Acta ZooBot Austria **155**, 2018, 85–105

The Vjosa (Vjosë) – the floodplains of an outstanding gravel bed river in southern Albania

Anton Drescher

The Vjosa floodplain is a unique example of an almost undisturbed gravelbed river in Southern Europe. The investigations discussed here refer to a river stretch between Kalivaçi and Poçemi. The great variety of habitats and vegetation types is documented with more than 60 relevés. An overview of the plant communities and plant assemblages shows the attempt of a plant sociological classification. The diversity encompasses a spectrum of ephemeral herbal pioneer assemblages to small remains of Platanus mixed woods. Largely unvegetated gravel beds in the active zone and wide *Imperata cylindrical* grasslands on higher niveaus of the floodplain have the highest areal share. The latter developed after cutting and repeatedly burning to gain pasture. Finally a succession scheme is presented and the importance of woody debris in the river channel is discussed.

Drescher A., 2018: Die Vjosa – Auen eines einzigartigen Wildflusses in Süd-Albanien.
Die Vjosa bildet eine in Südeuropa einzigartige Wildflußlandschaft von nahezu ungestörter Natur. Die vorliegenden Untersuchungen betreffen den Flußabschnitt zwischen Kalivaçi und Poçemi. Die Vielfalt an Lebensräumen und Vegetationstypen wird mit mehr als 60 Vegetationsaufnahmen dokumentiert. In einer Übersicht der Pflanzengesellschaften wird der Versuch einer Gliederung des noch unzureichenden Aufnahmematerials präsentiert. Das Spektrum reicht von ephemeren krautigen Pioniergesellschaften mit bereits einzelnen Sämlingen von Holzarten bis zu kleinen noch vorhandenen Resten von Platanen-Mischwäldern. Weitgehend unbewachsene Kiesflächen in der aktiven Zone und weite Graslandflächen mit dominantem *Imperata cylindrica* auf höheren Niveaus der Aue – enstanden durch Abholzung und wiederholtes Brennen zur Weidegewinnung – nehmen dabei die größten Flächenanteile ein. Abschließend wird ein Sukzessionsschema vorgestellt und die Bedeutung von Totholz in der aktiven Zone diskutiert.

Keywords: Southern Albania, Vjosa, gravel bed river, floodplain vegetation, succession.

Introduction

On the one hand, unmodified or nearly unmodified floodplains are areas of flood protection and, as a network of waterways, still play an underestimated role for biodiversity. On the other hand, they are subject to uncontrolled development regarding industry and power generation. The Vjosa catchment in southern Albania is one of the largest, almost completely untouched river catchments in all of the Balkan. Albania is striving for progress, and the fast growing industry and growing prosperity of city inhabitants is pushing the demand for electric energy. The plans for the construction of new power plants illustrates this impressively (see https://www.balkanrivers.net/en/key-areas/vjosa-river).

The huge loss of flooded areas of up to 90 percent of the original extent over the past 150 years in floodplains in central and southern Europe (e.g. Danube, Rhine, Po) vividly shows the deficits of this development. Therefore, for the last 25 years or so, restoration measures have been planned, are under construction, or are (partly) finished (Mosimann 1992, Schiemer & Reckendorfer 2000 u. 2004, Woolsey et al. 2005). The more or less untouched hydromorphological and hydrological conditions of the Vjosa catchment can serve as an example to understand the complicated interrelation between the hydrological preconditions, river bed morphology and distribution of species, vegetation, and animals, and can yield new knowledge for further restoration projects of floodplain areas all over the Mediterranean.

The study area

The Vjosa river (Aoos in Greece) and some of its tributaries like Sarandoporos and Drinos originate in northern Greece. The catchment comprises 6704 km^2, 4365 km^2 of which are situated on Albanian territory (see fig. 1 in Schiemer et al. 2018 this volume). In the upper stretch, gorges alternate with wider valley sections. The specific area more intensely surveyed here is situated between Kalivaçi and Poçemi (Fig. 7a and 8 in Schiemer et al. 2018 this volume). Aside from this section, some areas upstream near Sarandoporo along the Greek border, near Tepelenë, and west of Quesarat were visited.

Physical setting

The Appennines-Albanides-Hellenides chain constitute the southern part of this orogenic belt. The lower part of the Vjosa catchment is embedded in the external zone of the Albanides, the main geological structure of southern Albania.

At the beginning of the Trias, the Pangea continent split into fragments. Until the Cretaceous period, the microplate drifted to the east and later to the northeast. During the Neogene, the direction changed again caused by the movement of the African Plate to the north. This led to a fault and thrust system in Albania and NW Greece (Durmishi et al. 2014 and 2018 this volume). As a result of the tectonic movements, the Albanides show a very complex tectonic structure and consist of the eastern or Internal and the western or External Albanides (Aliaj 2006). The catchment area of the Vjosa river basin is embedded in the Ionian zone, the largest of the five tectonic zones of the External Albanides (for details, see Durmishi et al. 2014 and 2018 this volume). The valleys of the river Vjosa and its tributaries use predetermined tectonic lines of the Alpine thrust system. Marl, sandstone, and organogenic limestone, as well as Ophiolite originating from the south-eastern part of the catchment are represented in the transported sediments.

The middle part of the Vjosa valley is surrounded by average mountain ranges with an elevation between 300 m a.s.l. in the north and almost 2000 m in the south. The Gribe mountain range with its highest peak Mt. Kudhësit (1907 m) separates the valleys of the Vjosa river in the north and northeast with the large basin of Kutë and the Shushica valley in the southwest. The basin of Kutë is about 6 km long and 2 km wide. South of Kutë, an alluvial fan built by a tributary forces the river to change the main direction from SE–NW to E–W.

Data from a gauge near Poçemi show maximum discharge during the months of December to March originating from the rainy period in winter in the lowlands and from snow melting in early spring. The mean discharge for the period 1958 to 1990 has decreased from 180 m^{3}sec^{-1} (1958–1967) to 140 m^{3}sec^{-1} (1978–1988). For details, see Schiemer et al. (2018 this volume).

Flora, natural vegetation and land use in southern Albania

Due to its mountainous relief and climatic differentiation, southern Albania presents a high number of ecological niches. As a result, the level of biodiversity is very high compared with central European countries. A very small strip with Mediterranean flora and vegetation along the Adriatic coast is followed by a belt with submediterranean vegetation above around 100 m a.s.l. Some Mediterranean species less sensitive to temperatures below zero can still be found here, such as *Cercis siliquastrum, Platanus orientalis*, and *Vitex agnus-castis.* The majority of elements of the Mediterranean flora, e.g. *Arbutus andrachne,* several *Cistus* species*, Euphorbia dendroides, Lavandula stoechas, Myrtus communis, Nerium oleander, Olea europaea,* and *Smilax aspera* are already missing on the hilly slopes along the Vjosa river between Kalivaçi and Poçemi.

Following the floristic division of southeastern Europe by Glavač 1972 (cited in Horvat et al. 1974, Fig. 40) southern Albania is part of the Ionian-Aegaean Province of the Maroccan-mediterranean Region. The submediterranean subregion covers a strip with coastal mountain ranges behind the very small band with Mediterranean Flora. The number of endemic species in the coastal mountain ranges south and southeast of Vlorë is relatively low compared with the Western and Eastern North Albanian Alps. The number increases again in northern Greece.

Only a few patches of degraded deciduous woodland remained in southern Albania especially in areas close to the greek border with restricted access during the "Hodxa-regime". These areas are habitually coppiced and grazed by goats and sheep. Scattered small ground fires are regularly started to obtain areas for pasturing. Characteristic woody species of this altitudinal belt are *Carpinus orientalis, Fraxinus ornus, Quercus pubescens, Q. trojana, Cotinus coggygria, Cornus mas, Viburnum lantana, Hippocrepis* (= *Coronilla*) *emerus,* and *Phillyrea latifolia,* among others.

Along the river and especially in the deltas of the smaller tributaries, self sustaining, small scale farms dominate the landscape. The possibility of irrigation during the dry summer season is the reason for no floodplain forests (e.g. Alno-Fraxinetum angustifoliae, Populetum albae) are preserved on these stands.

