

First insights into the Orthoptera fauna of the Vjosa River floodplain at Poçëm (South Albania)

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The present study gives a first overview of the grasshopper, locust and cricket (Orthoptera) fauna of the Vjosa riverine system and is a contribution to the current knowledge of the Orthoptera fauna of Albania, which is still insufficiently recorded. At the end of April 2017, an entomological field trip was conducted to the Vjosa river floodplain at Poçëm and Kut, South Albania. Orthoptera species were collected with nets and pitfall traps. A total of 22 taxa were noted and 19 taxa could be identified to species level. Due to the short sampling and the early season when most of the taxa were juvenile, the presented species list is only a small subset of the total orthopteran species richness at the Vjosa riverine system. The list contains disturbance-dependent species and indicator species of natural dynamic riverine systems, and the first record of the mole cricket *Gryllotalpa stepposa* for Albania. The Vjosa floodplain and its vicinity offers a broad range of different habitats suitable for Orthoptera species and might be a potential hot spot of Orthoptera diversity.

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Die vorliegende Arbeit gibt einen ersten Überblick über die Orthopteren-Fauna des Vjosa Flusssystems und ist ein Beitrag zum derzeitigen Wissen über die Heuschreckenfauna Albaniens, welche immer noch unzureichend erfasst ist. Ende April 2017 wurde eine entomologische Exkursion in das Überschwemmungsgebiet des Vjosas bei Poçëm und Kut in Südalbanien durchgeführt. Die Heuschreckenarten wurden mit Netzen und Bodenfallen gesammelt. Insgesamt konnten 22 Taxa nachgewiesen und 19 Taxa bis auf Artniveau bestimmt werden. Aufgrund der kurzen Sammelperiode und der frühen Jahreszeit, zu welcher viele Orthopteren Taxa sich noch im Jugendstadium befinden, ist die präsentierte Artenliste nur ein kleiner Anteil der gesamten Heuschreckenvielfalt des Vjosa Flusssystems. Die Liste enthält störungsabhängige Arten und Indikatorarten für naturbelassene dynamische Flusssysteme sowie den ersten Nachweis der Maulwurfsgrille *Gryllotalpa stepposa* für Albanien. Das Überschwemmungsgebiet und dessen Umgebung bieten eine große Bandbreite unterschiedlicher für Heuschrecken nutzbarer Habitate und könnte ein Hot Spot der Orthoptera-Diversität sein.

Keywords: Orthoptera, Vjosa, natural, floodplain, Albania.

Introduction

The Vjosa riverine floodplain in Albania is a European-wide unique ecosystem. It has a largely undisturbed fluvial morphology over its entire length of about 272 km and provides the last opportunity to observe a European river course under near natural conditions, without damming and river engineering (see SCHIEMER et al. 2018 this volume). All such interventions modify the flow dynamic of rivers and change their fluvial geomorphology, ecosystem structures and ecosystem functioning (e.g. NILSSON & BERGGREN 2000, POFF et al. 2007, GRILL et al. 2015). This leads to a loss and fragmentation of riparian habitats and has negative impacts on the distribution and population size of riverine species (NAIMAN et al. 2005). Case studies on *Bryodemella tuberculata* and *Chorthippus pullus*, two of the most endangered Orthoptera species inhabiting open gravel bars of dynamic riverine systems, showed that area and degree of connection of gravel bars determined their occupancy, and that the species' gene flow is restricted by large rivers (STELTER et al. 1997, MAAG

et al. 2012). Numerous Orthoptera species are adapted to or inhabit a dynamic nature of river systems that are continuously shaped by floods and offer a mosaic of successional stages from open gravel bars without vegetation to softwoods (e.g. LATTERELL et al. 2006, DATRY et al. 2014). HELBING et al. (2014) found that each successional stage is characterized by a unique Orthoptera assemblage and differs in terms of abundance, richness and diversity of orthopteran species. In addition to the spatial-temporal heterogeneity, natural floodplains provide a complex thermal mosaic (TONOLLA et al. 2010). These diverse conditions at a small spatial scale cause the co-occurrence of many specialized taxa, and thus dynamic natural riverine systems should be considered biodiversity hot spots (WARD et al. 1999, ROBINSON et al. 2002).

