and highly endangered fauna deserving full protection.

   Within the short collection period - and at this stage of the assessment - we found**:**

   - **three species new to science,**
   - **several species new to Albania and**
   - **several species listed on the Red List of Endangered species.**

Fig.9. New species to science, images of *Rhyacopila* sp. from springs along Shushica Photo © Wolfram Graf

4. The same holds true for the riparian terrestrial fauna: a remarkable 68 species of riverbanks-inhabiting ground beetles were detected along the Shushica. Almost 30%, namely 19 species, have not yet been detected at the Vjosa (Paill *et al*. 2018, Schiemer *et al.* 2020). This confirms the special relevance of the Carabid fauna of the Shushica. Both, the lower and the upper reaches of the river are of particular importance. At the lower reaches near the confluence with the Vjosa, *Asaphidion flavicorne* and *Chlaenius viridis*, two extreme rarities of the European fauna were detected for the first time in Albania.

Fig.10. *Chlaenius viridis*, a remarkable species of Carabod beetle, characteristic for riparian zones. First record for Albania. Photo © Woflgang Paill

5. The fish fauna was analyzed by electrofishing and e-DNA assessment. Of eleven species recorded 9 are listed on the Red List of threatened species of the International Union for Conservation of Nature (IUCN). The (*Anguilla anquilla* Linnaeus 1758) - the European eel - has the highest conservation state. The species is considered as critically endangered. The European eel population has been declining since the 1980s throughout its geographical range of distribution. The Regulation of the Council of the European Union (EC 1100/2007) requiring member states to strictly reduce anthropogenic impacts.

   Longitudinal connectivity is also of paramount importance for other migratory species like *Barbus prespensis* and *Chondrostoma vardarense*. The blockage of upstream areas to migratory fish species would have significant negative impact, leading to massive population declines.

   The potential violations of international and national law by the blockage of migration routes due to the construction of hydropower dams is apparent.

Fig.11. European Eel.

Shushica is hosting a rich terrestrial riparian fauna: five amphibians (*Rana graeca, Rana dalmatina, Bombina variegata, Bufo bufo, Peloplylax kurtmuelleri*), five reptiles (*Testudo hermanni, Emys orbicularis, Podarcis muralis, Natrix natrix, Malpolon insignitus*), five mammals (*Lutra lutra, Vulpes vulpes, Martes foina, Mustela nivalis* and at least one bat species) and two semiaquatic bird species (*Charadrius dubius, Cinclus cinclus*) were recorded during the two days field survey along the Shushica River. Two species (*Lutra lutra*, *Bombina variegata*) are Annex II species of Habitat Directive (HD), while two species of amphibians (*Rana dalmatina, R. graeca*), four species of reptiles (*Testudo hermanni, Emys orbicularis, Podarcis muralis, Malpolon insignitus*) and bats are listed in the Annex IV of HD. Presence of *Cinclus cinclus* is an indicator of good water quality of Shushica River.

Otter (*Lutra lutra*) were present in four out of five stations investigated. Otters were absent only in the upper section of Shushica River (Station 3b), while its presence and marking activity was more frequent in the Station 1 (Gjorm). However, these results should be only considered preliminary and more species on terrestrial riparian fauna (Tetrapods) are expected to be reported with further investigations in the coming years.

Conclusions:

Our short exploratory tour provided only a flashlight on ecological and conservation issues of the Shushica, demonstrating its high value as part of the whole Vjosa river system.
Quite apparently, an intensive, long-term study is required to analyze its full ecological value. Such a detailed analysis is planned from spring 2022 until 2025 by an interdisciplinary consortium of six Albanian and Austrian universities. The planned studies will form the basis and a prerequisite for an evidence-based decision process of a River Basin Management of the Vjosa and its major tributaries.

Prof. Friedrich Schiemer and Prof. Aleko Miho

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Annex 1

Hydromorphological characterisation of Shushica

Geomorphology & Hydrology

Univ. Prof. Christoph Hauer & Dipl.-Ing. Patrick Holzapfel
University of Natural Resources and Life Sciences, Institute of Hydraulic Engineering and River Research, Vienna

Work Site 1

The monitored site at Gjorm has to be described as wandering gravel bed river within a laterally confined section. The confinement is given due to the incision of the river into former fluvial deposits by up to 10 m. These boundaries for channel formation on the reach scale have been linked in the Vjosa system to climate driven increased historical sediment supply rates (compare Hauer *et al.*, 2021). Applying the landscape reading parameters of active channel and active floodplain shows equilibrium width in this section. The reach scale morphology of this laterally stable wandering gravel bed channel has to be classified as riffle-pool type (compare to Montgomery & Buffington, 1997) with minor bifurcation tendencies. Moreover, the section of Gjorm has to be labeled as fully transport limited for both coarse- and fine bedload.

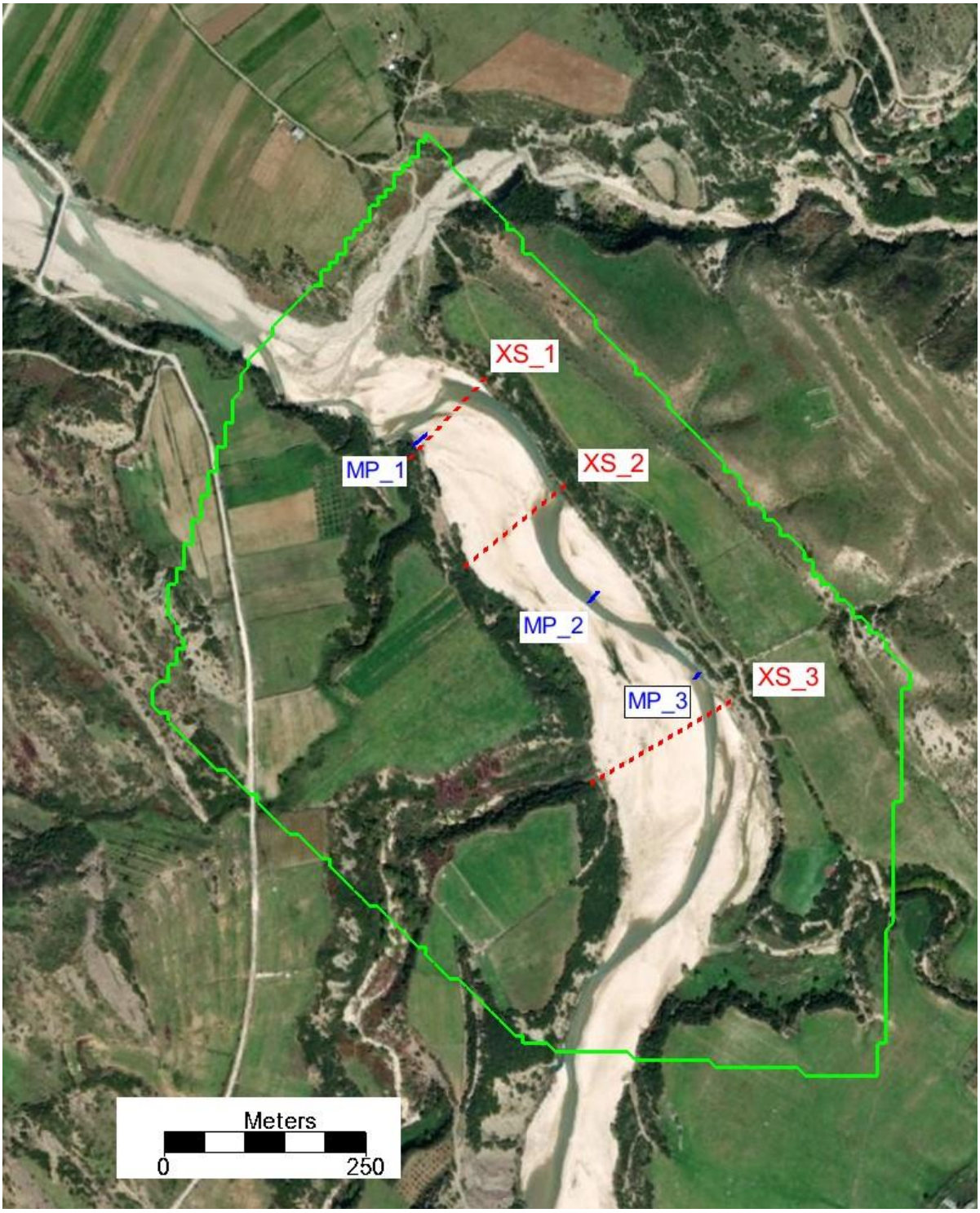

Figure 1. Aerial view of Shushica site 1; MP = measurement Profile (blue line); XS=cross-section (dashed red line); green polygon = DTM boundary

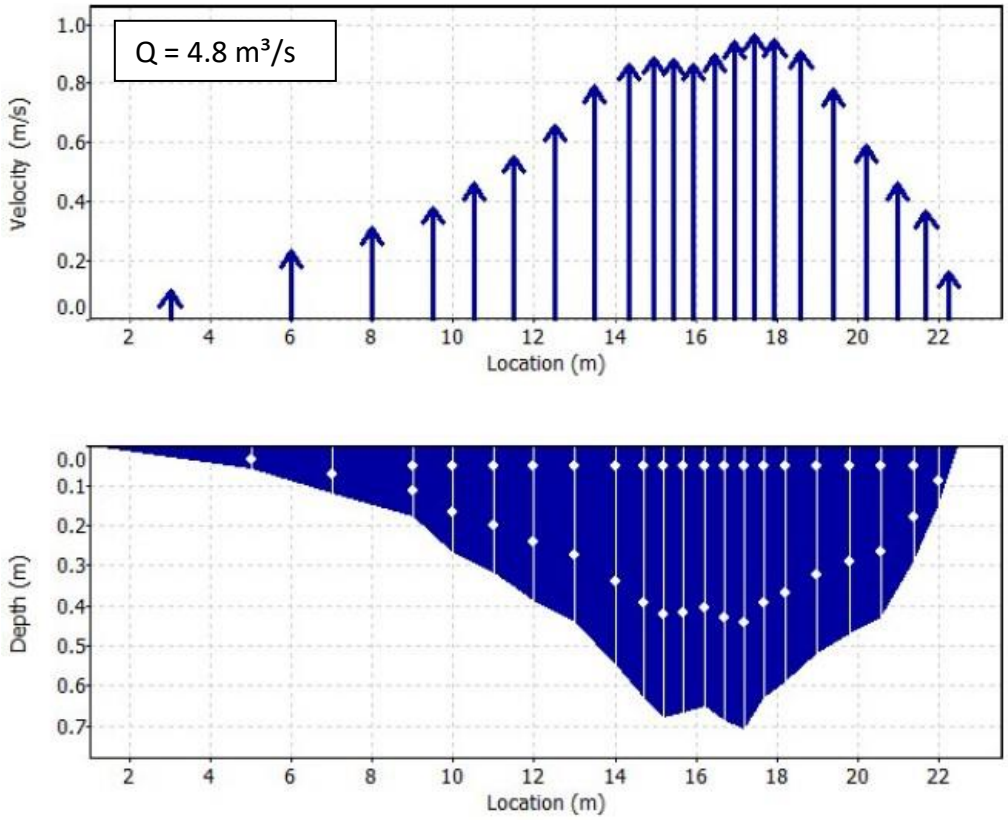

Figure 2. Measured mean flow velocity (top) and measurement profile MP_1 (bottom) at Shushica 1.

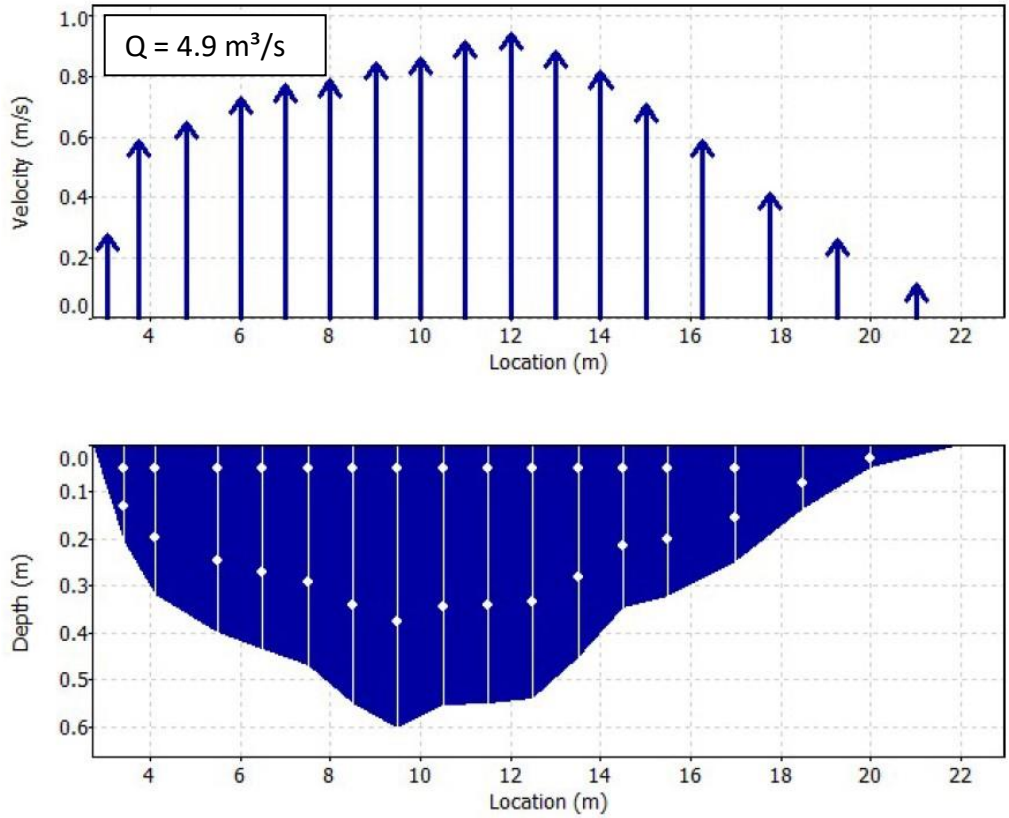

Figure 3. Measured mean flow velocity (top) and measurement profile MP_2 (bottom) at Shushica 1.