Large areas of coppiced submediterranean woodland included in the alliances Carpinion orientalis Horvat 1958 (Ass. Querco-Carpinetum and Orno-Carpinetum orientalis) often havily grazed, is used for sheep and goat breeding.

Around half of the population is largely engaged in subsistence agriculture, the share of the GDP being around 20 %. The dominant form of land use is mixed farming. The most important products in the valleys of southern Albania are wheat, maize, potatoes and vegetables. The production of fruits and grapes is restricted to slopes of the hilly area along the valleys. Usually the production of herbs for medicine and spices is neglected. In the communist era, around 100.000 people were engaged in collecting medicinal herbs. Proceeds of the worldwide export were about 50 Million US$, but they decreased successively after the regime change (Doka 2008).

Material and methods

In April and September 2017 69 relevés have been made in the floodplains of Vjosa and Sarandoporo river using the Braun-Blanquet approach (Braun-Blanquet 1964, Reichelt & Wilmans 1973). Depending on the vegetation type and the vegetation mosaic an area between 25 and 100 m^2 per plot was chosen. The data were put in the database TURBOVEG (Hennekens & Schaminée 2001) and for processing exported to the JUICE program package (Tichý 2002). For classification we used the divisive method "two way indicator species analysis" TWINSPAN (Hill 1979, Leyer & Wesche 2007). Before processing incomplete sampled plots as well as plots from outside the floodplain have been omitted. The material left was processed with TWINSPAN. The first division splitted the sample of 63 relevés into two great groups of plots: i) stands from ditches, backwaters, wetlands along hillslope streams and ii) stands from the active corridor. Each of these two underwent a separate further treatment. The smaller set of 20 relevés from ditches and backwaters refers to siltation stands. In the larger set of 43 relevés from the active corridor with coarse sediments from sand to gravel are combined.

To make the succession stages presented in the succession scheme in chapter 5 comprehensible, woody species were depicted in different strata following age and height classes, respectively:

- i) seedlings: few weeks to few months old (up to 10 cm high)
- ii) juvenile: less than one vegetation period (up to 30–50 cm high)
- iii) herb layer: 1–3 years old (up to 1 m high)
- iv) shrub layer: 3–7(?) years old (>1 m to 3(6) m high)
- v) tree layer: > 10 years old (> 6 m high)

In order to better illustrate the connection to the succession scheme in chapter 5, contrary to convention, woody species are presented in reverse from seedling stage to arborescent individuals in Tables 1 and 2. Furthermore, with only a few exceptions, all species with only one occurrence are not depicted in Tables 1 and 2.

For determination of vascular plant species we used Flora Europaea (Tutin & al. 1968–1980, Moore 1993), Pils 2016, Vangjeli 2015 and recent floristic publications (Barina & Pifkó 2008; Barina et al. 2009, 2011, 2013; Rakaj 2013). To check the distribution pattern of selected rare or endemic species, Barina 2017, Malo & Shuka 2008, 2013 were used. Some species were not determined to species level for several reasons: i) we found only non-flowering material, which is not possible to determine, e.g. *Elytrigia*; ii) due to a diverging species concept of different authors, e.g. *Hieracium*; iii) there is still insufficient knowledge and therefore poor treatment, e.g. *Rosa, Rubus, Taraxacum*. The nomenclature of scientific plant names follows the Euro+Med PlantBase (http://www.emplantbase.org/home.html) and in some cases the "The Plant List" (http://www.theplantlist.org/). The synsystematic system of higher ranks follows Mucina & al. (2016). On the association level, the available surveys (Dring et al. 2002; Kárpáti & Kárpáti 1961) are preliminary, incomplete, or do not follow the ICPN (Weber et al. 2000).

Results

The vegetation types of the floodplain both from the active channel and the backwaters of the Vjosa river are presented in Tables 1 and 2. Extremely dry stands dominated by mosses and lichens as well as therophytic short lived communities of temporary shallow water bodies from the alliance Charion vulgaris (Krause ex Krause & Lang 1977) Krause 1981 have not been sampled at all. A determination of *Chara* species without oogonia is not possible. Two localities of the latter type were observed in the floodplain near Kutë and near Tepelenë.

Plant assemblages of standing and slowly floating water bodies and their siltation stages (Tab. 1)

Ephemeral Pioneer vegetation (A5 in Schiemer et al. 2018 this volume)

***Cyperus fuscus*-community** (Tab. 1, cluster 1, relevé nrs. 6, 62)

In erosion and evorsion pools within the active channel, species poor assemblages with dominant *Potamogeton nodosus* colonise shallow waters. Total cover is below 10 percent. The amphibian species *Cyperus fuscus* accompanies the dominant *Potamogeton* on many stands. Shallow pools partly fall dry during summer. The fine grained sediment cover (silt to silty fine sand) shows high water capacity. *Cyperus fuscus* as well as *C. rotundus* are adapted to disturbance by (flash) floods. The stands are to be classified in the alliance Nanocyperion Koch ex Libbert 1932.

Nanocyperion-community (Tab. 1, Cluster 2, relevé nrs. 46, 64, 67)

The plant assemblage of nr. 46 with a relatively high total cover of 20 percent reminds one of relevés of the association Crypsio alopecuroidis-Cyperetum fusci Bioindi, Vegge, Bals & Taffetani 1999 reported from central-northern Italy. The relevés 64 and 67 from fixed erosion ponds in the active channel behind a groyne represent a special case (Fig. 1A). This may explain the higher number of species per plot compared with the ephemeral asemblage from a natural stand at the edge of the floodplain near Tepelenë.

Pioneer vegetation (A4 in Schiemer et al. 2018 this volume)

Near the river bank in shallow ponds that fall dry during low water periods pioneer vegetation develops. The species composition already contains seedlings of woody species. The sediment surface is fine grained.

Nanocyperion-community with seedlings of woody plants (Tab. 1, Cluster 3, relevé nrs. 29, 30, 31, 60, 61)

The random species composition is very similar to that of cluster 2, depending on the time when the site falls dry. In all samples seedlings of woody species are already present. The high total cover of 60 percent in plot nr. 60 is due to the willow species *Salix alba* and *S. triandra*. These sites are to be classified in the *Cyperus fuscus*-community.

The following three reed bed associations along the outer floodplain borders are included in the alliance Phragmition australis Koch 1926 (A7a in Schiemer et al. 2018 this volume).

Typhetum angustifoliae Pignatti 1953 (Tab. 1, Cluster 4, relevé nrs. 9, 57)

The backwaters are at least partly former side arms in the outer part of the floodplain. The two plots presented here are former side arms, one still used by a tributary near Kutë. The ditches are usually filled with water and fall dry in late summer. These sites represent the first stages of terrestrialisation, with gleysoils on clayey sediment.

The species poor plots are characterised by a high total cover between 80 and 100 percent. They are dominated by *Typha angustifolia* (FANELLI et al. 2015), accompanied by the helophytes *Sparganium erectum, Bolboschoenus maritimus, Mentha aquatica* and *Oenanthe* spec. Relevé nr. 9 already leads to Pioneer scrub (cluster 6) because of some few *Salix alba*-shrubs. Unfortunately due to the incomplete sampling with only five herb species a final characterisation is not possible.

Sparganietum erecti Roll 1938 (Tab. 1, Cluster 5, relevé nr. 7)

Typhetum latifoliae Nowinski 1930 (Tab. 1, Cluster 5, relevé nrs. 39, 40, 41)

Two vegetation types with similar ecological demands are united in this cluster. They represent stands from banks or shallow parts of very slow floating backwater courses and from the channelised tributary to the Vjosa near Kutë in an advanced stage of terrestrialisation. The topsoils already show a higher content of organic matter, while silt and clay are the dominant fractions of the mineral component. The stands are adapted to be covered by water during several weeks in spring (FANELLI et al. 2015). The samples show a total cover of vegetation between 40 and 95 % and are species poor (between 5 and 10 species per relevé) and dominated by *Sparganium erectum* and *Typha latifolia,* respectively.