In general, compared with other European countries, the fauna of Albania is poorly investigated and this applies also for the orthopteran fauna. The knowledge about species inventory, distribution patterns, habitat preference and conservation status of the Orthoptera living in Albania, especially the southern parts of the country, is very incomplete (LEMONIER-DARCEMONT et al. 2015, PUSKAS 2016). Thus, it is hardly surprising that the Orthoptera fauna inhabiting the various terrestrial habitats of the Vjosa floodplains has largely remained concealed as well. A recent study focussing on the history of orthopteran research in Albania in detail related the low research activities with the political isolation of the country over historical time scales, and the shortage of expertise by national institutions (PUSKAS 2016). Faced with this lack of information, it is a challenging task for orthopterologists to fill these gaps. In the last decade, scientific work on the orthopteran fauna of Albania has been intensified, and resulted in a considerable increase of the number of species known to live in the country. In 2015, the number of known Orthoptera species was 178 (PUSKÁS & SZÖVÉNYI 2016), whereas an unpublished checklist from Gellért Puskás listed 190 species at the beginning of 2017. Unfortunately, there is still no published checklist of the Orthoptera species found in Albania. In comparison, the number of Orthoptera species in FYR Macedonia is 175 (LEMONIER-DARCEMONT 2014) and 395 in Greece (WILLEMSE & WILLEMSE 2008, ALEXIOU 2017). Because of the wide range of topographic and climatic conditions in Albania, the number of orthopteran species is certainly underestimated. This has recently been elucidated by the description of new grasshopper species from Albania (LEMONNIER-DARCEMONT & DARCEMONT 2015). This study is a contribution to the current knowledge of the Orthoptera fauna of the Vjosa river and Albania.

Material and Methods

Study site

The study was conducted at the Vjosa riverine floodplain in southwestern Albania, near the villages of Poçëm and Kut (40°29' N, 19°43' E, 40–50 m a.s.l.). At the study area, the Vjosa river basin is nearly one kilometre wide and is composed of dynamic mosaics of terrestrial successional habitats, which have special characteristics according to the impact of the river. Young, pioneer patches are characterized by unvegetated open gravel and sand bars, bars with initial pioneer vegetation, while mature patches are characterized by elevated pioneer vegetation with grasslands, shrubs and trees. For a detailed description of the vegetation of the Vjosa floodplains see DRESCHER (2018 this volume).

Sampling design

Two field trips were conducted in 2017, one at the end of May and another in September, assessing orthopterans of the terrestrial habitats of the Vjosa floodplain. Sampling sites were first selected using virtual maps (Google Earth) to cover the most representative habitats of the studied area. Adults were mainly collected using nets for quickly fleeing grasshoppers (e.g. Acrididae). Manual catch was carried out at night to map small species (e.g. Tetrigidae and Tridactylidae). A great number of specimens were collected with pit-fall traps, used for a biodiversity survey of ground beetles (Carabidae) and spiders (Araneae). Only specimens which needed confirmation were collected and stored in 70 % and 96 % EthOH for morphological analyses. The material was identified by using different identification keys (HARZ 1975, BELLMANN 1993, SARDET et al. 2015) and collaboration with the expert taxonomists Axel Hochkirch (Trier), Gellért Puskás (Budapest) and Ionut Stefan Iorgu (Bucharest). Specimens are currently deposited in Austria in the collection of Wolfram Graf (University of Life Sciences, Vienna) and the collection of Wolfgang Paill (Universalmuseum Joanneum; Graz).

Results

22 taxa of Orthoptera were found during the investigation of the Vjosa river floodplain in southern Albania in 2017 (Tab. 1). A total of 19 taxa were identified to species level. Most of the observed Orthoptera were found as adults, except *Anacridium aegyptium*, *Poecilimon* sp. and the *Saga* sp. More than half of the species (thirteen species) are distributed preferably in the Mediterranean part of southern and south-eastern Europe, while eight species are widely distributed in Europe. All species are categorized in the European Red List of grasshoppers as least concern. Most of the observed species prefer gravel and sand bars with sparse vegetation. Differences regarding habitat affiliations concern vegetation density and moisture of the gravel and sand bars (Tab. 1). Some selected species found during the sampling at the Vjosa are shown in Figures 1–3.

Tab. 1: List of recorded taxa of grasshoppers at Vjosa floodplain at Poçëm and Kut and their European-wide distribution, habitat affiliation and conservation status after HOCHKIRCH et al. (2016). LC: Least concern. – Tab. 1: Liste der im Vjosa Flusssystem bei Poçëm und Kut gefundenen Heuschrecken Taxa und deren europaweite Verbreitung, Lebensraumanprüche und Naturschutzstatus nach HOCHKIRCH et al. (2016). Abkürzung LC: Least concern.