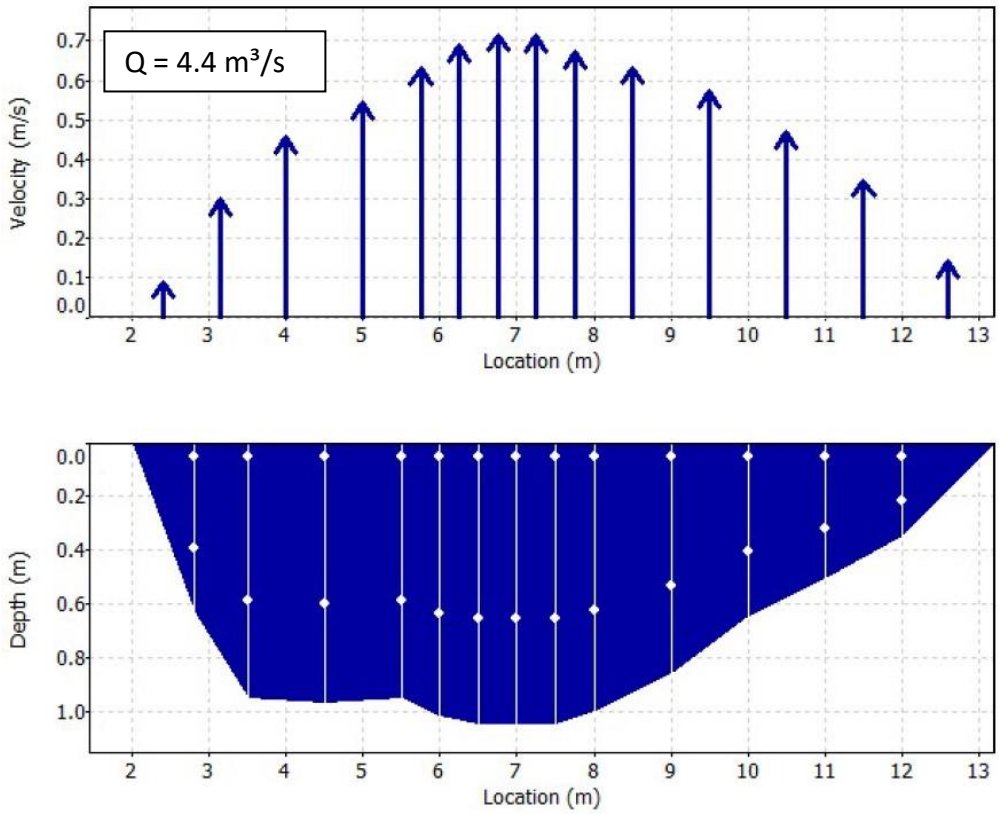

Figure 4. Measured mean flow velocity (top) and measurement profile MP_3 (bottom) at Shushica 1.

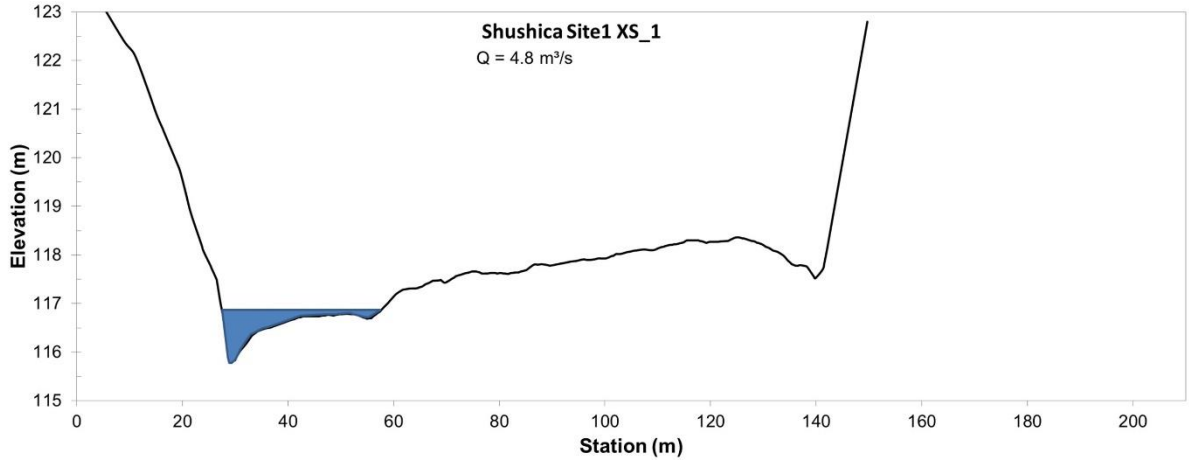

Figure 5. Cross-section XS_1 including measured water level at a discharge of 4.8 m³/s

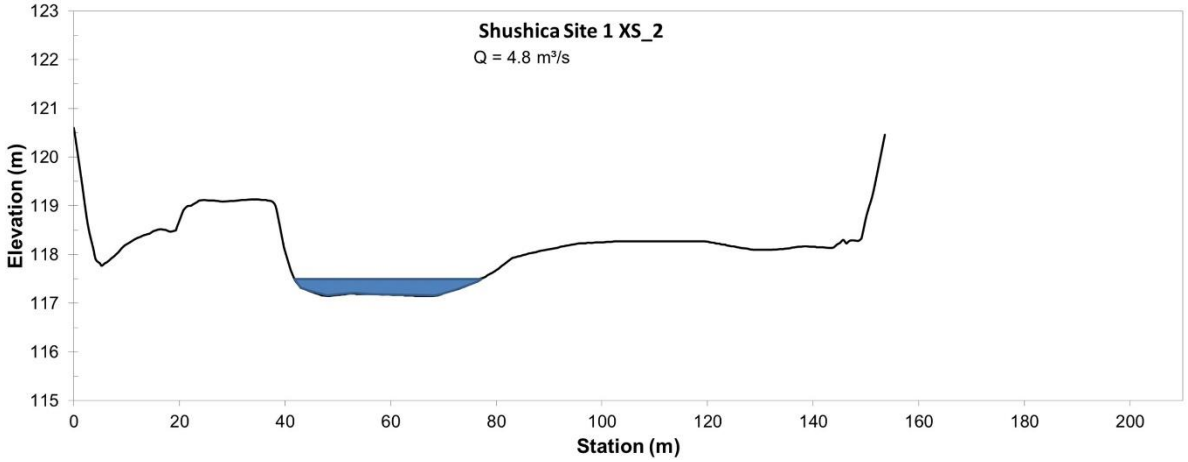

Figure 6. Cross-section XS_2 including measured water level at a discharge of 4.8 m³/s

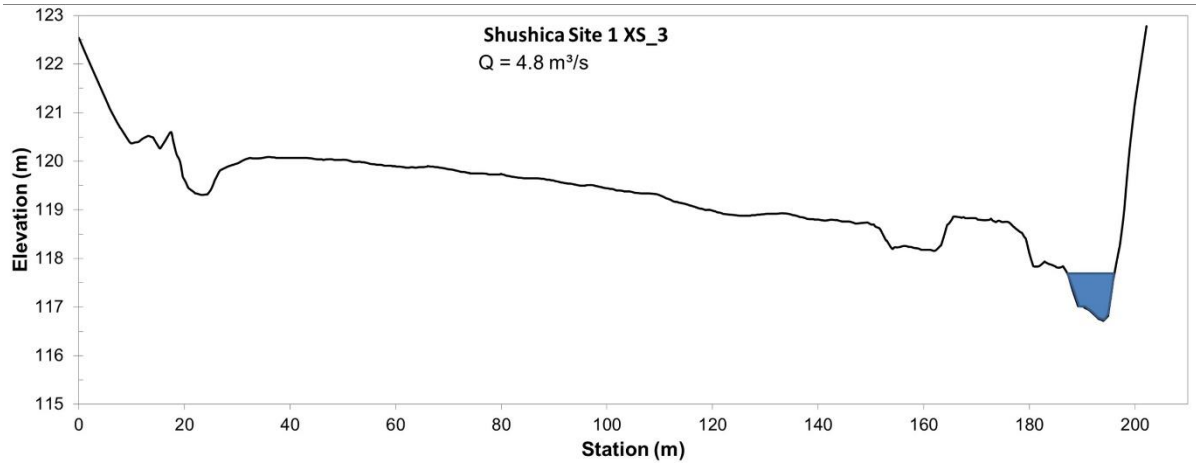

Figure 7. Cross-section XS_2 including measured water level at a discharge of 4.8 m³/s

Work Site 2

The second site can be described as a wandering gravel bed channel as well but confined by the steep valley slopes (no incision into former fluvial deposits). The sites exhibit larger non-fluvial elements due to mass-wasting processes along the hillslopes. Those elements are both, habitat forming and influencing sediment dynamics on the local scale. The river has to be classified as partially diamictic plane bed (compare to Hauer & Pulg, 2018) and mixed-riffle pool type on the reach scale. Bed-rock outcrop further determines the low fluvial deposition layer in this specific stretch which is also underlined by the bathymetric characteristics of the measured cross sections. The stretch is also transport limited concerning coarse and fine bedload

Figure 8. Aerial view of Shushica site 2; MP = measurement Profile (blue line); XS=cross-section (dashed red line); green polygon = DTM boundary

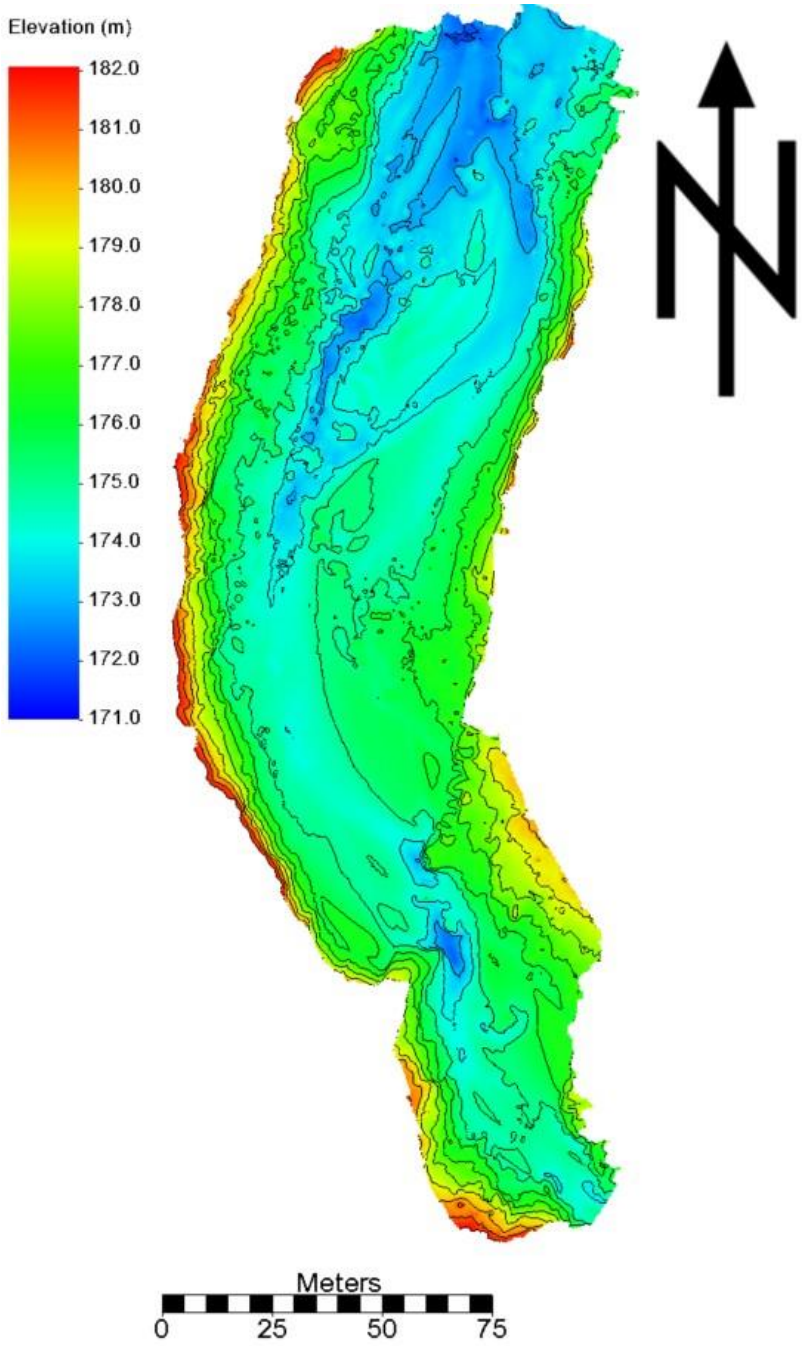

Figure 9. Digital Terrain Model of Shushica site 2

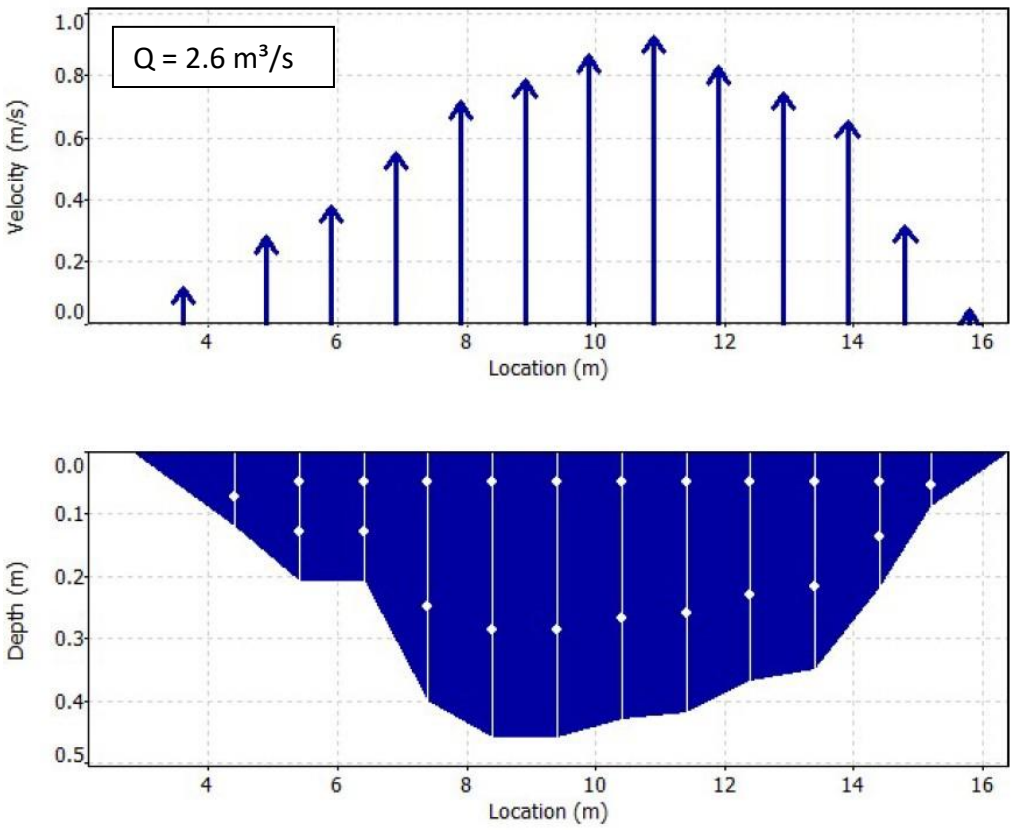

Figure 10. Measured mean flow velocity (top) and measurement profile MP_1 (bottom) at Shushica 2.