Pioneer scrub and softwood forests

***Salix triandra-Alnus glutinosa*-community** (Salicetum triandrae Malcuit 1929(?) (Tab. 1, Cluster 6, relevé nrs. 3, 42) (SCHIEMER et al. 2018 this volume, A6)

In a backwater in the elevated floodplain of the orographic left bank, in a completely silted former river course, a shrubbery with *Salix triandra* developed on gleysoils (relevé nr. 3). Incomplete sampling due to the onset of darkness makes a correlation of relevé nr. 3 with willow scrub associations very difficult. A similar composition of the herb layer with *Eleocharis palustris, Lythrum salicaria, Lycopus europaeus*, and the Mediterranean *Carex flacca* subsp. *serrulata* links this assemblage and that of relevé nr. 42 with that of cluster 4 and 5.

Salicetum albae Issler 1926 (Tab. 1, Cluster 7, relevé nrs. 38, 8) Softwood floodplain forest (SCHIEMER et al. 2018 this volume, A7b, c)

Tab. 1: Reduced synoptic table of plant assemblages of the siltation series. Species with only one occurrence are omitted. Abbreviations: H: Herb layer, Juv: Juvenile, Sh: Shrub layer, Sdlg: Seedling, T: Tree layer. – Tab 1: Reduzierte synoptische Tabelle der Vergesellschaftungen der Verlandungsserie. Arten mit nur einem Vorkommen in der Tabelle sind weggelassen. Abkürzungen: H: Krautschicht, Juv: Jungpflanzen, Sh: Strauchschicht, Sdlg: Sämling, T: Baumschicht.

Number of cluster		1	2	3	4	5	6	7
Number of relevés per cluster		2	3	5	2	4	2	2
Tamarix parviflora	Sdlg		67					
Salix triandra ssp. *triandra*	Sdlg		67					
Salix amplexicaulis	Sdlg		33					
Populus alba	Sdlg		33					
Alnus glutinosa	Sh						50	
Vitex agnus-castus	Sh							50
Tamarix parviflora	Sh						50	50
Salix alba	Juv			100				50

Number of cluster		1	2	3	4	5	6	7
Number of relevés per cluster		2	3	5	2	4	2	2
Salix amplexicaulis	Juv			40				
Salix triandra ssp. *triandra*	Juv			60		25		100
Salix alba	Sh				50		50	100
Salix triandra ssp. *triandra*	Sh						50	50
Ulmus minor	Sh							50
Alnus glutinosa	T							50
Populus alba	T							50
Salix alba	T							100
Potamogeton nodosus	H	100	33					
Agrostis stolonifera	H		67					
Equisetum ramosissimum	H		67					
Cyperus fuscus	H	50	100	40				
Veronica anagallis-aquatica	H		100	20				
Juncus articulatus	H		67	20				
Cyperus rotundus	H	50		40				
Cynodon dactylon	H		33	40				
Xanthium italicum	H			80				
Typha angustifolia	H		33	80	100	50	50	50
Sparganium erectum	H				100	75		100
Typha latifolia	H					75		50
Mentha spec.	H				50	100		100
Bolboschoenus maritimus	H				50	25	50	50
Lythrum salicaria	H					50	50	100
Lycopus europaeus	H			20		50	50	100
Eleocharis palustris	H		33	20		25	100	
Rumex conglomeratus	H				50	25	50	50
Persicaria lapathifolia	H		33	20		25	50	50
Alisma plantago-aquatica	H			40				50
Fimbristylis bisumbellata	H		33	20				
Chara cf. *vulgaris*	H		33					
Polygonum aviculare ssp. *aviculare*	H		33					
Mentha pulegium	H		33					
Nasturtium officinale	H		67					
Alisma lanceolatum	H		33					
Apium nodiflorum	H		67					
Polypogon monspeliensis	H		33					
Cyperus flavescens	H		67					
Crypsis alopecuroides	H		33					
Tamarix parviflora	Juv		33	20			50	
Digitaria sanguinalis	H		33	20				
Sonchus spec.	H		33	40				
Myriophyllum spicatum	H		33					
Populus alba	Juv			20				50
Cyperus esculentus	H				50			
Mentha aquatica	H				50			
Carex spec.	H				50	25		50
Rumex sanguineus	H					25		50
Vitex agnus-castus	Juv					25	50	
Rumex spec.	H					25	50	
Carex flacca ssp. *serrulata*	H						50	
Humulus lupulus	H						50	50
Potentilla spec.	H							50

Salix(-*Populus*)-woodlands represent the final stage of vegetation development in course of the siltation process in subfossile channels. The species composition of the tree layer varies from pure *Salix-alba* stands to mixed stands with admixed *Populus alba* and/or *Alnus glutinosa*. The presence of *Ulmus minor* in the shrub layer of the mixed stand as well as the rising number of species per plot indicate a further development to hardwood floodplain woodland. The herb layer is characterised by plants demanding a high soil moisture content like *Sparganium erectum, Lythrum salicaria, Lycopus europaeus* and others. In the advanced stage, beside *Ulmus minor* we already find other species from hardwood forests like *Brachypodium sylvaticum, Rubus sanctus,* and *Epipactis helleborine*.

The plant assemblages in the active channel (Tab. 2)

Pioneer stage with ephemeral vegetation

(B2 and C2 in Schiemer et al. 2018 this volume)

After withdrawal of flood, unvegetated gravel and sand bars are emerging (Fig.13a in Schiemer et al. 2018 this volume). These areas are exposed to seed rain from wind dispersed species (*Salix* spp., *Populus* spp., *Typha* spp.*, Imperata cylindrica, Saccharum ravennae* and others). The moist sediment provides good conditions for germination of seeds transported by water or those species germinable only for a short period of time (*Salix* spp., *Populus* spp.).

Ephemeral Pioneer vegetation on sandy substrate (Tab. 2, Cluster 1, relevé nr. 51)

Beside light demanding pioneer species (*Epilobium dodonaei, Heliotropium europaeum*) with mediterranean or submediterranean distribution, accidential ruderal species make up this assemblage with very scarce cover (Fig.13c in Schiemer et al. 2018 this volume). It is not known whether the community shows a wider distribution.

***Typha minima*-(*Salix triandra*-)community** (Tab. 2, Cluster 2 relevé nrs. 12, 53)

We have found this rare plant assemblage only in two localities in southern Albania until now: on flat banks of slowly flowing side arms NW of Kutë (Fig. 1B) and along the Sarandoporo river. The stands are flooded annually, the sandy to fine sandy sediment is moist throughout the vegetation period. The localities exhibit retarded flow as they are situated aside the main channel. Rhizome-hemicryptophytes are usually the dominant plant species in a stand with few other, mostly accidential species. The absence of periodical flooding leads to *Salix*-dominated assemblages and the vanishing of *Typha minima* (compare tab. 2, rel. 12 with seven woody species in the shrub and herb layer). This marks the succession to *Salix*-shrub. Although the ecological conditions are very similar an assignment to the associations Equiseto variegati-Typhetum minimae Br.-Bl. in Volk 1940 (Delarze et al. 2015) from the Alpine arch as well as the associations Phragmiti-Typhetum minimae Trinajstić (1985) and Calamagrostio pseudophragmites-Typhetum minimae Dihoru (2005) from the northern Balkan peninsula is not possible due to the floristic differences.

Herbal pioneer stage (Tab. 2, Cluster 3, relevé nrs. 5, 20, 22, 27, 28, 43)

The vegetation cover of the initial stages of succession is very low and varies between 1 and 5 percent. The sedimented material consists of coarse sand and gravel of varying proportions (Schiemer et al. 2018 this volume; Fig. 11, photo C). The stands are usually situated close to the main channel and often flooded several times per year (see bathymetry of Transect 3 in Schiemer et al. 2018 this volume; Fig. 11). The constant species *Equisetum ramosissimum, Cynodon dactylon, Sinapis arvensis* and *Elymus* spec. tolerate a moderate cover with sediment during course of floods. The total species number per plot (25 m square) is very low and varies from 2 to 6 with a mean value of 4. If the stands survive the annual larger flood, woody species appear and initiate succession.