Family Recorded species/taxa	European dis- tribution	Habitat affil- iation at Vjosa floodplain	Conservation status.
ACRIDIDAE			
<i>Acrida ungarica</i> (Herbst, 1786)	South and Southeast Europe	Gravel and sand bars with sparse vegetation and grassland	LC
<i>Acrotylus insubricus</i> (Scopoli, 1786)	South and Southeast Europe	Gravel and sand bars with sparse vegetation	LC
<i>Aiolopus strepens</i> (Latreille, 1804)	South and Southeast Europe	Gravel and sand bars with sparse and elevated pioneer vegetation	LC
<i>Anacridium aegyptium</i> (Linnaeus, 1764)	South and Southeast Europe	Elevated pioneer vegetation with shrubs	LC

Tab. 1 continued – Fortsetzung

Family Recorded species/taxa	European dis- tribution	Habitat affil- iation at Vjosa floodplain	Conservation status.
<i>Calliptamus italicus</i> (Linnaeus, 1758)	Europe (widely distributed, except northern part)	Dry gravel and sand bars with sparse vegetation and grassland	LC
<i>Chorthippus</i> sp.			
<i>Locusta migratoria</i> (Linnaeus, 1758)	widely distributed in Europe	Dry gravel and sand bars with sparse vegetation and grassland	LC
<i>Omocestus rufipes</i> (Zetterstedt, 1821)	widely distributed in Europe	Dry gravel and sand bars with sparse vegetation and grassland	LC
<i>Sphingonotus caeruleus</i> (Linnaeus, 1767)	widely distributed in Europe	Dry gravel and sand bars with sparse vegetation	LC
TETRIGIDAE			
<i>Paratettix meridionalis</i> (Rambur, 1838)	South and Southeast Europe	Moist gravel and sand bars with sparse vegetation	LC
<i>Tetrix bolivari</i> (Saulcy, 1901)	South and Southeast Europe	Moist gravel and sand bars with sparse vegetation	LC
<i>Tetrix depressa</i> (Brisout de Barneville, 1848)	South and Southeast Europe	Moist gravel and sand bars with sparse vegetation	LC
<i>Tetrix tenuicornis</i> (Sahlberg, 1891)	widely distributed in Europe	Gravel and sand bars with sparse vegetation	LC
TETTIGONIIDAE			
<i>Saga</i> sp.	South and Southeast Europe	Dry gravel and sand bars with sparse and elevated pioneer vegetation	
<i>Poecilimon</i> sp.	South and Southeast Europe	Elevated pioneer vegetation with shrubs and softwood	
GRYLLIDAE			
<i>Eumodicogryllus bordigalensis</i> (Latreille; 1804)	Europe (widely distributed, except northern part)	Dry gravel and sand bars with sparse vegetation	LC
<i>Gryllus bimaculatus</i> (De Geer, 1773)	South and Southeast Europe	Gravel and sand bars with sparse and elevated pioneer vegetation	LC
<i>Melanogryllus desertus</i> (Pallas, 1741)	South and Southeast Europe	Gravel and sand bars with sparse vegetation	LC
<i>Pteronemobius heydenii</i> (Fischer, 1853)	Europe (widely distributed, except northern part)	Moist gravel and sand bars with sparse and elevated pioneer vegetation	LC
GRYLLOTALPIDAE			
<i>Gryllotalpa stepposa</i> (Zhan-tiev, 1991)	Southeast Europe	Moist Gravel and sand bars with sparse vegetation and elevated pioneer vegetation	LC
TRIDACTYLIDAE			
<i>Xya pfaendleri</i> (Harz, 1970)	South and Southeast Europe	Muddy sand bars with sparse vegetation	LC
<i>Xya variegata</i> (Latreille, 1804)	South and Southeast Europe	Muddy sand bars with sparse vegetation	LC

Discussion

The present data of 22 Orthoptera taxa were compiled during one short expedition of a few days at the end of April and therefore only reflects a small subset of the Orthoptera species expected to occur at the Vjosa riverine system and its vicinity. This implicates that the species list should be considered preliminary, but does provide first insights into the habitat use and community structure of the Orthoptera species inhabiting the unique floodplain area of the Vjosa river, underscoring the urgency of conservation measures.