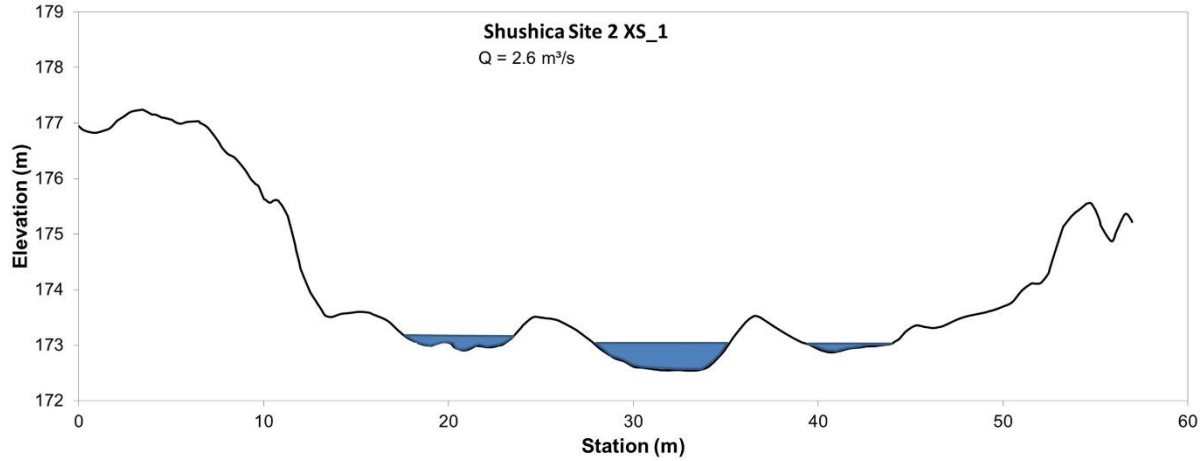

Figure 11. Cross-section XS_1 including measured water level at a discharge of 2.6 m³/s

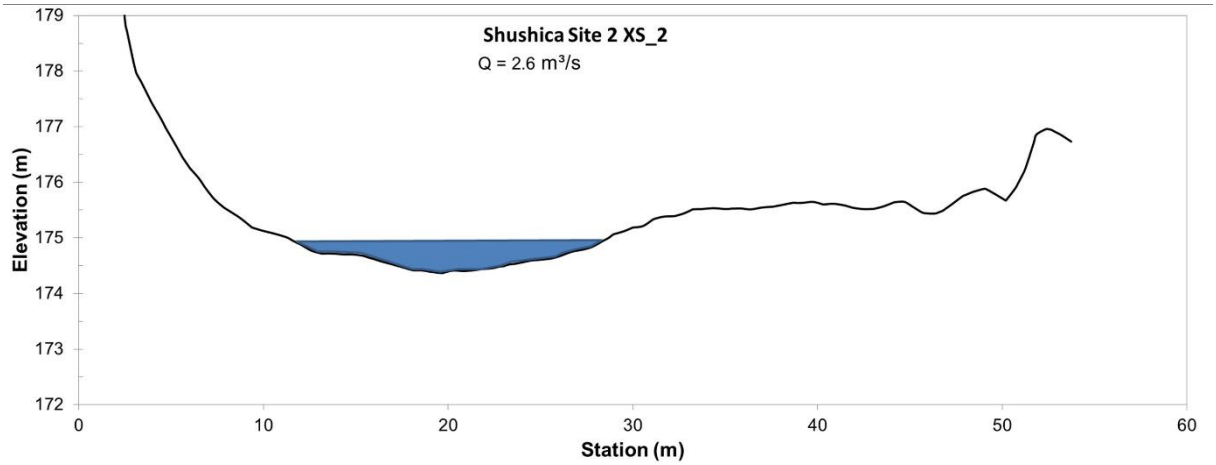

Figure 12. Cross-section XS_2 including measured water level at a discharge of 2.6 m³/s

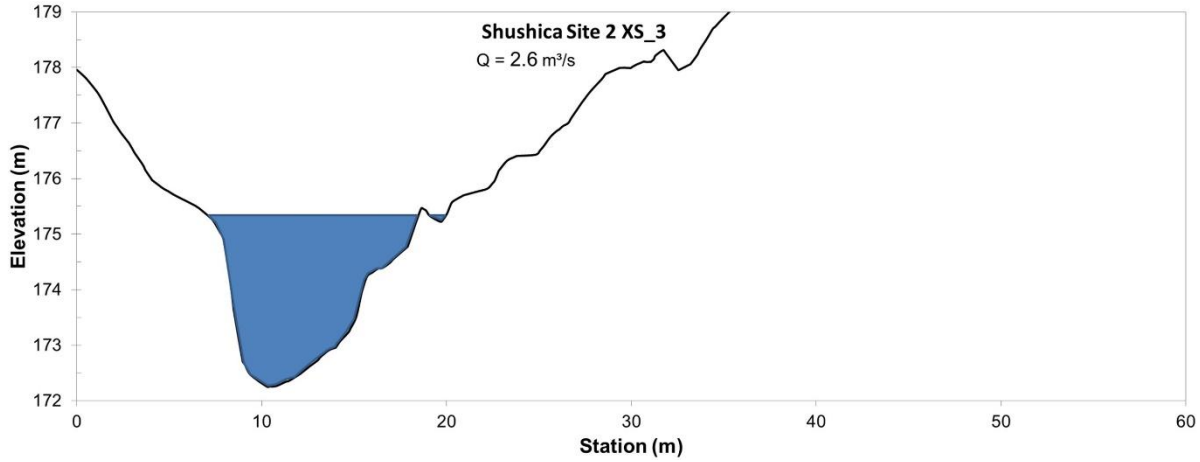

Figure 13. Cross-section XS_3 including measured water level at a discharge of 2.6 m³/s

Annex 2

Evaluation of impacts of Shushica hydropower plants

Univ. Prof. Christoph Hauer
University of Natural Resources and Life Sciences, Institute of Hydraulic Engineering and River Research, Vienna

Technical boundaries:

- Diversion run-of-the river hydropower plants
- Four of them in a row (chain)
- Height of dam facilities (5 m – 10 m)
- Impounded river sections (100 m – 1000 m)

General process descriptions (hydrology / sedimentology):

- Water diversion leads to changes during low- and mean-flow periods (probably no residual flow)
- Flood magnitude will not be affected due to the hydropower facilities (no flood retention possible)
- Coarse bed load will be trapped to 100% in the impounded section
- Suspended load will settle in terms of low flow and mean flow conditions within the impoundments
- During floods suspended sediments will be transported through the impounded section to a large extent, erosion of deposited fines in the delta area of the power plant will be possible

Technical / economic problems:

Due to the high variability in yearly flow rates, it seems unlikely to operate run-of the river power plants in an economically productive way. Even if two or more turbines are installed with lower operational capacities, the high-flow periods cannot be used efficiently, because the diversion channel might be designed for this variability. In terms of an increased design discharge of the diversion channel, a high risk of abrasion is given (case study UNIPER at the Upper Isar /Germany) and renewing of the turbines will be an economic issue. Five years of continuous monitoring of discharges would be necessary (according to international standards) to enable a feasibility assessment for construction.

High evapotranspiration (in summer periods) will decrease the useable water volume (even if they are run-of the river power plants in the cascade), evapotranspiration in the probably residual flow sections (lower parts of the cascade) will reduce the total volume of water for production within the cascade, even more. Thus, reduced inflow rate following the cascade downstream due to increased losses will negatively impact the hydropower production rate. Especially by the optional diversion of higher discharges, the finer bed load will be trapped in the reservoir and the suspended sediments will be sluiced through the turbine and the residual flow could probably disappear in the coarse river bed downstream (case Upper Isar / Germany)

With a height of 5 – 10 m, there are no technical possibilities for an adequate sediment sluicing (e.g. coarse or fine bed-load) through the impounded sections. Thus, a continuous fill up of the impoundments with sediments start in the cascade from the upper part and will continue when an equilibrium status is achieved in the first impounded section. However, this development will also affect the diversion channel and maintenance work to reduce technically problematic depositions (e.g. reducing the water intake to the turbine) will be necessary.

<u>Impacts on river morphology /groundwater / water temperature:</u>
Sediment trapping of the impoundments will lead to coarsening of bed surface in downstream river sections.

Moreover, river incision can be expected already in the short- to mid-term run.

In addition to coarsening of the river bed surface, infiltration of fine sediment (if not diverted) will lead to (more sustainable clogging) of the gravel matrix (further impacts on ecology)

River bed incision will have consequences on the groundwater stage; lowering of the ground water level can be expected for the alluvium downstream of the power plants.

Water diversion will have an impact on groundwater exchange in total. Stretches with former infiltration of the river into the groundwater may be cut-off. Thus, not only a lowering of the groundwater table but impacts on the distribution might be expected.

The Shushica drains about 20% of the Vjosa catchment. Hence, the trapping of sediments in the impounded section will also have an impact on the Vjosa downstream of the Shushica mouth especially for the Delta region.

Annex 3

Vegetation

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University of Graz, Division of Plant Sciences
& PD Mag. Dr. Gregory Egger,
Karlsruhe Institute of Technology (KIT), Institute of Geography and Geoecology (IFGG);
University of Natural Resources and Life Sciences, Vienna (BOKU), Institute of Hydrobiology and Aquatic Ecosystem Management (IHG); Naturraumplanung Egger

The assessment of the river stretches described below is based on vegetation surveys in the active floodplain and the surrounding area. Three work sites along the Shushica River and one work site in the lower Bence River course have been evaluated.

The habitat types and their vegetation are listed in Annex 1 of the European Union Habitats Directive (92/43/EEC, amended document from June 10th, 2013). The whole active channel is essentially represented by FFH-habitat type 3220 (Alpine rivers and herbaceous vegetation along their banks), listed in the European Red list of habitats as "Vulnerable" (Janssen J.A.M. *et al.* 2016. European Red List of Habitats, 2. Terrestrial and freshwater habitats. Publications Office of the European Union. https://doi.org/10.2779/091,372, Keith *et al*. 2013). River banks are partially covered with fragments of 92C0 habitat elements (*Platanus orientalis* and *Liquidambar orientalis* woods *Platanion orientalis*).

Work Site 1: Shushica downstream Gjorm, upstream of the new road bridge

The active channel of the Shushica between 40°20'3.49"N / 19°38'36.96"E and 40°20'16.48"N / 19°38'26.02"E upstream of the road bridge covers a length of about 1 km and is situated between 116.4to 118.5 m a.s.l.

Active channel in this river section is between 90 and 180 m wide, largely unvegetated or covered at a very low percentage with pioneer vegetation. The higher proportion of dead-wood compared to the Vjosa at Pocem and Kalivac is related to the higher forest cover in the upper Shushica valley and forest patches directly adjacent to the river.

Areas with fine sediments within the active channel and on the lower banks are rare. On such locations the willows *Salix alba, S. triandra subsp. triandra* and *S. eleagnos* dominate the loose shrub stands. *Equisetum arvense* and *E. ramosissimus* as well as the drought resistant grass *Cynodon dactylon* are the most frequent species on these highly dynamic stands. Besides that

Veronica anagallis-aquatica and *Juncus* cf*. bufonius* which have higher water requirements colonize stands with a higher share of fine grained sediment.

The steep orografic left bank is built of Jurassic and Cretaceous limestone with hardwood bushes *of Quercus coccifera, Spartium junceum*, *Phlomis fruticosa* a.o. (photo 20210530_132309).

Further upstream a species-rich plant assemblage dominated by *Rubus sanctus* (releve Nr. 99) was recorded with 10 species of shrubs and lianas and over 50 species of herbs on an area of 100 m^2.

The orografic right bank is lower and exhibits a richer geomorphological structure of riverine deposits. It is overtopped with fine sediment layers of up to 60 cm height (figure 3). Correspondingly the vegetation shows a higher differentiation: areas up to two meters above mean water level are dominated by *Pteridium aquilinum* with some bushes of *Platanus orientalis*, *Spartium junceum* a.o. (releve Nr. 98, Fo Nr. 20210530_133051)

Fig. 1: Coarse sediment of the active channel with large woody debris.

Fig. 2: Scattered shrubs of *Tamarix* sp. and *Salix amplexicaulis* in the active

Fig. 3: Eroded river bank

Fig. 4: Maximum height of flood marked by washed up flotsam

Work Site 2: Bratay, Ottoman Bridge

40°15'46.93"N / 19°40'24.80"E bis 40°16'7.53"N / 19°40'18.61"E;
Active channel narrow, 30–45 m wide, characterized by large boulders.

This section of the Shushica River has incised into a landslide mass. The active channel is very narrow, the width is 30 to 55 meters and excepionally up to 90 meters. Smaller dimensions of the sediment have been cleared out by flood pulses, and individual large boulders could not be transported due to insufficient tractive force. Mosses on boulders characterize the zone with fluctuating seasonal water levels. On low narrow terraces a vegetation type dominated by small shrubs with bendable branches such as *Salix amplexicaulis* is developed. They can endure strong current without breaking [releve Nr. 101]. Only sporadically flooded sites show a very rich flora.

On the steeper banks the vegetation changes quite abruptly into Macchia with (Sub-) Mediterranean species like *Pistacia therebinthus, Juniperus oxycedrus, Quercus coccifera* among the scrubs and *Teucrium capitatum, Chrysopogon gryllus, Brachypodium retusum, Convolvulus cantabrica, C. elegantissima, Asparagus acutifolius* a.o. among the herbs (releves. Nr. 102, 103) The small scale transition results in a high biodiversity at small scale compared to the large floodplain extension at the lower Vjosa (Drescher, 2018).

The rugged areas higher up, are used as pastures, vegetated by Mediterranean scrub species e.g. *Paliurus spina-christi, Phillyrea* cf*. media, Clematis flammula, Pyrus eleagrifolia, Cercis siliquastrum, Crataegus monogyna* a.o. . Margins of the maquis are occupied by species-rich fringe and mantle communities. Flatter areas are used as farmland.