Woody pioneer stage (Tab. 2, Cluster 4, relevé nrs. 63, 65)

These two plots represent the first succession stage in the second year. The total vegetation cover is still low. Seedlings of woody species (*Populus nigra, Salix alba, Tamarix parviflora, Platanus orientalis,* and *Salix amplexicaulis*) try to establish themselves. Beside those, typical species of pioneer stands in floodplains appear, such as *Chondrilla juncea, Dittrichia viscosa, Echinochloa crus-galli, Verbascum sinuatum,* and *Verbena officinalis*, and sporadically also *Kickxia spuria* or *Solanum nigrum*. Most of them are common in cultivated fields or on waste ground. The higher mean number of species per plot is probably an artefact of the sampling period in September compared with relevés done in April with only 4 species per plot.

Early succession stage with several shrub species in the herb layer

(B3 and C3 in Schiemer et al. 2018 this volume)

Pioneer vegetation with woody species in the herb layer (Tab. 2, Cluster 5, relevé nrs. 1, 10, 16, 17, 18, 21, 35)

The stands along transect 2 are situated relatively close to the main channel (Fig. 13d in Schiemer et al. 2018 this volume). In addition to the woody species mentioned above we found *Salix eleagnos* and *Alnus glutinosa*.

Pioneer vegetation without woody species in the herb layer (Tab. 2, Cluster 6 relevé nrs. 19, 23, 24, 25, 26)

The stands are in more or less the same position as those from cluster 5. The relevés are species-poor with a mean species number of 6 per plot. Cluster 5 with a mean species number of 11.7 shows almost double that amount. It is not clear why woody species are missing as seedlings or in the herb layer. One possibility could be the coincidence of seed set of willow and poplar species with the decline of the water level in the main channel. Another possible reason is the strong competition of *Imperata cylindrica* in the rhizosphere. As hydrological data are not available, this cannot be proven.

Early succession stage with several shrub species

(B4 and C4 in Schiemer et al. 2018 this volume)

***Populus nigra-Salix eleagnos*-community** (Tab. 2, Cluster 7, relevé nrs. 52, 54, 55)

This vegetation type is reported only from Sarandoporo river. The reason for the species richness (mean value > 12, range from 8 to 18) is unknow, though it is likely the influx from the surrounding slopes, situated close to the river banks.

***Tamarix-Platanus-Vitex*-community** (Tab. 2, Cluster 8, relevé nrs. 2, 14, 15, 32, 33, 34, 59, 66)

Shrub communities with 3 to 4 different woody species (*Tamarix parviflora, Platanus orientalis, Populus nigra, Salix amplexicaulis,* and *Vitex agnus-castus*) occur along Sarandoporo and Vjosa river (relevé nr. 66, Fig. 13b in SCHIEMER et al. 2018 this volume). The species number per plot ranges from 9 to 25 (mean value > 14). It rises with age of vegetation development. The reason for the high species number in plot 2 is unknown, the relatively high position within the active channel is at least one of the main factors, and the relatively low total cover is another.

Early succession stage with woody vegetation

(D2 in SCHIEMER et al. 2018 this volume)

***Platanus orientalis-Alnus glutinosa*-community** (Tab. 2, Cluster 9, relevé nrs. 4, 56, 58, 70)

In the elevated floodplain level with more than 20 years of vegetation development, remnants of woodland remained despite very high grazing pressure from sheep and goats (Fig. 1C). The plots show a high species number (> 21) per relevé due to the moderate cover values of the tree layer between 40 and 70 percent. It was surprising to find *Listera ovata* in one of the plots. In central Europe this species grows in moist woodland. The fine-grained sediment and a moderate humus layer contribute to a well-balanced water supply during spring. The trees with an age of up to 20 years have access to groundwater and provide shadow for grazing animals. This might be the reason for the survival of these remnants in an overgrazed landscape.

Relevé number 56 represents a special case of very low degradation due to the situation near the Greek border. Because of the low pasturing pressure in this plot, we found the highest species number (27) of all woody vegetation types here. Lianas typical of mediterranean hardwood floodplain forests, like *Vitis vinifera* and *Periploca graeca, also* occurr here – a sign of long development of the vegetation cover. Several species from the surrounding slopes were found in the herb layer, such as *Quercus pubescens, Q. cerris, Paliurus spina-christi*, and *Cotinus coggygria*.

Populus nigra-Populus alba-community (Tab. 2, Cluster 10, relevé nrs. 68, 69)

Open woodland in the elevated floodplain with a very low species number owing to the very high grazing pressure. No other woody species than *Pyracantha coccinea* and the thorny climber *Smilax aspera* survive the intense browsing (Fig. 1E).

Degraded early succession stages

(D1 in SCHIEMER et al. 2018 this volume)

***Imperata cylindrica* grassland** (Tab. 2, Cluster 11A, relevé nr. 36)

Regularly burned areas on elevated niveaus of the floodplain are dominated by cogongrass (*Imperata cylindrica*) (Fig. 1D). This perennial rhizomatous grass is native to east and southeast Asia, Australia and eastern and southern Africa. The grassland is burned usually during winter and spring, because only the young shoots provide good fodder for pasturing by sheep. At that time the root system of cogongrass, up to 1.2 meters deep, reaches the high groundwater table and quick resprouting is stimulated. During summer and autumn