The Orthoptera community of the Vjosa floodplain at Poçëm is largely characterized by Mediterranean faunal elements (HARZ 1975, BELLMANN 1993). Most of the observed species are widely distributed from the West to the East of southern Europe along the Mediterranean Sea, but their distributional areas do not extend far to the North (e.g. *Acrotylus insubricus*, *Tetrix depressa*, *Xya pfaendleri*). The occurrence of these species in Europe is strongly linked with mild Mediterranean climate, whereby some species like *Aiolopus strepens* and *Tetrix bolivari* are also found in the eastern part of Europe with a more continental climate. In addition, some very thermophilous Orthoptera species, which are quite wide-spread in Central Europe, occur at the Vjosa floodplain, for example *Calliptamus italicus*, *Omocestus rufipes* or *Pteronemobius heydenii*. They penetrate quite far north, but in the northern part of their distribution range they are bound to rare habitats with a warm and special microclimate. Remarkable is the first record of the mole cricket *Gryllotalpa stepposa* for Albania. The total distribution area of the species stretches from the central Balkan peninsula to central Asia. In Europe, it was only known from the south-eastern part of the continent (Bulgaria, FYR Macedonia, Greece, Hungary; Romania and Serbia), with Hungary as the westernmost distribution boundary (IORGU et al. 2016 & 2017). In the South of the Balkan peninsula, *Gryllotalpa stepposa* (ZHANTIEV 1991) is replaced by *Gryllotalpa krimbasi* (BACCETTI 1992), another mole cricket, that is hardly distinguishable morphologically and only differs in chromosome number from *G. stepposa*. Further morphological and genetical analyses are necessary to clarify the taxonomy of the south-eastern mole crickets.

The Vjosa floodplain at the study site is characterized by its huge extended gravel and sand bars of different ages and successional vegetation, typical of a highly dynamic and natural flowing river (WARD et al. 2002). They offer a broad range of various successional stages and, depending on their age, exposition and humidity, shape the Orthoptera assemblages in the Vjosa floodplain (e.g. DATRY et al. 2014, HELBING et al. 2014). Almost unvegetated and dry gravel bars are inhabited by *Acrotylus insubricus* and *Sphingonotus caerulans* (JAUN-HOLDEREGGER & ZETTEL 2008). These species are camouflaged perfectly on the substrate and quickly fly away when they are disturbed while simultaneously showing their blue (*S. caerulans*) or red (*A. insubricus*) hindwings (BELLMANN 1993). Because of their ability to fly over great distances, they are well adapted to pioneer habitats with a high turnover rate and quickly colonize fresh gravel bars (TISCHEW & KIRMER 2007). There, they feed on small herbs, grasses or dead organic material. Extended and nearly unvegetated gravel bars represent an optimal natural habitat for these species, making them vulnerable to modifications of riverine systems and the associated loss of river dynamics. *Sphingonotus caerulans* and *Acrotylus insubricus* are categorized in the European Red List of Orthoptera (HOCHKIRCH et al. 2016) as least concern (LC). Nevertheless, they are often endangered on national levels and only exist in secondary habitats like gravel and sand pits.