Fig. 5: Shushica River stretch incised into a landslide mass.


Fig. 6, 7: Shushica River stretch incised into a landslide mass.

Work Site 3: downstream (NW) Kallerat

40°14'25.19"N / 19°42'31.30"E to 40°14'20.75"N / 19°42'38.64"E.

Active channel: 80-100m width

The active channel is largely unvegetated. The parts of the channel above mean flood level/mean water line (scroll bars and islands) are covered with pioneer scrub vegetation, in rare cases even used as farmland. In some parts of the stretch bush vegetation protect the steep banks.

The steep, vertical erosion banks (often more than 3 meters) on the orografic left side are of high floristic value (photo 20210601_111950) with *Ferulago nodosa, Parietaria lusitanica, Campanula pyramidalis* u.a.

Submediterran deciduous trees e.g. *Quercus cerris, Acer obtusatum,* and shrubs such as *Cercis siliquastrum, Coronilla emerus* partly shade the orographic left river bank. In addition, there are also species with wider distribution range like *Rosa canina, Crataegus monogyna, Hedera helix, Clematis vitalba, Prunus spinose,* and species with restricted submediterranean-montane distribution e.g. *Symphytum ottomanum.* Beside that also species with a large area in temperate and subtropical Europe and Asia are also found here such as *Calystegia sepium* and *Mentha longifolia*.

On the orographic left shore originates a slope toe spring with *Berula erecta* , which characteristically is found in Albania in cold streams and karstic springs of the mediterranean-montane belt

Fig. 8: Shushica River section near Kallerat (worksite 3)

Fig. 9: Vertical erosion banks

Fig. 10: Active channel

Annex 4

Macroinvertebrates

Dr. Wolfram Graf & B.A. B.Sc. Pia Teufl
B.A. B.Sc. Teufl Pia, BOKU, University of Natural Resources and Life Sciences, Institute of Hydrobiology and Aquatic Ecosystem Management, Vienna

Collections of macroinvertebrates were made from 30thof May to 4th of June 2021, whereby the rivers Sarantoporos, Shushica, Benje, Drinos, Dishnica and Vjosa were investigated (table 1). The aim of the study was to document the occurrence of various aquatic organisms and their distribution within the Vjosa catchment.

Methods:
Adults were sampled with sweeping nets and light-traps, benthic stages were collected using a D-frame net via kick-sampling method.

Results:
In total, 45 species were collected. Among already known species from the Vjosa, several new species for the catchment were recorded. The most interesting findings are three species, which are most probably new to science. The stonefly *Helenoperla malickyi*, described from Greek, is known only from a very small area worldwide.
Additional material like Mayflies, Dragonflies and Beetles was sent to experts and analyses are under progress.

Table 1: collection sites and dates

Sampling site	River	Coordinates North	Date
Kanikol	Vjosa	40°07'58.9"N 20°30'06.5"E	02.06.2021
Poro	Vjosa	40°38'26.5"N 19°24'05.5"E	01.02.2021
Kosine	Vjosa	40°16'10.5"N 20°16'56.0"E	03.06.2021
Golëmi	Drinos	40°12'39.3"N 20°05'26.7"E	02.06.2021
DJ Aragona	Vjosa	40°31'45.1"N 19°43'35.3"E	04.06.2021
Dishnica	Dishnica	40°20'01.9"N 20°10'29.0"E	03.06.2021

Sarantaporos	Sarantaporos	40°05'25.6"N 20°37'40.4"E	02.06.2021
Benje	Benje	40°14'55.5"N 19°58'22.7"E	03.06.2021
Qeserat	Vjosa	40°22'50.9"N 19°53'34.2"E	04.06.2021
Kashisht	Vjosa	40°35'51.8"N 19°32'12.9"E	01.02.2021
Shushica upstream	Shushica	40°11'44.9"N 19°47'06.2"E	31.05.2021
Shushica 1	Shushica	40°20'19.1"N 19°38'14.0"E	30.05.2021
Brataj	Shushica	40°16'0.65"N 19°40'18.97"E	
Tepelena	Vjosa	40°17'37.5"N 20°01'30.9"E	03.06.2021

DIPTERA
Family Tipulidae
Tipula (Emodotipula) obscuriventris **New to Albania!** Remarkable species: red list status NT
Tipula (Yamatotipula) lateralis

NEUROPTERA
Family Osmilidae
Osmylus fulvicephalus

PLECOPTERA
Family Nemouridae
Protonemura cf. *rauschi*

Family Perlidae
Eoperla ochracea
Helenoperla malickyi special conservation needed
Marthamea vitripennis
Perla marginata

Family Chloroperlidae
Chloroperla tripunctata

TRICHOPTERA
Family Rhyacophilidae
Rhyacophila diakoftensis
Rhyacacophila sp. new species to science
Rhyacacophila sp. new species to science
Rhyacophila loxias
Rhyacopila balcanica

Famly Glossosomatidae
Agapetus laniger
Synagapetus sp. new species to science

Family Hydroptilidae
Allotrichia vilnensis

Hydroptila brissaga
Hydroptila vectis
Hydroptila simulans
Hydroptila tineoides
Hydroptila sparsa

Family Psychomyiidae
Psychomyia pusilla
Tinodes macedonicus
Tinodes rostocki

Family Philopotamidae
Philopotamus montanus
Philopotamus variegatus
Wormaldia subnigra

Family Hydropsychidae
Cheumatopsyche lepida
Diplectrona atra
Hydropsyche peristerica
Hydropsyche mostarensis
Hydropsyche modesta
Hydropsyche bulbifera

Family Polycentropodidae
Polycentropus excisus
Polycentropus ieraptera dirfis
Polycentropus flavomaculatus

Family Odontoceridae
Odontocerum albicorne

Family Limnephilidae
Limnephilus graecus

Family Lepidostomatidae
Lepidostoma hirtum

Family Leptoceridae
Adicella filicornis
Leptocerus interruptus

Family Sericostomatidae
Notidobia nekibe
Sericostoma flavicorne

Family Beraeamyidae
Beraeamyia hrabei

Family Uenoidae
Thremma anomalum

Photo 1: Collection with sweeping net at Uji i Ftohte, N40°15.011' E20°03.548', location of the rare stonefly *Helenoperla malickyi*

Photo 2: Light trap

Photo 3: *Oligoneuriella rhenana* from Shushica at Brataj

Photo 4: *Synagapetus* sp., larval case from springs along the Shushica

Photo 5: New species to science, imagines of *Rhyacopila* sp. from springs along Shushic

Photo 6: *Wormaldia subnigra* from Shushica at Brataj

Photo 7: *Caenis macrura*, Brataj, Sushica River, 01.06.2021 - 46˚16' 3.21" N/19˚ 40' 16.11"

Photo 8: *Eoperla ochracea*, Drinos

Photo 9: Algal blooms at Drinos at Golëmi

Photo 10: Chironomidae buildings at the Shushica

Photo 11: *Natrix tesselata*, Shushica

Photo 12: *Prosopistoma pennigerum* from Vjosa at Kanikol

Photo 13: *Perla marginata* from Bence

Photo 14*: Chloroperla tripunctata* exuviae from Schushica

Photo 15: *Chloroperla tripunctata* from Schushica

Photo 16: *Beraeamyia hrabei* from Benje

Photo 17: *Rhithrogena* sp., Shushica at Kuc

Annex 5

Provisional report on the water beetle fauna of the Shushica River

Mag.[a] Michaela Brojer
Museum of Natural History Vienna

Three localities of the Shushica River were examined during the Science Week at the Vjosa tributaries during June 2021. Work Site 1 (Shu1) was located 2.5 km north from Gjorm village (Fig.1), Work Site 2 (Shu2) was located at Brataj Bridge close to Brataj village (Fig. 2), Work Site 3 (Shu3) was located 4.8 km southeast from Brataj village (Fig. 3). The water beetle fauna was explored by collecting on a qualitative level using a hand net (mesh width 100µm) and by sampling different habitats.

Habitats examined at the three localities along Shushica River:
Work Site1 (Shu1):

- rockpool above the water line with muddy sand and crevices filled with water (Shu1a)
- gravelly streambed (high current) & gravelly shoreline (lower current) (Shu1b, Shu1d)
- loamy and sandy puddle on riverbank (Shu1c)

Work Site2 (Shu2):

- gravelly streambed (high current) & gravelly shoreline (lower current) (Shu2a)
- spring pools along riverbank between Brataj Bridge and right tributary (Shu2b)
- right tributary (gravel, rocks, moss) (Shu2c)
- gravelly streambed & rock with moss (high current) (Shu2d)

Work Site3 (Shu3):

- loamy and sandy puddle on riverbank (Shu3a, Shu3d)
- disconnected side-branch (stagnant water with small spring trickles) (Shu3b)
- gravelly and rocky streambed and shoreline (Shu3c)

Overall, at three different localities examined in May 2021, 36 different species of water beetles (including True Water Beetles and Shore Beetles) can be differentiated so far (see Table 1).

Among the very speciose family of Hydraenidae there are 11 species determined from the three different localities at the Shushica River. Whereas some species prefer high current in the course of a river, living in the interstitial of the pebbly and gravelly streambed (e.g., *Hydraena vedrasi* ORCHYMONT, 1931), many species are found along the shoreline as well as in

the loamy and sandy puddles of the riverbank (e.g., *Hydraena subjuncta* ORCHYMONT, 1930, *Ochthebius striatus* (CASTELNAU, 1840)). Especially the latter two habitats are highly affected by the natural flow of a river. Among the Hydraenidae *Ochthebius alpheius* JANSSENS, 1959 is collected for the first time in Albania. Until now this species was only known from Greece.

Three species of the genus *Georissus* LATREILLE were already collected during the former expeditions to Vjosa and reported for the first time for Albania (Schiemer *et al.* 2020, Graf *et al.* 2018). In general, Georissidae are psammophilous, colonizing wet, loamy or sandy shores of standing and flowing waters and are very rarely collected due to their cryptic lifestyle. Aside from that, *Georissus* LATREILLE apparently prefers undisturbed riverine habitats which over the last decades became rare all over Europe and are therefore listed in several regional Red Lists. The specimens at Shushica were collected at a loamy and sandy puddle along the riverbank of the Shushica at Work Site 3 (Shu3a).

The Elmidae collected at the Shushica mostly prefer rocky and mossy habitats of high current. Among this family there are outstanding findings to report. After *Potamophilus acuminatus* (FABRICIUS, 1782) was collected for the first time for Albania at the former Vjosa surveys this species is also found at the Shushica. The genera *Riolus* (MULSANT & REY) and *Esolus* (MULSANT & REY) are recorded for the first time for Albania. For all the species of *Riolus*, partly not yet determined to species level, it´s noteworthy that all of them were only collected at Work Site 2 (Shu2).

Table 1: Provisional list of water beetles at the three localities (Shu1, Shu2, Shu3) along the Shushica River during the Science Week at the Vjosa tributaries in June 2021. Species names of beetles not yet determined to species level will be handed later.

Family	Species	Shu1	Shu2	Shu3
Gyrinidae	*Gyrinus* sp.		Shu2c	
Haliplidae	*Peltodytes* sp.	Shu1a		
Dytiscidae	*Agabus* sp.		Shu2a	
	Bidessus sp.		Shu2a	Shu3b Shu3d
Sphaeriusidae	*Sphaerius* sp.			Shu3b
Helophoridae	*Helophorus* sp. 1	Shu1a Shu1c Shu1d	Shu2a Shu2c Shu2d	Shu3a Shu3d
	Helophorus sp. 2			Shu3a
Georissidae	*Georissus* sp.			Shu3a
Hydrophilidae	*Coelostoma* sp.	Shu1a		Shu3b Shu3d
	Enochrus sp.	Shu1d		Shu3d
	Laccobius sp. 1	Shu1a Shu1b Shu1d	Shu2a Shu2b Shu2c	Shu3a Shu3b Shu3d
	Laccobius sp. 2	Shu1a Shu1c	Shu2a	Shu3a Shu3b Shu3d
	Laccobius sp. 3			Shu3b Shu3d
	Laccobius sp. 4			Shu3b Shu3d

Hydraenidae	*Hydraena* cf. *bicolorata* JÄCH, 1997		Shu2d	
	Hydraena simonidea ORCHYMONT, 1931	Shu1d		
	Hydraena subjuncta ORCHYMONT, 1930	Shu1a Shu1d	Shu2a Shu2c Shu2d	Shu3b Shu3c Shu3d
	Hydraena vedrasi ORCHYMONT, 1931	Shu1b	Shu2a Shu2c Shu2d	Shu3b Shu3c Shu3d
	Limnebius sp.	Shu1a Shu1b Shu1d		
	Ochthebius alpheius JANSSENS, 1959		Shu2a	
	Ochthebius difficilis MULSANT, 1844		Shu2a	Shu3a Shu3b Shu3c
	Ochthebius metallescens ROSENHAUER, 1847		Shu2c	
	Ochthebius nobilis VILLA & VILLA, 1835		Shu2a Shu2c Shu2d	Shu3a Shu3b Shu3c Shu3d
	Ochthebius parvannulatus DELGADO & JÄCH, 2009	Shu1a Shu1b		Shu3a Shu3d
	Ochthebius striatus (CASTELNAU, 1840)	Shu1a Shu1b Shu1d	Shu2a Shu2c	Shu3a Shu3b Shu3c Shu3d
Elmidae	*Elmis rioloides* KUWERT, 1890	Shu1a Shu1b	Shu2c	
	Esolus parallelepipedus (MÜLLER, 1806)	Shu1b Shu1d	Shu2a Shu2b Shu2c Shu2d	Shu3b Shu3c
	Limnius intermedius FAIRMAIRE, 1881	Shu1b	Shu2a Shu2c Shu2d	Shu 3c
	Potamophilus acuminatus (FABRICIUS, 1782)	Shu1a		
	Riolus cf. nitens (MÜLLER, 1817)		Shu2a	
	Riolus sp. 1		Shu2c Shu2d	
	Riolus sp. 2		Shu2d	
Dryopidae	*Dryops* sp.		Shu2a Shu2c	Shu3a
Limnichidae	*Limnichus* sp.	Shu1a Shu1c	Shu2b	
Heteroceridae	*Heteroceridae* sp. 1	Shu1a		Shu3b
	Heteroceridae sp. 2	Shu1a Shu1c		Shu3b