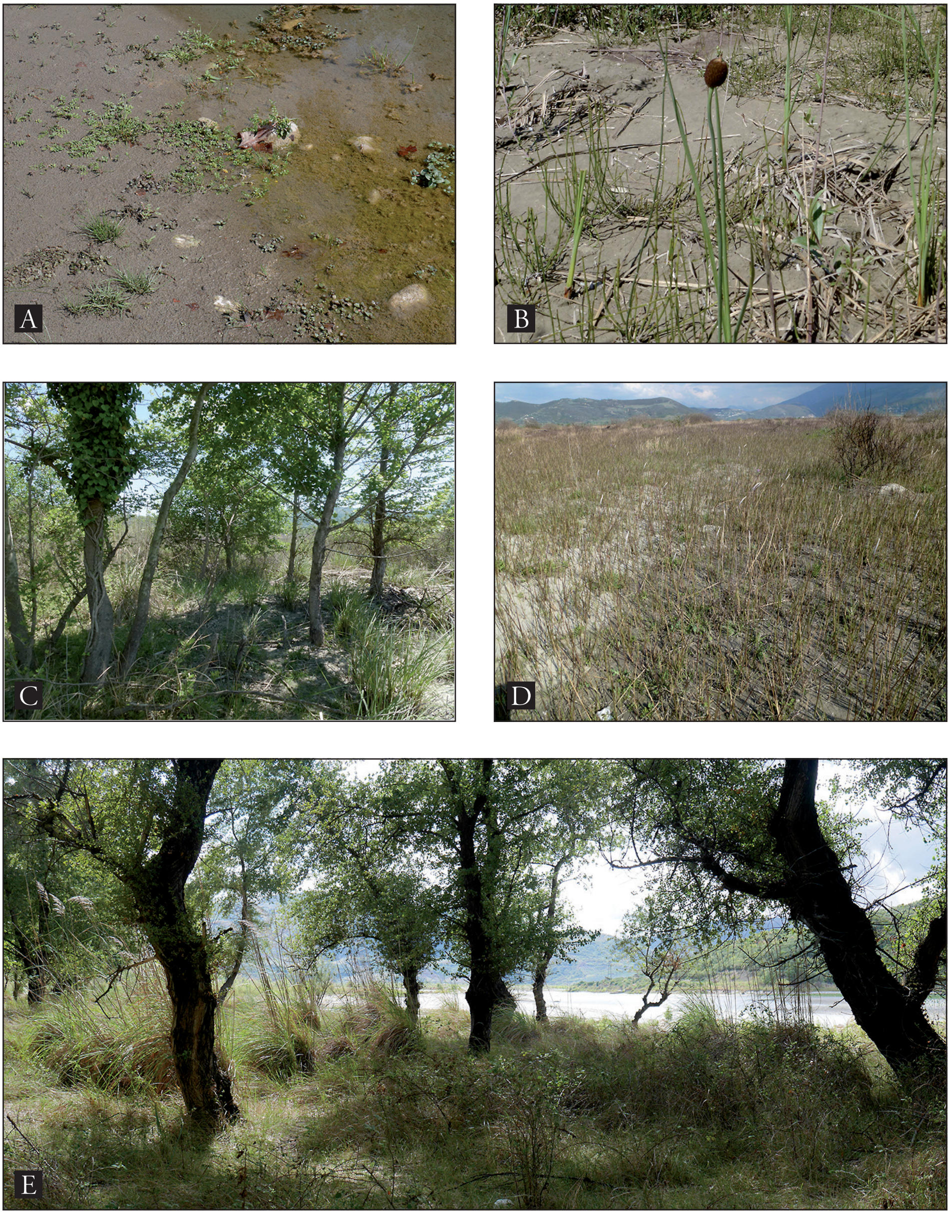

Fig. 1: Photo gallery of vegetation assemblages: A: *Nanocyperion*-community (evorsion pool near Poçemi); B: *Typha minima*-community NW of Kutë; C: *Platanus orientalis-Alnus glutinosa*-community between transect 1 and 2; D: Regularly burned stand with dominating cogongrass (*Imperata cylindrica*) and a single individual of monk's pepper (*Vitex agnus-castis*) (transect 2); E: *Populus nigra-Populus alba*-community near Poçemi. – Abb. 1: Fotos von Pflanzenvergesellschaftungen: A: Nanocyperion-Gesellschaft (Kolk bei Poçemi); B: *Typha minima*-Gesellschaft NW von Kutë; C: *Platanus orientalis-Alnus glutinosa*-Gesellschaft zwischen Transekt 1 und 2; D: Regelmäßig gebrannter Standort mit dominantem Silberhaargras (*Imperata cylindrica*) und einem Individuum von Mönchspfeffer (*Vitex agnus-castis*) (Transekt 2); E: *Populus nigra-Populus alba*-Gesellschaft bei Poçemi.

Tab. 2: Reduced synoptic table of plant communities of the aggradation series. Species with only one occurrence are omitted. Abbreviations see Tab. 1. – Tab. 2: Reduzierte synoptische Tabelle der Vergesellschaftungen des aktiven Flussbettes. Arten mit nur einem Vorkommen in der Tabelle sind weggelassen. Abkürzungen siehe Tab. 1.

Number of cluster		1	2	3	4	5	6	7	8	9	10	11A	11B
Number of relevés per cluster		1	2	6	2	7	5	3	8	4	2	1	2
Medicago coronata	H	100						33					
Astragalus vesicarius ssp. *carniolica*	H	100						33					
Dorycnium germanicum	H	100											
Epilobium dodonaei	H	100											
Echium vulgare	H	100											
Heliotropium europaeum	H	100						67					
Typha minima	H		100										
Typha angustifolia	H		50										
Typha shuttleworthii	H		50										
Populus nigra	Sdlg				50			33					
Rubus sanctus	Sdlg				50								
Tamarix parviflora	Sdlg				50								
Clematis vitalba	Sdlg				50								
Salix alba	Sdlg				100								
Platanus orientalis	Juv		50		100	29	20	33	13	50			
Populus nigra	Juv	100	50			43		33					
Salix eleagnos	Juv	100				71		33					
Salix alba	Juv					71							
Salix amplexicaulis	Juv				50	71		33	13				
Tamarix parviflora	Juv		50			57	20		25				
Alnus glutinosa	Juv		50				20			25			
Vitex agnus-castus	Juv					14			25	25	50	100	
Rosa sempervirens	Juv										100		
Carpinus orientalis	Juv									25			
Clematis vitalba	Juv									25			
Cornus mas	Juv									25			
Cornus sanguinea	Juv									50			
Hedera helix	Juv									50			
Periploca graeca	Juv							33		25			
Phillyrea latifolia	Juv									25			
Quercus cerris	Juv									25			
Quercus pubescens agg.	Juv									25			
Ulmus minor	Juv									25			
Salix triandra ssp. *triandra*	Juv		50										
Salix triandra ssp. *triandra*	Sh		50										
Populus nigra	Sh							100	13				
Salix eleagnos	Sh							67	13				
Tamarix parviflora	Sh							33	88				
Salix amplexicaulis	Sh		50						38				
Platanus orientalis	Sh		50						88	75	100		
Vitex agnus-castus	Sh								75	50		100	100
Saccharum ravennae	Sh								38	25	50	100	50
Rubus sanctus	Sh								13	25	100		
Salix alba	Sh		50						13				
Smilax aspera	Sh										50		
Pyracantha coccinea	Sh										50		
Cornus sanguinea	Sh									25			
Juniperus oxycedrus ssp. *oxycedrus*	Sh									25			

Number of cluster		1	2	3	4	5	6	7	8	9	10	11A	11B
Number of relevés per cluster		1	2	6	2	7	5	3	8	4	2	1	2
Carpinus orientalis	Sh									25			
Spartium junceum	Sh												50
Platanus orientalis	T									100			
Alnus glutinosa	T									100	50		
Populus nigra	T									25	50		
Populus alba	T										50		
Persicaria lapathifolia	H			50	50	29			13				
Xanthium italicum	H	100	100	50	50	100	80	67	50				
Equisetum ramosissimum	H		50	67	50	71	20	33	25	50			
Cynodon dactylon	H			67	50	29	80	67	38			100	50
Agrostis stolonifera	H			67		86	40	33	25	50	50		
Ditttrichia graveolens	H		50		100	71	20		25	25			
Elymus repens	H					43	40	33	75	25			
Imperata cylindrica	H		50			14	100		100	50		100	100
Chondrilla juncea	H				50	29	100		38				
Dittrichia viscosa	H				100				25	25			
Echinochloa crus-galli	H				100								
Verbascum sinuatum	H				100				25	25		100	50
Verbena officinalis	H				100	14		33					
Daucus carota	H					14	20		50	25		100	100
Sonchus oleraceus	H					14			63			100	
Erigeron annuus	H								50	25		100	50
Rubus sanctus	H								13	100	50	100	50
Saccharum ravennae	H								25	50	100		
Elymus caninus	H									50	100		
Bromus erectus	H								13	25			
Buglossoides purpurocaerulea	H									25			
Calamintha sylvatica ssp. *ascendens*	H									25			
Carex flacca ssp. *serrulata*	H									25		100	0
Lysimachia punctata	H									25			
Prunella vulgaris	H									50			
Brachypodium sylvaticum	H									50			100
Bellis perennis	H									25		100	100
Plantago lanceolata	H				50				25			100	50
Sherardia arvensis	H								13			100	100
Trifolium repens	H									25			50
Trifolium fragiferum	H												100
Micromeria juliana	H							33					50
Eryngium campestre	H							0	13			100	100
Euphorbia chamaesyce	H				50			33	13			100	50
Dactylis glomerata	H									50		100	50
Vicia angustifolia ssp. *angustifolia*	H									25			50
Asperula aristata	H							33		25			
Barbarea species	H			17		14							
Tussilago farfara	H		50		50			67	13				
Brachypodium sylvaticum ssp. *glaucovirens*	H									50			
Catapodium rigidum	H					14			13				
Dorycnium hirsutum	H							33		25			
Elymus species	H		50	17				33					
Equisetum arvense	H		50							50			
Gypsophila species	H							33		25			
Mentha species	H					29			25				

Number of cluster		1	2	3	4	5	6	7	8	9	10	11A	11B
Number of relevés per cluster		1	2	6	2	7	5	3	8	4	2	1	2
Juncus bufonius agg.	H					29							
Lycopus europaeus	H					14				25			
Lythrum salicaria	H			17		14				25			
Mentha longifolia	H		50						13				
Sonchus species	H				50					25			
Spartium junceum	H						40	33					
Taraxacum sect. *Ruderalia*	H								13	25			
Tragus racemosus	H				50			33					
Potentilla reptans	H									50			
Scirpoides holoschoenus	H									25			50

its drought tolerance is an advantage in competition. Only *Vitex agnus-castus* and *Spartium junceum* survive the surface fires.