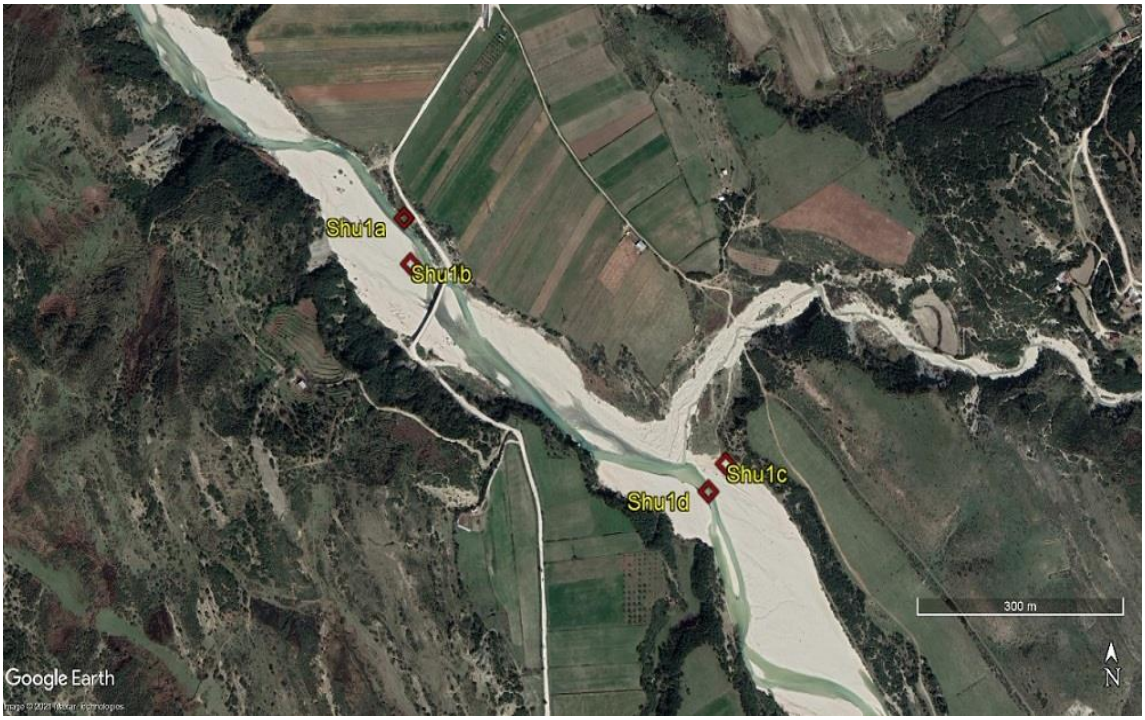

Figure *1*: Work Site 1 (2.5 km north from Gjorm village) at river Shushica with (sampling points (Shu1a, Shu1b, Shu1c, Shu1d) of different habitats are marked).

Figure *2*: Work Site 2 (at Brataj Bridge close to Brataj village) at Shushica River with sampling points (Shu2a, Shu2b, Shu2c, Shu2d) of different habitats marked.

Figure 3: Work Site 3: (4.8 km southeast from Brataj village) at Shushica River with sampling points (Shu3a, Shu3b, Shu3c, Shu3d) of different habitats marked.

Annex 6

Provisional report on the mollusc fauna of the Shushica River

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Introduction
Five localities were examined at the Shushica River during the science week on May 30th and 31srt 2021 concerning molluscs. Different methods were applied: larger species (>5mm) were mainly recorded by hand picking. For records of smaller species, samples of mud and river deposits (up to 10 liters) were sieved with mash widths of 4 and 0,5mm. The sieved material was sorted out under a stereomicroscope.

Sample sites
Work Site (WS)1/1- mainly dry river bed of the Shushica, sieving of loamy sediment
Work Site 1/2- beneath rocks at the riverbed, sieving of rock litter
Work Site 1/3– large river deposits of Schushica River sieving of rock litter
Kuc 3a:1 – nearly dry riverbed of the Shushica, rocks
Brataj 3a:2 – spring near the bridge of Brataj

Results and discussion
In total, 39 species could be reported, 37 of them gastropods, 2 of them mussels (tab. 1.). Species numbers reach from 1 (Brataj 3a;2) to 30 (WS1/3).

Concerning protection, two of them, the snail *Vertigo angustior* and the mussels *Unio crassus* are listed in the Annex II of the habitats directive of the European Union.

Apart from that, the number of four different Hydrobioidea (i.e. “spring snails“ in a broader sense) is remarkable, as this informal group of water snails is very often restricted to areas with clear water and tends to build local endemics. Furthermore, their taxonomic issues are far from being resolved. In the current case, four species could only be determined to Genus level (*Iglica sp. 1, 2, 3)*, for another one just a vague assumption is possible (*Hydrobioidea* sp.) due to missing determination literature.

	WS 1		WS2		WS3		Kuc 3a:1		Brataj 3a:2	
Gastropoda	l	e	l	e	l	e	l	e	l	e
Acanthinula aculeata (O.F. Müller, 1774)						1				
Agardhiella sp.						1				
Albinaria scopulosa (Charpentier, 1852)							1			
Carychium tridentatum (Risso, 1826)						1				
Cecilioides acicula (O. F. Müller, 1774)		1								
Cecilioides tumulorum (Bourguignat, 1841)						1				
Cernuella cf cisalpina (Rossmässler, 1837)	1					1				
Charpentieria stigmatica sturmi (Pfeiffer, 1848)				1	1					
Cochlicella acuta (O. F. Müller, 1774)		1				1				
Cochlostoma sp.							1			
Daudebardia sp.				1						
Galba truncatula (O. F. Müller, 1774)						1				
Gittenbergia sororcula Benoit, 1859		1								
Helix lucorum Linné, 1758				1						
Hippeutis complanatus (Linné, 1758)						1				
Hydrobioidea sp.									1	
Iglica sp. 1		1				1				
Iglica sp. 2						1				
Iglica sp. 3						1				
Lauria cylindracea (Da Costa, 1778)		1								
Lauria semproni (Charpentier, 1837)						1				
Lindholmiola corcyrensis (Rossmässler, 1838)		1		1	1	1		1		
Lucilla scintilla (R.T. Lowe, 1852)						1				
Lucilla singleyama (Pilsbry, 1890)						1				
Mediterrania hydatina (Rossmässler, 1838)		1				1				
Monacha claustralis (Rossmässler, 1834)	1				1					
Monacha frequens (Mousson, 1859)		1						1		
Pomatias elegans (W. Hartmann, 1840)		1	1	1		1	1	1		
Punctum pygmaeum (Draparnaud, 1801)		1				1		1		
Rupistrella philippi (Cantraine, 1841)						1				
Trochoidea pyramidata (Draparnaud, 1805)						1				
Truncatellina cylindrica (A. Férussac, 1807)						1				
Vallonia pulchella (O. F. Müller, 1774)						1				
Vavata cristata (O. F. Müller, 1774)						1				
Vertigo angustior (Jeffreys, 1830)						1				
Vitrea illyrica (Wagner, 1917)				1		1				
Vitrea subrimata (Reinhardt, 1871)						1				
Bivalvia										
Euglesa casertana (Poli, 1791)						1				
Unio crassus (Philipsson, 1788)						1				
In total	2	10	1	6	3	28	3	4	1	0

Table 1: Mollusc species found at the science week at Shushica River 2021. l: living animals. E: only empty shells reported

Annex 7

Assessment of the fish fauna of the Shushica River

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Agricultural University of Tirana, Faculty of Agriculture and Environment,

The sampling campaign was compromised of electrofishing (EF) for juvenile and adult fish by point abundance sampling (Copp & Peňáz 1988) in May 2021 at selected wadable sites. For EF, the backpack-generator ELT60-IIH from H. Grassl with direct current at 1.3 kW and 500 V was used.

Tab.1: Relative fish species share (in %) in River Shushica. At Shushica worksite 1 (downstream Gjorm) and worksite 2 (Bratay, Osmanic bridge). IUCN criteria

	IUCN	Site 1	Site 2
Barbus prespensis	LC	47.5	20.0
Alburnoides aff. *prespensis*	-	43.0	22.1
Squalius platyceps	LC	2.5	15.8
Oxynoemacheilus pindus	VU	0.6	16.8
Pachychilon pictum	LC	0.5	11.6
Cobitis ohridana	LC	4.3	2.1
Anguilla Anguilla	CR	0.6	5.3
Chondrostoma vardarense	NT	0.5	1.1
Gobio skadarensis	EN	-	3.2
Alburnus scoranza	LC	-	2.1
Salmo farioides	-	0.4	-

Fig. 1 European Eel

Comments:
Of the eleven species recorded nine are listed on the Red List of threatened species of the International Union for Conservation of Nature (IUCN). The (*Anguilla anquilla* Linnaeus 1758) – the European eel – has the highest conservation state. The species is considered as critically endangered. The European eel population has been declining since the 1980s throughout its throughout its geographical range of distribution. Recent estimates indicate that only 10% of the historical European eel populations are intact.

The species has a unique catadromous life history cycle, migrating between marine and freshwater environments. Longitudinal connectivity is of paramount importance for such long-distance migratory species and migration barriers are considered as major threat. Considering the current dramatic situation regarding eel stocks several legislative documents and conservation directives have targeted its protection. The Regulation of the Council of the European Union (EC 1100/2007) requiring member states to strictly reduce anthropogenic impacts.

The Balkan Catchments still constitute a considerable proportion of the overall of European eel stock. A detailed analysis was provided by Meulenbroek *et al.* (2020) "Conservation Requirements of European Eel (*Anquilla anquilla*) in a Balkan catchment," demonstrating the excellent hydromorphological state of the Vjosa-Aoos system and identifying it as a main source area of the European eel.

Longitudinal connectivity is also of paramount importance for other migratory species like *Barbus prespensis* and *Chondrostoma vardarense*. The blockage of upstream areas to migratory fish species would have significant negative impact, leading to massive population declines. The potential violations of international and national law by the blockage of migration routes due to the construction of hydropower dams is apparent.

Thus, it deserves highest conservation efforts. The construction of hydropower dams would significantly degrade the high ecologic value of the entire river system.

Annex 8

The Carabid fauna of the Shushica River: first insights (Coleoptera: Carabidae)

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Universalmuseum Joanneum

Study sites and methods

During a three day trip along the Shushica River (30.05.-02.06.2021), carabid beetles were collected at 18 sampling sites (Fig. 1, 2, 3). To get an adequate overview of the regional fauna, four sections spread over the course of the river were defined: Section A, situated two kilometres upstream of the confluence of the Shushica with the Vjosa River, sections B (Work site 1)and C (Work Site 2) in the middle course of the river around Gjorm and Brataj, and section D in the headwaters of the river near the village Kuç. Most samples were taken by the authors of this short contribution, Wolfgang Paill and Johanna Gunczy, supplemented by Gernot Kunz. The determination was done by the first author. Most of the beetles have already been determined to species level, but the material from section B is still missing.

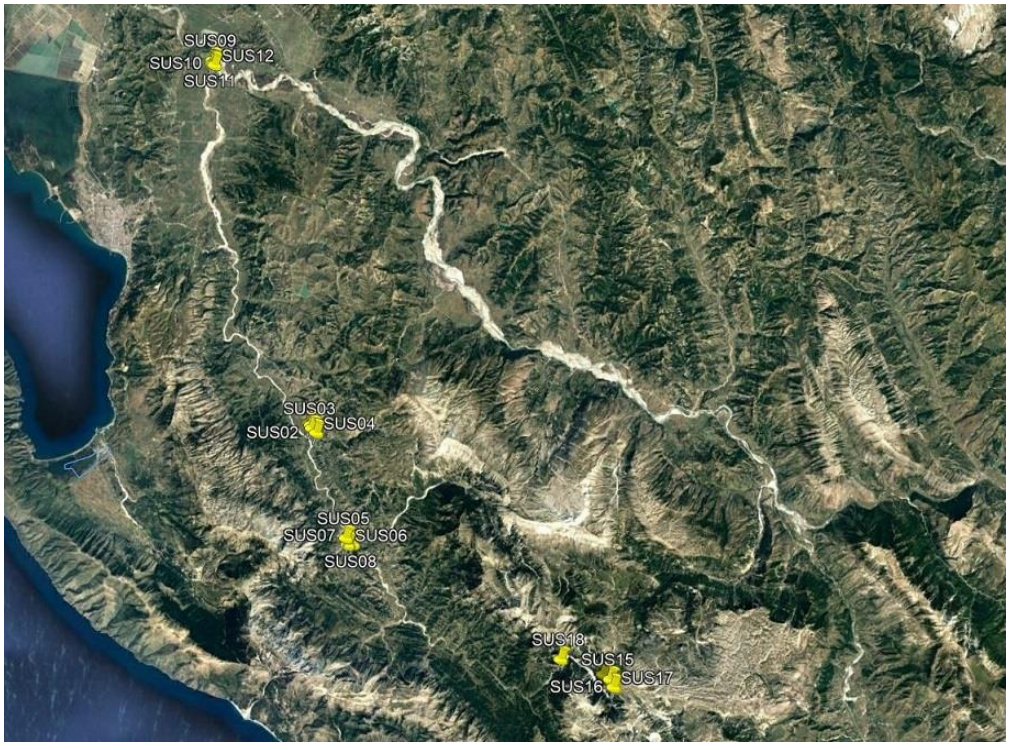

Fig. 1: General sections of investigation (A, B, C, D) and exact sampling sites (SUS01-SUS18). © Google Earth

Fig. 2: Selected sampling sites in section A (left: site SUS09, right: site SUS10). Photos: W. Paill

Fig. 3: Selected sampling sites in the sections C and D (left: SUS08, right: site SUS18). Photos: W. Paill

Fig. 4: Sampling by hand along the Shushica in section D (left). Sampling by light attraction executed by Johanna Gunczy and Wolfgang Paill in section A (right). Photos: G. Kunz

Preliminary Results

Based on more than 1000 collected specimens, 68 carabid species were registered at the designated sampling sites along the Shushica River so far (Tab. 1). Some of them are of high faunistic and natural conservation interest. Details about some selected species are provided below.

Asaphidion flavicorne (Solsky, 1874)

First record in Albania! European findings of this Middle Asian species have so far been limited to Bulgaria and Greece (Apfelbeck 1904, Guéorguiev & Guéorguiev 1995, Marggi *et al.* 2017). We found three specimens, at sections A and B (upstream the mouth of the Shushica and at the middle course, especially at site SUS08, see Fig. 2).

Bembidion aetolicum (Apfelbeck, 1901)
This Western Balkan endemic is very rare and restricted to certain parts of Greece and Albania (Marggi *et al.* 2017). The nominotypical form is known from Northern Greece (Ätolien, Thessalien) and the Tomorr Mountains in Central Albania (Müller-Motzfeld 1986, Guéorguiev 2007a). We found three specimens in section D, at the upper course of the Shushica near Kuç, (SUS18, Fig. 2).

Bembidion brunoi (Bonavita, 2001)

This taxon was recently described from the Southern Balkans, partly from the Aoos River, headwater of the Vjosa. Apart from there, it was so far only found in Bosnia Herzegovina (Bonavita 2001), Montenegro (Guéorguiev 2011) and Albania (Guéorguiev 2007a, Paill *et al.* 2018). Because of this restricted distribution area, Guéorguiev (2007b) described the species as locally endemic. Similar to the occurrence along the Vjosa (Paill et al. 2018, Paill & Gunczy unpubl.), this highly stenotopic species inhabits initial stages of gravel sediment bars along the Shushica as well. There it is one of the dominant species.

Bembidion grandipenne (Schaum, 1862)
Although more widespread than previously assumed (Guéorguiev 2007b treated the nominotypical form as a Balkan Endemic), this is another very rare species. In Europe, only a few findings of mostly single specimens are known from Macedonia (Hristovski & Guéorguiev 2015, Hristovski et al. 2010), Bulgaria, Montenegro and Kosovo (e. g. Guéorguiev 2011). Along the Shushica, we found the species both at the middle course (section C, SUS09) as well as at the headwater in high numbers (Section D, SUS18).

Bembidion hypocrita illyricum (Netolitzky, 1918)
Within this polytypic Mediterranean species, the nominotypical form is restricted to Southwest Europe, while the subspecies *illyricus* inhabits the Balkan peninsula (e. g. Bonavita & Vigna Taglianti 2005, Neri 2019). There, the distribution extents from Slovenia to the Peloponnese (Bonavita & Vigna Taglianti 2005, Drovenik & Peks 1999, Marggi *et al.* 2017), with single, widely disjunct locations. For example, the species was only recently safely reported from Bulgaria for the first time with only a single specimen by Guéorguiev (2011).

In addition, from Macedonia only two historic specimens and a single recent finding are documented (Hristovski & Guéorguiev 2015, Hristovski *et al.* 2010), and the taxon has not been reported from the well-studied Western Rhodopes yet (Guéorguiev & Lobo 2006). Within Albania, some old records from different parts of the country, like one specimen cited from “Argyrökastron,” are known (Guéorguiev 2007a). We collected *Bembidion hypocrita illyricum* at the upper course of the Shushica near Kuç (section D, SUS18), which is not far from the location mentioned above. It was found in initial stages of gravel sediment bars along a rapidly flowing part of the brook (Fig. 2) in high numbers, forming one of the dominant species of the local carabid community. (section D, SUS18).

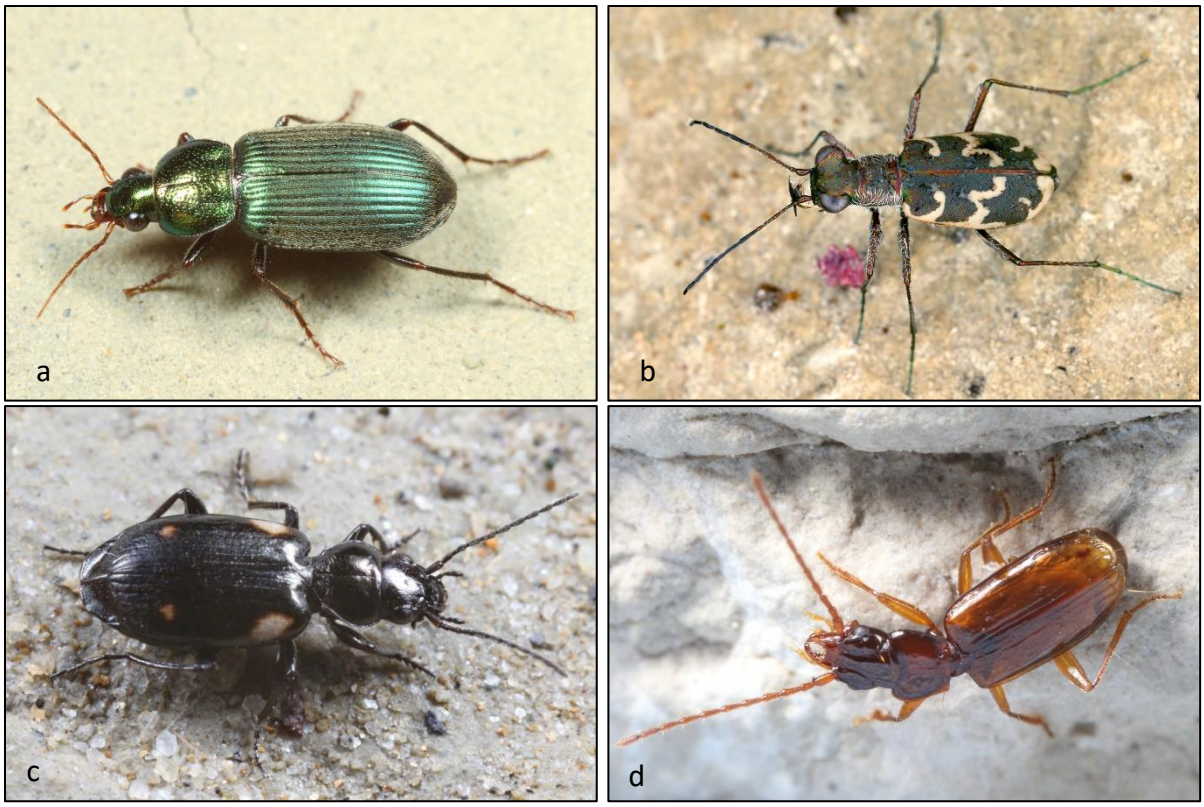

Fig. 5: *Chlaenius viridis*, *Cylindera arenaria viennensis, Lionychus quadrillum,* and *Thalassophilus longicornis.* Photos: G. Kunz (b), W. Paill (a, c, d,)

Chlaenius viridis (Ménétriés, 1832)
This species constitutes another first record in Albania! Although this Turano-Mediterranean species is generally widespread, it is only known in very few locations. For example, only single specimens have been documented from Montenegro (e. g. Mandl 1981), Macedonia (e. g. Hristovski & Guéorguiev 2015), Bosnia Herzegovina and Greece (Wrase 2005) within Europe so far. We found a single female in section A, living on a fine-grained sediment bar with initial vegetation (Fig. 2, right).

Cylindera arenaria viennensis (Schrank, 1781)

Since the first indisputable documentation of this taxon for Albania from the Vjosa published by Paill *et al.* (2018), we hereby provide another finding from the upper course of the Shushica. The specimens were found in a regularly flooded outer part of the floodplain on moist fine-grained terrain.

Dyschirius laeviusculus (Putzeys, 1846)
The only known Albanian finding of this species from the locality Kula e Lumës near Kukës in Northern Albania (Hieke *et al*. 1986) was thought to outline the southern boundary of this species' distribution in the Balkan Peninsula (Guéorguiev 2007a). Our finding from the confluence of the Shushica River with the Vjosa (section A), however, would shift this boundary approximately 180 kilometres further to the south. A single specimen was collected on a loamy cut bank of the Shushica (site SUS09, Fig. 1, left)

Lionychus quadrillum (Duftschmid, 1812)

The only known record of this species from Albania dates back more than 100 years ago (Guéorguiev 2007a). Here we present the most recent findings. We collected this species in

small populations in both upstream-sections C and D, inhabiting middle-coarse-grained sediment bars directly at the water level.

Sinechostictus millerianus (Heyden, 1883)

The distribution of this Central-Eastearn European species on the Balkans is rather scattered. This is indicated, for example, by the data from Ćurčić *et al.* (2007), Guéorguiev (2008, 2011) and Hristovski & Guéorguiev (2015). As there is only one single specimen registered from Albania collected more than 80 years ago; here, we provide the second and most recent finding (Guéorguiev 2007a). The specimens were found syntopicly with e. g. *Bembidion hypocrita Illyricum*, living at the water edge of coarse-grained sediment bars in section D near the village Kuç (SUS18).

Thalassophilus longicornis (Sturm, 1825)

The first detailed data for this widespread, but rare Eurocaucasian species for Albania were given by Paill *et al.* (2018). Now, we provide a further finding for this country. Like several species before, *T. longicornis* was also found at site SUS18 at the headwater of the Shushica near Kuç.

Tab. 1: Annotated list of documented carabid species in alphabetical order. The taxonomy predominantly follows Löbl & Löbl (2017). !!! = first record for the fauna of Albania, !! = second finding for Albania, ! = first recent finding (only historical records from Albania until now).

taxon	**range restriction on the Balkans**	**faunistic relevance for Albania**	**not yet found along the Vjosa**
Amara aenea (De Geer, 1774)			
Amara sp.			x
Asaphidion flavicorne (Solsky, 1874)		!!!	x
Asaphidion nebulosum (P. Rossi, 1792)	Balkan subendemic		
Asaphidion rossii (Schaum, 1857)			
Bembidion aetolicum Apfelbeck, 1901	West Balkan endemic	!	x
Bembidion brunnicorne Dejean, 1831			
Bembidion brunoi (Bonavita, 2001)	local endemic		
Bembidion bualei Jacquelin du Val, 1852			
Bembidion combustum Ménétriés, 1832			
Bembidion concoeruleum Netolitzky, 1943			
Bembidion conforme (Dejean, 1831)			x
Bembidion dalmatinum Dejean, 1831			
Bembidion decorum (Panzer, 1799)			
Bembidion grandipenne Schaum, 1862		!	x
Bembidion hypocrita illyricum Netolitzky, 1918	Balkan endemic	!	x
Bembidion latiplaga Chaudoir, 1850			
Bembidion lunulatum (Geoffroy, 1785)			
Bembidion praeustum Dejean, 1831			x
Bembidion punctulatum Drapiez, 1820			
Bembidion quadripustulatum Audinet-Serville, 1821			
Bembidion quadricolle (Motschulsky, 1844)			
Bembidion scapulare Dejean, 1831			
Bembidion siculum smyrnense Apfelbeck, 1904			
Bembidion striatum (Fabricius, 1792)			
Bembidion subcostatum vau Netolitzky, 1913			
Bembidion testaceum (Duftschmid, 1812)		!	x
Bembidion varium (Olivier, 1795)			
Bembidion vseteckai dissimile J. Müller, 1943			

Calathus circumseptus Germar, 1823			
Calathus fuscipes (Goeze, 1777)			
Calathus sp.			x
Calomera littoralis nemoralis (Olivier, 1790)			
Carabus coriaceus excavatus Charpentier, 1825	Balkan endemic		
Carabus preslii preslii Dejean, 1830	West Balkan endemic		x
Chlaenius festivus (Panzer, 1796)			
Chlaenius flavipes Ménétriés, 1832			
Chlaenius vestitus (Paykull, 1790)			
Chlaenius viridis Ménétriés, 1832		!!!	x
Cylindera arenaria viennensis (Schrank, 1781)		!!	
Dixus obscurus (Dejean, 1825)		!	x
Dyschirius agnatus Motschulsky, 1844			
Dyschirius gracilis (Heer, 1837)			
Dyschirius laeviusculus Putzeys, 1846		!!	x
Dyschirius minutus albanicus J. Müller, 1922			
Dyschirius morio Putzeys, 1867			
Dyschirius substriatus priscus J. Müller, 1922			
Harpalus sp.			x
Lionychus quadrillum (Duftschmid, 1812)		!!	x
Microlestes luctuosus Holdhaus, 1904		!	x
Ocys sp.		!	
Olisthopus fuscatus Dejean, 1828			
Omophron limbatum (Fabricius, 1777)			
Ophonus cribricollis (Dejean, 1829)			
Perileptus areolatus (Creutzer, 1799)			
Poecilus striatopunctatus (Duftschmid, 1812)			
Pterostichus melas (Creutzer, 1799)			
Scarites terricola Bonelli, 1813			
Sinechostictus millerianus (Heyden, 1883)		!!	x
Stenolophus discophorus (Fischer von Waldheim, 1823)			
Tachys fulvicollis (Dejean, 1831)			
Tachyura diabrachys (Kolenati, 1845)			
Tachyura hoemorroidalis (Ponza, 1805)			
Thalassophilus longicornis (Sturm, 1825)		!!	
Trechus subnotatus subnotatus Dejean, 1831	Balkan endemic		x
Trechus quadristriatus (Schrank, 1781)			
Zabrus sp.			x
Zabrus tenebrioides (Goeze, 1777)			

Tab. 2: List of documented carabid species, sorted according to their occurrence within the differentiated sections of the Shushica. Alluvial species of high natural conservation interest are highlighted by shading.

	section A (SUS09-SUS12)	**section C (SUS05-SUS08)**	**section D (SUS13-SUS18)**
Amara aenea (De Geer, 1774)	x		
Bembidion latiplaga Chaudoir, 1850	x		
Bembidion quadripustulatum Audinet-Serville, 1821	x		
Bembidion quadricolle (Motschulsky, 1844)	x		
Bembidion striatum (Fabricius, 1792)	x		
Bembidion testaceum (Duftschmid, 1812)	x		
Calathus circumseptus Germar, 1823	x		
Calomera littoralis nemoralis (Olivier, 1790)	x		