Overgrazed shrubland (Tab. 2, Cluster 11B, relevé nrs. 37, 11)

If high grazing pressure is maintained for a longer period, no woody species other than *Vitex agnus-castus* and *Spartium junceum* survive (Fig. 13e in SCHIEMER et al. 2018 this volume). In between the single shrubs, tussocks of *Saccharum* (*Tripidium*) *ravennae* overtop the shrubs. If the area is burned regularly, *Imperata cylindrica* gains dominance (see rel. 36). Species numbers range between 14 and 21, but because the grazed herb layer is not higher than 5 to 19 cm, several species may have been overlooked (FANELLI et al. 2015).

Syntaxonomical survey of the presented plant communities

Vegetation of freshwater springs, shorelines and swamps

Class: Isoëto-Nanojuncetea Br.-Bl. et Tx. in Br.-Bl. et al. 1952
- Order: Nanocyperetalia Klika 1935
  - Alliance: Nanocyperion 1926
    - Ass.: Crypsio alopecuroidis-Cyperetum fusci Bioindi, Vegge, Bals & Taffetani 1999
      - *Cyperus fuscus*-community
      - Nanocyperion-community

Class Phragmito-Magnocaricetea Klika in Klika et Novák 1941
- Order: Phragmitetalia Koch 1926
  - Alliance: Phragmition communis Koch 1926
    - Typhetum angustifoliae Pignatti 1953
    - Sparganietum erecti Roll 1938
    - Typhetum latifoliae Nowinsky 1930
- Order: Bolboschoenetalia maritimi Hejny in Holub et al. 1967
  - Alliance: Scirpion maritimi Dahl et Hadać 1941
    - (?) *Bolboschoenus maritimus*-community

Vegetation of the nemoral forest zone

Intrazonal boreo-temperate grasslands and heath

Class: Molinio-Arrhenatheretea Tx. 1937
- Order: Potentillo-Polygonetalia avicularis Tx. 1947
  - Alliance: Trifolion maritimi Br.-Bl. ex Br.-Bl. et al. 1952

Azonal vegetation

Alluvial forests and scrub

Class: Alno glutinosae-Populetea albae P. Fukarek et Fabijanić 1968
  Order: Populetalia albae Br.-Bl. ex Tchou 1949
    Alliance: Platanion orientalis I. Kárpáti et V. Kárpáti 1961
      Platanus orientalis-Alnus glutinosa-community
      Populus nigra-Populus alba-community
    (?) Alliance: Lauro nobilis-Fraxinion angustifoliae I. Kárpáti et V. Kárpáti 1961

Class: Salicetea purpureae Moor 1958
  Order: Salicetalia purpureae Moor 1958
    Alliance: Salicion eleagnos-daphnoidis (Moor 1959) Grass 1993
      Epilobium dodonaei-community (Ephemeral pioneer vegetation)
        Populus nigra-Salix elaeagnos-community
    Alliance: Salicion albae Soó 1951
      Salicetum albae Issler 1926
    Alliance: Salicion triandrae T. Müller et Görs 1958
      Salix triandra-Alnus glutinosa-community
      Typha minima-(*Salix triandra*-)community
  Order: Tamaricetalia ramosissimae Borza et Boşcaiu ex Dolţu et al. 1980
    Alliance: Tamaricion parviflorae I. Kárpáti et V. Kárpáti 1961
      Tamarix-Platanus-Vitex-community
      (?) Tamaricetum parviflorae Kárpáti 1961

NATURA 2000 habitat types of community interest

In the following the classification of the NATURA 2000 habitats is applied to the above described vegetation units (The Council of the European Communities 1992/43/EEC, European Commission 2013, see also Rodwell et al. 1998).

Annex I: Natural habitat types of community interest whose conservation requires the designation of special areas of conservation.

3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoëto Nanojuncetea*
3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
3170 Mediterranean temporary ponds
3240 Alpine rivers and their ligneous vegetation with *Salix elaeagnos*
6420 Mediterranean tall humid herb grasslands of the *Molinio-Holoschoenion*
72A0 Reed beds
92A0 *Salix alba* and *Populus alba* galleries
92C0 Oriental plane woods
92D0 Southern riparian galleries and thickets (*Nerio-Tamaricetea* and *Securinegion tinctoriae*)

Two of the above listed habitat types (3170, 92D0) are of high monitoring importance.

Beside those species that are rare all over Europe like *Typha minima*, require special concern. *Typha minima,* part of the Berne Convention, Appendix I (Council of Europe 1979), is critically endangered and has been extinct in large areas of Europe during 20th century (e.g., Endress 1976, Müller 1991, Pehr 1934, Rotter et al. 2018, Stauffer 1961). Also in Albania it is critically endangered due to the plans for the establishment power plants and regulation measures (Barina 2017, Save the Blue Heart of Europe 2017).

Succession

Succession schemata are the attempt to reconstruct the temporal development of plant assemblages on the basis of patches of the vegetation mosaic of different age. In other words, to reach a conclusion regarding a temporal development from a spatial pattern. The conceptual design is based on observations in the field and our experience from natural stretches of the gravel bed rivers Tagliamento and Lech in the Alps (…) as well as from the rivers Lim, Tara, and Buna on the Balkan (Drescher unpublished).

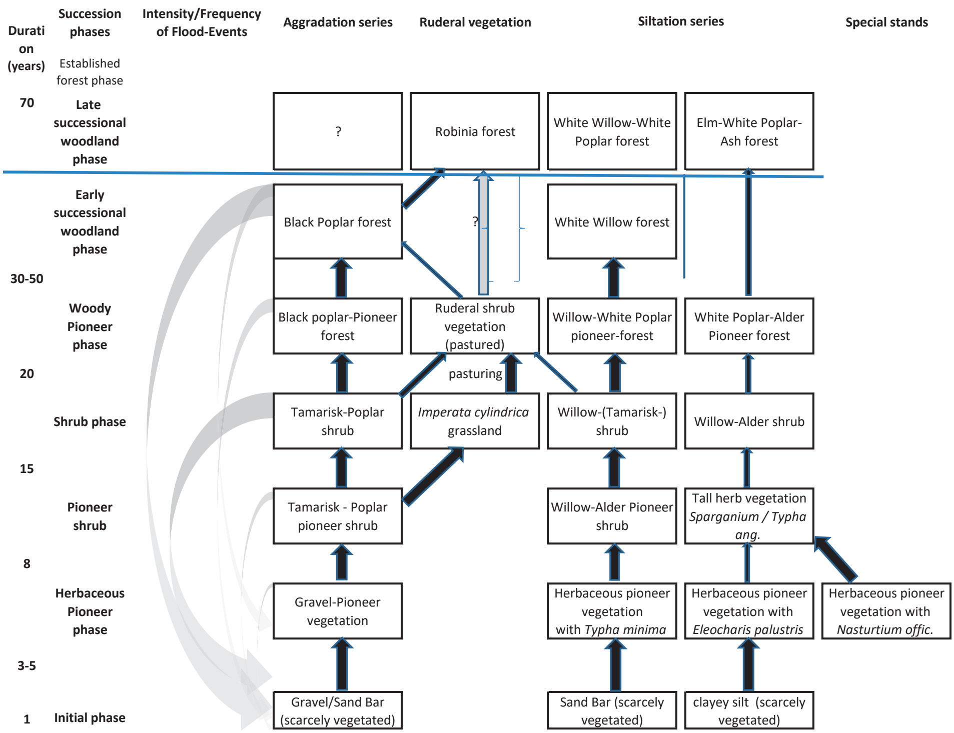

Fig. 2: Succession scheme for the plant assemblages occurring in the active channel and elevated floodplain. The curved arrows on the left side of the figure mark the events, the width of the arrows indicate the intensity of the disturbance. The straight arrows between the succession stages mark the probable direction of development of the plant assemblages. – Abb. 2: Sukzessionsschema für die Pflanzengesellschaften der aktiven Zone und der höheren Niveaus der Vjosa-Aue. Die gekrümmten Pfeile am linken Rand markieren die Überflutungsereignisse, die Breite der Pfeile symbolisiert die Intensität der Ereignisse. Die geraden Pfeile zwischen den einzelnen Sukzessionsstadien zeigen die wahrscheinliche Entwicklung der Pflanzengesellschaften an.