Carabus coriaceus excavatus Charpentier, 1825	x		
Chlaenius festivus (Panzer, 1796)	x		
Chlaenius viridis Ménétriés, 1832	x		
Cylindera arenaria viennensis (Schrank, 1781)	x		
Dixus obscurus (Dejean, 1825)	x		
Dyschirius agnatus Motschulsky, 1844	x		
Dyschirius gracilis (Heer, 1837)	x		
Dyschirius laeviusculus Putzeys, 1846	x		
Dyschirius minutus albanicus J. Müller, 1922	x		
Dyschirius morio Putzeys, 1867	x		
Dyschirius substriatus priscus J. Müller, 1922	x		
Harpalus sp.	x		
Microlestes luctuosus Holdhaus, 1904	x		
Poecilus striatopunctatus (Duftschmid, 1812)	x		
Pterostichus melas (Creutzer, 1799)	x		
Scarites terricola Bonelli, 1813	x		
Olisthopus fuscatus Dejean, 1828	x		
Tachys fulvicollis (Dejean, 1831)	x		
Zabrus tenebrioides (Goeze, 1777)	x		
Asaphidion flavicorne (Solsky, 1874)	x	x	
Asaphidion rossii (Schaum, 1857)	x	x	
Bembidion lunulatum (Geoffroy, 1785)	x	x	
Bembidion punctulatum Drapiez, 1820	x	x	
Bembidion scapulare Dejean, 1831	x	x	
Bembidion subcostatum vau Netolitzky, 1913	x	x	
Bembidion varium (Olivier, 1795)	x	x	
Bembidion vseteckai dissimile J. Müller, 1943	x	x	
Tachyura hoemorroidalis (Ponza, 1805)	x	x	
Asaphidion nebulosum (P. Rossi, 1792)	x	x	x
Bembidion brunoi (Bonavita, 2001)	x	x	x
Bembidion concoeruleum Netolitzky, 1943	x	x	x
Bembidion dalmatinum Dejean, 1831	x	x	x
Bembidion bualei Jacquelin du Val, 1852	x	x	x
Bembidion praeustum Dejean, 1831	x	x	x
Omophron limbatum (Fabricius, 1777)	x	x	x
Perileptus areolatus (Creutzer, 1799)	x	x	x
Tachyura diabrachys (Kolenati, 1845)	x	x	x
Bembidion decorum (Panzer, 1799)	x		x
Calathus fuscipes (Goeze, 1777)	x		x
Chlaenius vestitus (Paykull, 1790)	x		x
Ophonus cribricollis (Dejean, 1829)	x		x
Stenolophus discophorus (Fischer von Waldheim, 1823)	x		x
Bembidion brunnicorne Dejean, 1831		x	x
Bembidion combustum Ménétriés, 1832		x	x
Bembidion conforme (Dejean, 1831)		x	x
Bembidion grandipenne Schaum, 1862		x	x
Lionychus quadrillum (Duftschmid, 1812)		x	x
Amara sp.			x
Bembidion aetolicum Apfelbeck, 1901			x
Bembidion hypocrita illyricum Netolitzky, 1918			x
Bembidion siculum smyrnense Apfelbeck, 1904			x
Calathus sp.			x
Carabus preslii preslii Dejean, 1830			x
Chlaenius flavipes Ménétriés, 1832			x
Ocys sp.			x
Sinechostictus millerianus (Heyden, 1883)			x

Thalassophilus longicornis (Sturm, 1825)			x
Trechus subnotatus subnotatus Dejean, 1831			x
Trechus quadristriatus (Schrank, 1781)			x
Zabrus sp.			x

Discussion

Without having evaluated all the collected material, remarkably 68 species of riverbanks-inhabiting ground beetles were detected along the Shushica. Almost 30 %, namely 19 species, have not yet been detected at the Vjosa (Paill *et al.* 2018, Schiemer *et al.* 2020). This confirms the special relevance of the Carabid fauna of the Shushica. Both, the lower and the upper reaches of the river are of particular importance. At the lower reaches near the confluence with the Vjosa, *Asaphidion flavicorne* and *Chlaenius viridis*, two extreme rarities of the European fauna were detected for the first time in Albania. In this area, the number of documented species is considerable and significantly higher than in the other sections due to the high diversity of habitats. In total, six species of the genus *Dyschirius* and 16 species of the genus *Bembidion* were detected at this stretch of the river. The upper reaches of the river on the other hand are equally interesting and of high conservational relevance. With *Bembidion aetolicum*, *Bembidion grandipenne* and *Bembidion hypocrita illyricum*, three very rare species present by sustainable populations were found.

The Shushica is not only habitat to a remarkable fauna of ground beetles, which is worth protecting, but it is also of utmost importance for its interaction with the Vjosa. It can be assumed that during extreme floods of the Vjosa, which are unlikely to occur at the same time on the Shushica, numerous river-dwelling and flying beetles will temporarily move to the Shuchica tributary to repopulate the Vjosa after the water has receded.

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Annex 9

Birds, Dragonflies and Scorpionflies

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The Vjosa River and its tributaries in Albania are currently threatened by plans to build hydropower plants. To prevent possibly irreversible damage to these pristine rivers, the aim of the "Science week" was to gather as much scientific information as possible about the value of this unobstructed and naturally flowing river system.

During this week, we tried to cover all (or most) of the pre-selected transects situated at the Shushica and Bence River applying taxon-specific state of the art techniques to inventory the extant biodiversity.

For surveying the avifauna, we tried to cover the full length of the transects by foot recording each individual bird. Bird species were identified visually using binoculars or acoustically. Since the focus lay on recording the ornithological diversity to the fullest extent possible, specimen counts were omitted, however, highest numbers of specimens per species that have been observed simultaneously, were recorded as well (Bibby 2004).

The intact river system with natural shores, gravel banks and temporary islands provide ideal habitat for river- and/or stream-adapted species like the common sandpiper (*Actitis hypoleucos*), the pied wagtail (*Motacilla alba*), the gray wagtail (*Motacilla cinerea*) and the little ringed plover (*Charadrius dubius*). The latter one was also observed breeding and protecting their newly hatched chicks. Furthermore, the common house martin (*Delichon urbicum*), the barn swallow (*Hirundo rustica*), the red-rumped swallow (*Cercropis daurica*) as well as the European bee-eater (*Merops apiaster*) were observed drinking water and hunting for insects, respectively.

Fig.1: Left: The little ringed plover (*Charadrius dubius*) depends on gravel banks and pits near freshwater for nesting but also needs muddy areas for hunting insects. Right: Chicks of the little ringed plover were observed on a gravel bank at the Shushica.

The natural dynamics of the river forming mud and gravel banks, pools, pits, pockets and niches covered by vegetation as well as variable shorelines further favors other species as well, that have vanished from other human-influenced European rivers. At the confluence of the Shushica and Vjosa River for example, the Eurasian stone-curlew (*Burrhinus oedicnemus*) was observed at a dry sandy mud bank adjacent to small pools surrounded by vegetation. At the same location, the European nightjar (*Caprimulgus europaeus*) was recorded acoustically and visually at night. Both species have previously been reported from the Narta Lagoon, which also constitute a part of the National Network of Protected Areas in Albania (Mladenov *et al.* 2017).

Fig.2: European nightjar (*Caprimulgus europaeus*) recorded at the confluence of the Shushica and Vjosa River.

Alongside surveying the avifauna and other vertebrate diversity, I also recorded dragon- and damselflies as well as species of the order Mecoptera. Dragonflies and damselflies were either identified from the distance using binoculars or caught with a hand net and then determined up close. Exuviae were also collected and identified. Scorpionflies and hanging flies were caught by hand.

Dragonflies have been proposed as an indicator species to classify and qualitatively describe aquatic habitats (e.g. Chovanec 2019, Gómez-Tolosa *et al.* 2021). Consequently, the Shushica and Bence Rivers housing a swath of different habitats as contrasting as bare gravel banks and thick vegetation covered shores along the course of the river, also provide suitable niches for a variety of dragon- and damselflies.

Fig.3: Left: The small pincertail (*Onychogomphus forcipatus*) prefers gravel banks along clean and faster flowing rivers. Right: The Eastern spectre (*Caliaeshna microstigma*) inhabits more shaded stretches of smaller water bodies i.e. streams and brooks.

Although information about the Mecoptera in Albania is rather scarce, following the common understanding, three scorpionfly species (family Panorpidae) as well as *Bittacus italicus* (family Bittacidae) can be expected (Bartoš 1965, Devetak 1991, Dvořák 2018). The presence of *B. italicus* is especially noteworthy as this species is generally assumed to be present but extremely rare throughout most of Europe. In the course of the "Vjosa Science Busters week" *B. italicus* was found at two locations at both Shushica and Vjosa River at riparian forests with adjacent shrubs and hedges. These findings are quite significant since hanging flies seem to be dependent on floodplain forests and shrub-surrounded thickets near larger rivers, which, due to human influence have decreased in the last decades across large parts of Europe.

Fig.4: *Bittacus italicus* feeding on a white-legged damselfly (*Platycnemis pennipes*).

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Annex 10

Report on Otter, other Mammals, Amphibians and Reptiles of Shushica River

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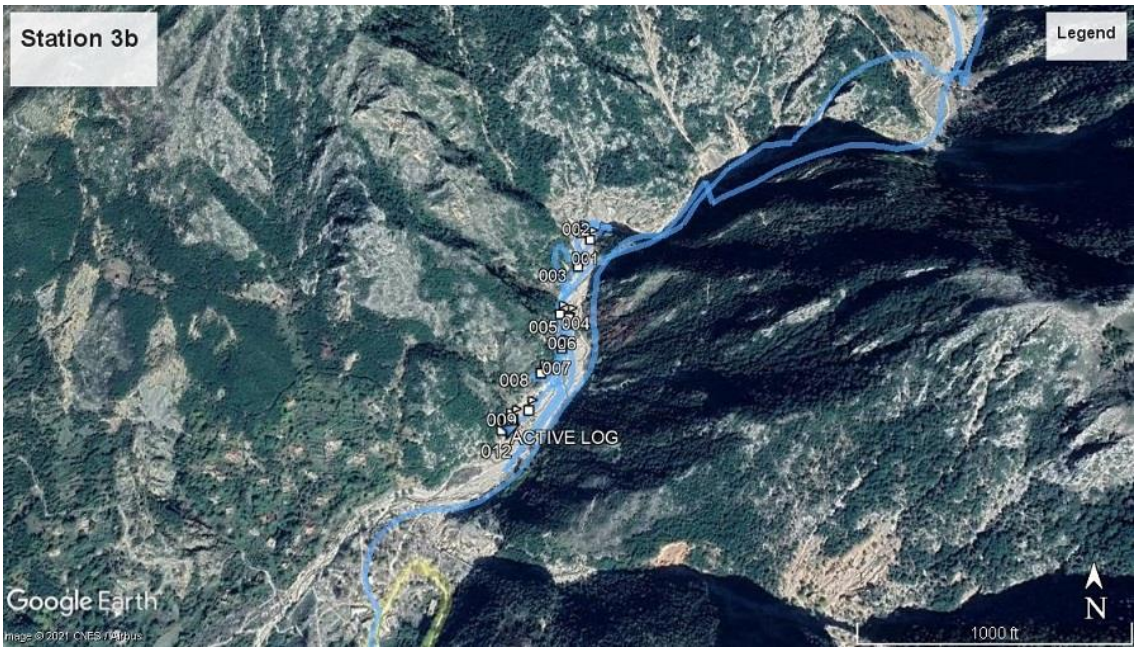
Introduction

This is a report on the preliminary findings of terrestrial riparian fauna (Otter, other Mammals, Amphibians, and Reptiles) along Shushica river valley. A two-day field investigation was conducted in the middle and upper sections of the Shushica River. Distribution data on the vertebrate terrestrial fauna in each of the investigated river stations and data on otter marking activity are provided. Based on these data some preliminary conclusions are drawn, confirming the ecological values and sensitivity of the Shushica River. Some observations of other taxa, such as birds (Aves) and crabs (Crustacea) were also recorded during the field investigation.

Sites and Methods

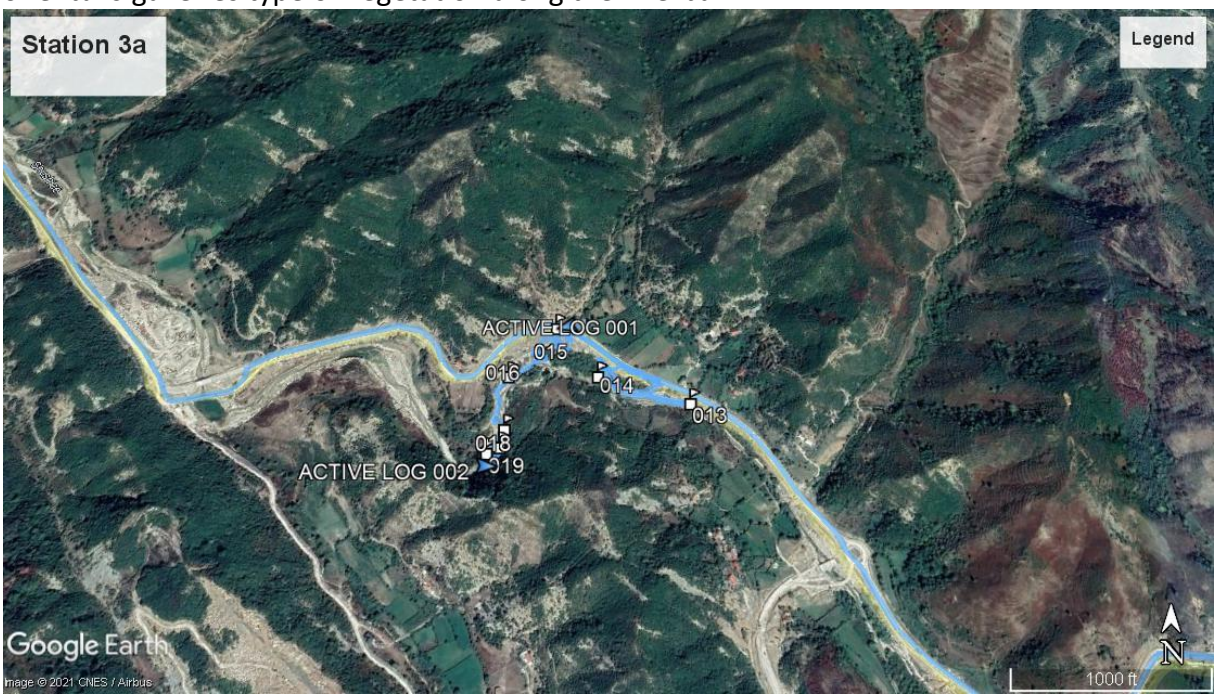
Five river stations (cc 1km long river section each) have been investigated.
Station 1,2 refers to worksite 1, 2.

Station 3b. Zall i Zhurit (Kuç, upstream). Investigated on May 30th, 2021. No riparian vegetation along the riverbank. Riverbed with stones and gravel (pebble)



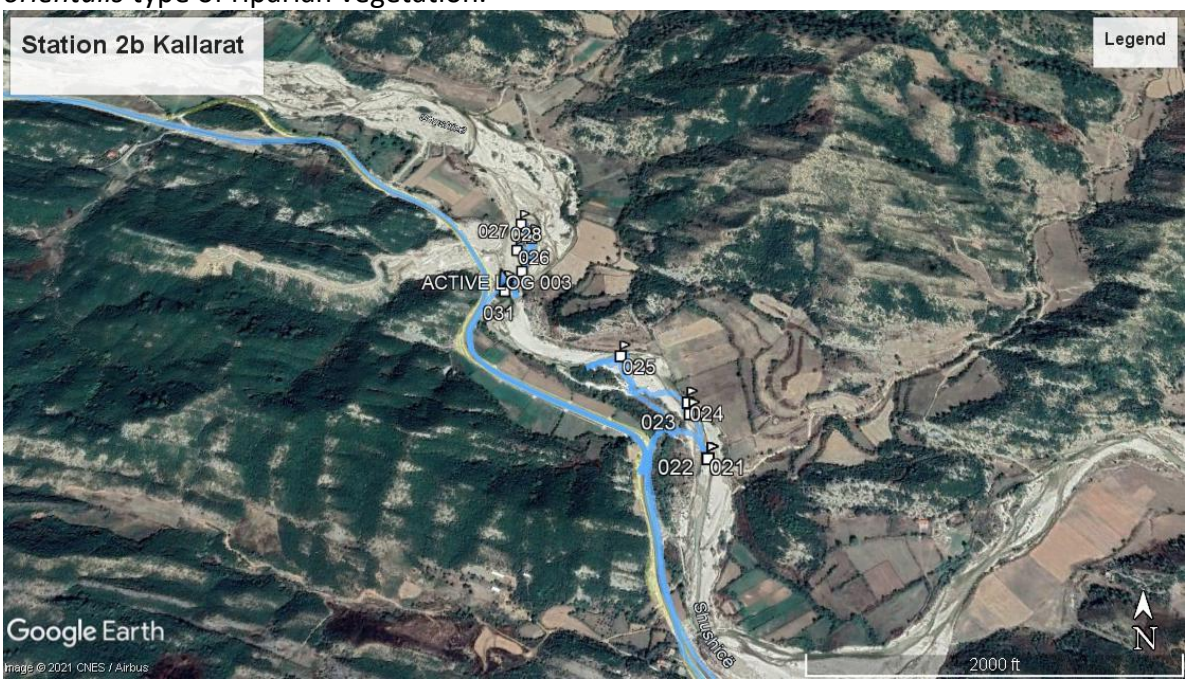
Station 3b. Zalli i Zhurit (Kuc). Photo F. Bego

Station 3a. Kuç (downstream). Investigated on May 30th, 2021. *Salix alba* and *Platanus orientalis* galleries type of vegetation along the riverbank.



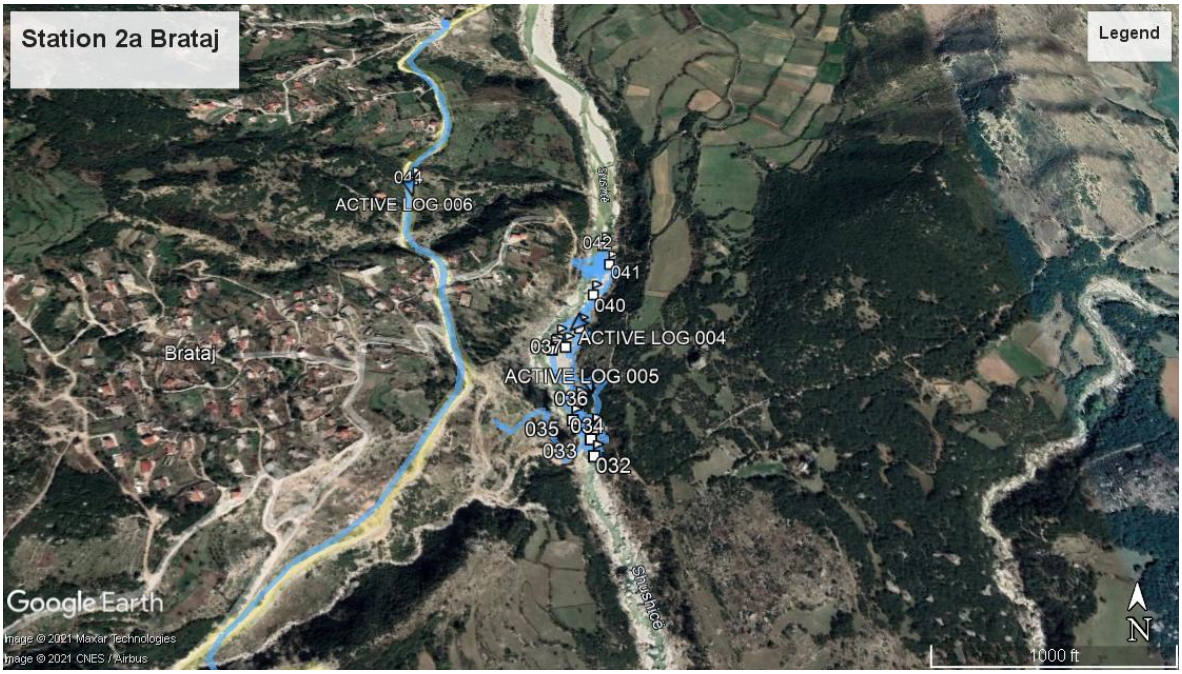
Station 3a. Kuc (downstream). Photo F. Bego

Station 2b. Kallarat. Investigated on May 30th, 2021. Wide riverbed with two branches of the river courses. Gravel riverbed and pockets of fine sediments. *Salix alba* and *Platanus orientalis* type of riparian vegetation.



Station 2b. Kallarat (Photo F. Bego)

Station 2a. Brataj bridge. Investigated on May 31st, 2021. Narrow riverbed, with steep riverbanks and rapid river flow. Rare trees of *Platanus orientalis* along the riverbank. Stony and gravel riverbed with pockets of sand and fine sediments and ponds of slow running waters.



Station 2a. Brataj old bridge

Station 1. Gjormi bridge. Wide riverbed. Gravel riverbed, with pockets of sandy and fine sedimentation and muddy ponds on both sides of the riverbed. Investigated on May 31st, 2021.

Station 1. Gjormi bridge (Photo F. Bego)

The main method was that of visual encounter survey (VES) along the investigated river sections. Animals observed while travelling from one station to the other were recorded, including road kills. Otter marking activity is measured as number of sprainting points and number of spraints per 1 km river length. All fresh spraints of otter (*Lutra lutra*) were sampled for further diet analysis. All observations were recorded in GPS (etrex Garmin) and photos were taken whenever possible.

Preliminary Results

All data recorded during the field survey are provided in the Table 1.

Table 1. Summary of the results with records on terrestrial riparian Fauna

Station	Date	WPs	Taxa group	Species recorded	Notes
Station 3b. Zall i Zhurit. Kuç	30.05.2021	WP001	Amphibia	*Rana graeca*	1 adult and tadpoles
		WP002	Amphibia	*Rana graeca*	1 adult
		WP003	Amphibia	*Rana graeca*	Tadpole
		WP004	Amphibia	*Rana dalmatina*	1 adult
		WP005	Amphibia	*Rana graeca*	1 adult
		WP006	Amphibia	*Rana graeca*	1 adult
		WP007	Amphibia	*Rana graeca*	Tadpole
		WP008	Amphibia	*Pelophylax kurtmuelleri*	2 inds. adult
		WP009	Amphibia	*Pelophylax kurtmuelleri*	One adult and two subadults
		WP010	Amphibia	*Pelophylax kurtmuelleri* *Rana graeca*	2 subadults, and one adult of R. graeca
		WP011	Amphibia	*Rana graeca*	1 adult
		WP012	Amphibia	*Rana graeca*	2 inds
Station 3a. *Kuç. downstream*	30.05.2021	WP013	Amphibia	*Rana graeca*	1 ind.
		WP014	Amphibia Mammalia	*Rana graeca, Martes foina*	Adult of *R. graeca,* and scat of *M. foina*
		WP015	Amphibia	*Pelophylax kurtmuelleri, Bombina variegata*	2 adults of P. kurtmuelleri and one subadult of B. variegata
		WP016	Amphibia	*Pelophylax kurtmuelleri, Bombina variegata, Rana graeca*	5 inds of P. kurtmuelleri of different age, one ind. of B. variegata and R. graeca
		WP017	Mammalia	*Vulpes vulpes*	Old and fresh scats
		WP018	Mammalia	*Lutra lutra*	Old spraint
		WP019	Amphibia	*Bufo bufo, Pelophylax kurtmuelleri*	Abundant presence of tadpoles
		WP020	Mammalia	*Lutra lutra*	2 fresh + 2 old spraints and tracks on mud (sample for diet analysis)
		WP021	Reptilia	*Testudo hermanni*	Female, on the roadside
Station 2b. Kallerat	30.05.2021	WP023	Mammalia	*Lutra lutra*	Old spraint on a big stone

Station	Date	WPs	Taxa group	Species recorded	Notes
		WP024	Mammalia	*Lutra lutra*	Fresh tracks, 2 sprainting sites, 2 fresh and 2 old spraints (2 samples for diet analysis)
		WP026	Amphibia	*Pelophylax kurtmuelleri*	Tadpoles and subadults
		WP027	Amphibia	*Bombina variegata, Pelophylax kurtmuelleri*	Abundant Tadpoles
		WP028	Mammalia	*Vulpes vulpes*	Scats on the stone
		WP029	Mammalia	*Lutra lutra*	2 old spraints on a big stone
		WP030	Amphibia	*Pelophylax kurtmuelleri*	2 adults
		WP031	Mammalia	*Lutra lutra*	4 old + 1 fresh spraints on a sandy rock (one sample for diet analysis)
Station 2a. Brataj old bridge	31.05.2021	WP032	Crustacea	*Potamobius sp.*	
		WP033	Mammalia	*Vulpes vulpes*	Scats on a big rock
		WP034	Reptilia	*Podarcis muralis*	On a big stone
		WP035	Mammalia	*Lutra lutra*	Tracks on sandy and gravel riverbanks
		WP036	Mammalia	*Lutra lutra*	Old spraint on a stone, next to a pool
		WP037	Aves	*Cinclus cinclus*	One ind.
		WP038	Amphibia	*Pelophylax kurtmuelleri*	Mating calls and tadpoles
		WP039	Mammalia	*Lutra lutra*	Fresh spraint (sampled for diet analysis)
		WP040	Amphibia	*Pelophylax kurtmuelleri*	2 inds.
		WP041	Amphibia, Mammalia	*Pelophylax kurtmuelleri; Lutra Lutra*	1 ind., P. kurtmuelleri; 1 fresh+ 3 old spraints
		WP042	Amphibia, Mammalia, Crustacea	*Pelophylax kurtmuelleri, Lutra lutra, Potamobius sp.*	-few inds; -fresh tracks on mud;
		WP043	Mammalia	*Lutra lutra*	Old spraint on a yellow colour stone
		WP044	Reptilia	*Malpolon insignitus*	Subadult, killed on the road
Station 1. Gjormi bridge	31.05.2021	WP045	Mammalia	Bats, *Mustela nivalis*	Bats droppings under the bridge; scat of M. nivalis
		WP046	Mammalia	*Lutra lutra*	Old spraint under the bridge
		WP047	Mammalia	*Lutra lutra*	2 sprainting points (jelly secretions, 1 fresh + 1 old spraint; 1 fresh spraint).

Station	Date	WPs	Taxa group	Species recorded	Notes
					Fresh spraints sampled for diet analysis
		WP048	Mammalia	*Lutra lutra*	Jelly secretion and spraint under the new bridge
		WP049	Mammalia	*Lutra lutra*	Fresh tracks on muddy sediments and 2 old and 1 fresh spraints, and jelly secretion on gravel. Fresh spraint sampled for diet analysis
		WP050	Mammalia, Aves	*Lutra lutra, Charadrius dubius*	Jelly secretions, one fresh spraint, and scratching on gravel/sandy riberbank. One individual of *Ch. dubius.*
		WP051	Mammalia	*Lutra lutra*	Fresh tracks of otter on soft sandy and gravel riverbank
		WP052	Mammalia	*Lutra lutra*	Two scratchings, 2 fresh and 3 old spraints of otter (3 on stones, 2 on sandy scratchings). Fresh spraints sampled for diet analysis
		WP053	Amphibia, Reptilia	*Pelophylax kurtmuelleri, Natrix natrix, Emys orbicularis*	Abundant presence of P. kurtmuelleri; tracks on mud of E. orbicularis; N. natrix (juvenile)
		WP054	Mammalia	*Lutra lutra*	5 spranting points: a- 4 fresh + 1old; b-2 Fresh + 1 old; c- 1 Fresh + 2 old; d- 1 Fresh + 1 old; e- 2 old spraints
		WP055	Mammalia	*Lutra lutra*	Scratching and jelly secretion on sandy and muddy riverbank

Rana graeca (Station 3b)

Rana dalmatina (Station 3b)

Pelophylax kurtmuelleri (Station 3b)

Bombina variegata (Station 3a)

Lutra lutra spraint (Station 3a)

Testudo hermanni (female, on the road)

Podarcis muralis (female, Station 2a)

Lutra lutra (fresh spraint, Station 2b)

Bufo bufo tadpoles (Station 3a)

Malpolon insignitus (juv., roadkill, Station 2a)

Potamobius sp. (Station 2a)

Lutra lutra (old spraint, Station 2a)

Lutra lutra (fresh tracks, Station 1)

Emys orbicularis (tracks on mud, Station 1)

Lutra lutra scratching (Station 1)

Bats droppings under the bridge (Station 1)

Discussion

Shushica is hosting a rich terrestrial riparian fauna: five amphibians (*Rana graeca, Rana dalmatina, Bombina variegata, Bufo bufo, Peloplylax kurtmuelleri*), five reptiles (*Testudo hermanni, Emys orbicularis, Podarcis muralis, Natrix natrix, Malpolon insignitus*), five Mammals (*Lutra lutra, Vulpes vulpes, Martes foina, Mustela nivalis*, and at least one bat species) and two semiaquatic bird species (*Charadrius dubius, Cinclus cinclus*) were recorded during the two days field survey along the Shushica River. Two species (*Lutra lutra*, *Bombina variegata*) are Annex II species of Habitat Directive (HD), while two species of amphibians (*Rana dalmatina, R. graeca*), four species of reptiles (*Testudo hermanni, Emys orbicularis, Podarcis muralis, Malpolon insignitus*) and bats are listed in the Annex IV of HD. Presence of *Cinclus cinclus* is an indicator of good water quality of Shushica River. Otter (*Lutra lutra*) were present in four out of five stations investigated. Otter were absent only in the upper section of Shushica River (Station 3b), while its presence and marking activity was more frequent in the Station 1 (Gjorm). However, these results should be only considered preliminary and more species on terrestrial riparian fauna (Tetrapods) are expected to be reported with further investigations in the coming years.