Depending on the river morphology and the predominant sediment we distinguish three series:

i) siltation series on silty to clayey sediment in concave geomorphologic forms like oxbow lakes, erosion and evorsion pools within the active channel.
ii) aggradation series on sandy sediment
iii) aggradation series on coarse sandy and gravelly sediment

In the study area the development ends with the early successional woodland phase indicated with a blue horizontal line. The succession is retarded by burning and grazing.

Discussion

Owing to the short time for field work some habitat types e.g. dry grassland on gravelly stands without contact to the groundwater table during the vegetation period are not represented in the vegetation tables. Others are only poorly represented. The reason for that is also the rarity of these habitat types. A check of the vegetation database of Albania (De Sanctis 2017) and the gravel bar database (Kalniková & Kudrnovsky 2017) show, that relevés from pioneer vegetation from southern Albania are completely lacking.

The importance of large woody debris for island formation

Gurnell et al. 2001 highlight the importance of large woody debris for island formation in the Tagliamento system (see also Kollmann et al. 1999). In the Vjosa corridor, large woody debris is widely missing because large areas along the river banks were already deforested a long time ago (Fig. 3A). As sedimentation and erosion also lead to the development of islands, and because the importance of large woody debris varies along the river course, hydrological processes as well as the vegetation composition on new islands govern the development as well as the intervals and intensity of floods (Schiemer et al. 2018 this volume; Fig. 9, photo A). On a small scale shrubs and even annual herbs like *Xanthium italicum* serve as a trap for fine-grained sediments (Fig 3B).

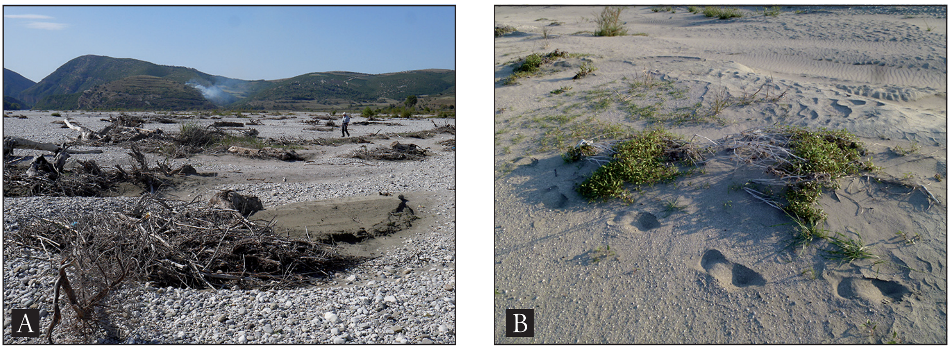

Fig. 3: A: Stretch of the active channel of the river Vjosa between Tepelenë and Kalivaçi with large woody debris; B: Annual *Xanthium italicum* with burs usually dispersed by animals remaining on the dead individual. The seedlings function as a trap for fine grained sediments. – Abb. 3: A: Abschnitt der Vjosa zwischen Tepelenë und Kalivaçi mit Totholz im Flussbett; B: *Xanthium italicum* mit vielen normalerweise epizoochoren Diasporen, die an der abgestorbenen Pflanze verblieben. Die Sämlinge fungieren als Falle für Feinsedimente.

Naturalness of riverine vegetation along Vjosa river

In general, the vegetation of gravel islands and gravel bars in the active channel is quite natural. Especially the diversity of river morphologies, sediment fractions, and habitat types throughout the entire catchment is a rarity in all of Europe. Degradation and regression caused by farming, grazing, and logging are reversible, and thanks to its hydrological dynamics the Vjosa system is of inestimable value not only for science. It can serve as a natural laboratory to study the interrelation between the geological and geomorphological setting, sediment transport, the hydrological features, and the connectivity between river and adjacent floodplain. As we still do not really understand these interrelations, such natural laboratories are essential for river restoration actions.

The occurrence of nemoral elements of the central European flora (e.g., *Festuca gigantea, Listera/Neottia ovata*) is remarkable and has been reported also from the Nestos floodplain in northeastern Greece (Schuler 2000).

The significance of non native species in the Vjosa-system

The share of non-native species in the Vjosa floodplain is remarkably low. The only woody species we found is *Robinia pseudacacia*. Species like *Amorpha fruticosa*, already a pest in floodplains of gravel bed rivers e.g. along the lower Tagliamento, does not occur in the floodplains of southern Albania (Hayek 1927, Markgraf 1931, 1932, Barina 2017).

Barina et al. 2013 share this opinion. All the more surprising are the plantations of *Paulownia tomentosa*. This species of central and western Chinese origin is cultivated widely in central Europe as an ornamental and is reported to be invasive especially because of the wind dispersed seeds. We think, that the advantages of this fast growing species for the pulp industry do not counterbalance the possible disturbances and damages of natural vegetation.

Conclusions

The Vjosa catchment is one of the few remaining examples of an almost completely undisturbed network of rivers, that can serve as a field experiment for hydrogeomorphological studies and investigations on the connectivity between floodplain and riverine vegetation. Remarkable for the entire catchment is the subordinate role of large woody debris for island formation in the corridor compared with gravel bed-rivers in the Alps, e.g. the Tagliamento in Friuli (Northern Italy). This can only be understood when taking into account the large-scale deforestation for pasturing and agriculture in large parts of the catchments. Own observations lead to the conclusion that the collection of large woody debris for fuel plays a subordinate role.

Literature

Aliaj S., 2006: The Albanian orogeny: convergence zone between Eurasia and the Adria microplate. In: The Adria microplate: GPS Geodesy, Tectonics and Hazards, pp. 133–149.

Barina Z., (Ed.) 2017: Distribution atlas of the vascular plants in Albania. Hungarian Natural History Museum, Budapest.

Barina Z. & Pifkó D., 2008: Additions and amendments to the flora of Albania. Willdenowia 38, 455–464.

Barina Z., Pifkó D. & Mesterházy A., 2009: Contributions to the flora of Albania. Willdenowia 39, 293–299.

Barina Z., Pifkó D. & Mesterházy A., 2011: Contributions to the flora of Albania, 3. Willdenowia 41, 329–339.

Barina Z., Rakaj M. & Pifkó D., 2013: Contributions to the flora of Albania, 4. Willdenowia 43, 165–184.

Barina Z., Rakaj M., Somogy G., Erős-Honti Z. & Pifkó D., 2013: The alien flora of Albania: history, current status and future trends. Weed Research 54, 196–215.

Braun-Blanquet J., 1964: Pflanzensoziologie. Grundzüge der Vegetationskunde. 3rd rev. ed. Springer Verlag, Berlin, Wien, New York.

Delarze R., Gonseth Y., Eggenberg S. & Vust M., 2015: Lebensräume der Schweiz. Ökologie – Gefährdung – Kennarten. Ott Verlag, Bern.

De Santis M., Fanelli G., Mullaj A. & Attore F., 2017: Vegetation database of Albania. Phytocoenologia 47, 107–108.

Dihoru G.C. & Răduţoiu D.I., 2005: Calamagrostio pseudophragmites-Typhetum minimae in the southwestern part of Romania (Oltenia). – Phytologia Balcanica 11(1), 73–77.

Dring J., Hoda P., Mersinllari M., Mullaj A., Pignatti S & Rodwell J., 2002: Plant communities of Albania – a preliminary overview. – Annali di Botanica N.S. 2, 7–30.

Durmishi C., Prifti I. & Nazaj S., 2014: Regional Geological Panorama. In: CBGA 2014 Field trip FT3 Geodynamic Evolution, Petroleum Geology, Potential Source Rocks, Reservoirs, Seals Carbonate Sedimentary Systems, Ionian and Sazani Zones, Albania, 3–16.

Durmishi C., Daja S., Besnik A., Dindi E., Sinojmeri A., Naza S.j, Qorri A. & Muçi R., 2018: Synthesis of geological, hydrogeological, sedimentological settings and geo-touristic features of the Vjosa Watershed. Acta ZooBot Austria 155.

Endress P.K., 1976: Der Verbreitungsrückgang von Myricaria germanica Desv. und Typha minima Hoppe auf der Alpennordseite Graubündens. Vierteljahresschrift der Naturforschenden Gesellschaft Zürich 120, 1–14.

Fanelli G., De Sanctis M., Gjeta E., Mullaj A. & Attorre F., 2015: The vegetation of the Buna river protected landscape (Albania). Hacquetia 14(2), 129–174.

Gurnell A.M., Petts G.E., Hannah D.M., Smith B.P.G., Edwards P.J.,Kollmann J., Ward J.V. & Tockner K., 2001: Riparian vegetation and island formation along the gravel-bed Fiume Tagliamento, Italy. Earth Surface Processes and Landforms 26, 31–62.

Hayek A., 1927: Prodromus Florae peninsulae Balcanicae 1. Repertorium specierum novarum regni vegetabilis. Beihefte 30, 1–1193.

Hennekens S.M. & Schaminée J.H.J., 2001: TURBOVEG a comprehensive data base management system for vegetation data. Journal of Vegetation Science 12, 589–591.

Hill M.O., 1979: TWINSPAN – a FORTRAN program for arranging multivariate data in an ordered two-way table by classification of individuals and attributes, Cornell Univ. Ithaka, New York.

Horvat I., Glavač V. & Ellenberg H., 1974: Vegetation Südosteuropas. G. Fischer, Stuttgart.

Kalniková V. & Kudrnovsky H., 2017: Gravel bar vegetation database. Phytocoenologia 47, 109–110.

Kárpáti I. & Kárpáti V., 1961: Die zönologischen Verhältnisse der Auenwälder Albaniens. Acta bot. Acad. scient. Hung. 7, 235–301.

Kollmann J., Vieli M., Edwards P.E., Tockner K. & Ward J.V., 1999: Interactions between vegetation development and island formation in the Alpine river Tagliamento. Applied Vegetation Science 2, 25–36.

Leyer I. & Wesche K., 2007: Multivariate Statistik in der Ökologie. Springer, Berlin-Heidelberg.

Malo S. & Shuka L., 2008: New records on the flora of the Gjirokastra region (South Albania). Natura Montenegrina 7, 369–373.

Malo S. & Shuka L., 2013: Distribution of Colchicum doerfleri Halácsy, Colchicum triphyllum Kunze and Colchicum bivonae Guss. in Albania. International Journal of Ecosystems and Ecology Sciences 3, 273–278.

Markgraf F., 1931: Pflanzen aus Albanien 1928. Denkschriften der Kaiserlich Akademie der Wissenschaft in Wien, Math.-Naturwiss. Klasse 102, 317–360. + 1 plate +1 map.

Markgraf F., 1932: Pflanzengeographie von Albanien. Bibliotheca Botanica (Stuttgart) 105, 1–130.

Mosimann R., 1992: Die Emme wieder ins Gleichgewicht bringen. Natur und Mensch 1992(4), 189–194.

Mucina L., Bültmann H. Dierssen K., Theurillat J.-P., Raus T., Carni A., Sumberová K., Willner W. Dengler J., (…) & Tichý L., 2016: Vegetation of Europe: Hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. Applied Vegetation Science 19, suppl. 1, 3–264.

Müller N., 1991: Verbreitung, Vergesellschaftung und Rückgang des Zwergrohrkolbens (*Typha minima* Hoppe). Hoppea 50, 323–341.

Pehr F., 1934: Beiträge zur floristischen Landesforschung in Kärnten. Carinthia II, 123–124/43–44, 41–46.

Pils G., 2016: Illustrated Flora of Albania. Eigenverlag G. Pils.

Rakaj M., Pifkó D., Shuka L. & Barina Z., 2013: Catalogue of the newly reported and confirmed vascular plant taxa from Albania (1990–2012). Wulfenia 20, 17–42.

Reichelt G. & Wilmanns O., 1973: Vegetationsgeographie. Westermann, Braunschweig.

Rodwell J.S., Dring J., Pignatti S., Schaminé J. & Mucina L., 1998: Scientific Background to the EUNIS Habitat Classification: Phytosociological relationships of EUNIS Habitats. Lancaster University Unit of Vegetation Science: Report to the European Environment Agency.

Rotter D., Riedl-Dorn C., Zsak K. & Schratt-Ehrendorfer L., 2018: Die Typha-Arten der Donau-Auen Wiens und Niederösterreichs vor und nach der Donauregulierung: Eine Vorschau auf die wissenschaftliche Gesamtbearbeitung des Manuskripts von Siegfried Reissek (circa 1860). Neilreichia 9, 161–176.

Schiemer F., Drescher A., Hauer C. & Schwarz U., 2018: The Vjosa River corridor: a riverine ecosystem of European significance. Acta ZooBot Austria 155, in this volume.

Schiemer F. & Reckendorfer W., 2000: Das Donau-Restaurierungsprojekt. Gewässervernetzung Regelsbrunn. Abh. Zool.-Bot. Gesellschaft Österreich 31, 194 pp.

Schiemer F. & Reckendorfer W., 2004: Das Donau-Restaurierungsprojekt. Ökologische Auswirkungen. Abh. Zool.-Bot. Gesellschaft Österreich 34, 185 pp.

Schuler A., 2000: Beobachtungen zur Flora und Vegetation der Nestos-Aue in Nordost-Griechenland. Tuexenia 20, 419–427.

Stauffer H.U., 1961: Veränderungen in der Flora des Aargaues. Mitteilungen der Aargauischen naturforsch. Ges. 26, 36–57.

Tichý L., 2002: JUICE, software for vegetation classification. Journal of Vegetation Science 13, 452–453.

Trinajstić I., Lovašen-Eberhardt Ž. & Tomec M., 1995: Phragmiti-Typhetum minimae Trinajstić in the vegetation cover of northern Croatia. – Acta Botanica Croatica 44, 53–57.

Tutin T., Heywood V., Burges A. & Valentine D., (Eds.) 1968–1980: Flora Europaea, vols. 2–5. Cambridge University Press.

Tutin T.G., Burges N.A. & Edmondson J.R., 1993: Flora Europaea. Vol. 1: Psilotaceae to Platanaceae. 2nd ed. Cambridge University Press.

Ubrizsy G. & Penzes A., 1960: Beiträge zur Kenntnis der Flora und der Vegetation Albaniens. Acta bot. Acad. scient. Hung. 6, 166–70.

Vangjeli J., 2015: Excursion Flora of Albania. Koeltz Scientific Books, Königstein.

Weber H.E., Moravec J. & Theurillat J.-P., 2000: International Code of Phytosociological Nomenclature. 3rd ed. Journal of Vegetation Science1, 739–768.

Woolsey S., Weber C., Gonser T., Hoehn E., Hostmann M., Junker B., Roulier C., Schweizer S., Tiegs S., Tockner K. & Peter A., 2005: Handbuch für die Erfolgskontrolle bei Fliessgewässerrevitalisierungen. Publikation des Rhone-Thur Projektes. Eawag, WSL, LCH-EPFL, VAW-ETHZ. 112 pp.

Raab-Straube E. von & Raus T., (Eds.), 2017: Euro+Med-Checklist Notulae, 7.– Willdenowia, 47, 1, (89).

Online sources:

Council of Europe (Ed.), 1979: Convention on the Conservation of European Wildlife and Natural Habitats. Appendix I – Strictly protected flora species. European Treaty Series - No. 104. https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDCTMContent?documentId=0900001680304354

Doka D., 2008: Albaniens vergessener Exportschlager. Humboldt kosmos 91 <https://www.humboldt-foundation.de/web/kosmos-humboldtianer-im-fokus-91-4.html> (most recent access: 2018-07-24).

Euro+Med PlantBase: http://www.emplantbase.org/home.html (most recent access: 2018-05-15).

The Plant List: http://www.theplantlist.org/ (most recent access: 2018-05-15).

European Commission (Ed.), 2013: Interpretation manual of European Union habitats – EUR28.

Save the Blue Heart of Europe 2017: Vjosa River – Europe's unknown wild jewel. http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf (most recent access: 2018-07-30).

Received: 2018 08 05

Address:

Mag. Dr. Anton Drescher, Schillingsdorfer Straße 27, 8010 Kainbach. University of Graz, Institute of Biology, Division of Plant Sciences, Holteigasse 6, 8010 Graz.
E-mail: acdrescher48@gmail.com, anton.drescher@uni-graz.at