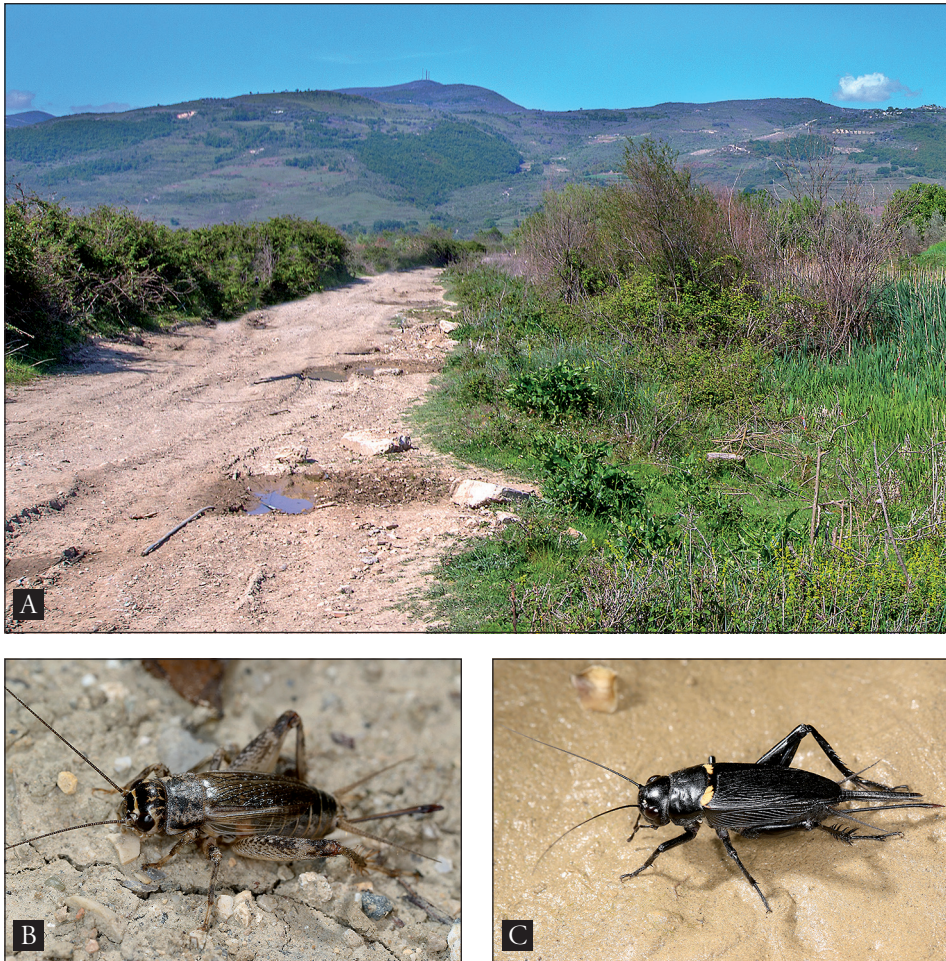


Fig. 1: Open habitats like this country lane to the Vjosa river (A), facilitate observation of crickets like the Bordeaux cricket (*Eumodicogryllus bordigalensis*), 24.04.2017 (B) and the Mediterranean field cricket (*Gryllus bimaculatus*), 29.04.2017 (C). © Gernot KUNZ.– Abb. 1: Offene Lebensräume, wie dieser Feldweg zur Vjosa (A), erleichtern ein Auffinden von Grillen wie der Südlichen Grille (*Eumodicogryllus bordigalensis*) (B) und der Mittelmeer-Feldgrille (*Gryllus bimaculatus*) (C). © Gernot KUNZ.

Remarkable were the findings of the two pygmy mole crickets *Xya pfaendleri* and *Xya variegata*. Adults of the small-sized species reach a total length of 4–6.5 mm (HARZ 1975). They are typical floodplain specialists and indicator species of highly dynamic river systems and survive only under very site-specific conditions (MÜNSCH et al. 2013). They inhabit moist sites with fine sediments and a high proportion of bare soil (Fig. 2) with a warm microclimate (BELLMANN 1993). With their mole-like front legs they build burrow systems in the sandy and muddy soil and graze algae from the surface of the sediments (MESSNER 1963, BELLMANN 1993). The pygmy mole crickets are typical pioneer species of gravel and sand bars that are abundantly relocated by the river and react rather sensitively to flood-



Fig. 2: A desiccating river bed of the Vjosa (A), a perfect habitat of the Colourful molehopper (*Xya variegata*) 24.4.2017 (B) and the Mediterranean pygmy grasshopper (*Paratettix meridionalis*) 29.4.2017 (C) © Gernot KUNZ. – Abb. 2: Ein in Austrocknung befindliches Flussbett der Vjosa (A), ein idealer Lebensraum für die Gefleckte Grabschrecke (*Xya variegata*) (B) und die Mittelmeer-Dornschröcke (*Paratettix meridionalis*) (C). © Gernot KUNZ.

plain regulations. European-wide, *Xya pfaendleri* and *Xya variegata* are categorized as least concern (LC), but because of the loss of their natural habitats along river systems due to river modifications, many populations are threatened and restricted to secondary habitats in many European areas (BERG et al. 2000, HOCHKIRCH et al. 2016).

Gravel and sand bars of a higher age are more stabilized and have lower turnover rates (WARD et al. 2002). Therefore, they are characterized by heterogenous moisture and temperature conditions and provide many habitats with distinct vegetation (GURNELL & PETTS 2002, TONOLLA et al. 2010). Dry areas with very sparse vegetation and grasslands are preferred by thermophilous and xerophilous species (e.g. *Acrida ungarica*, *Calliptamus*

italicus, *Eumodicogryllus bordigalensis*, *Gryllus bimaculatus*, *Omocestus rufipes*) (Fig. 1 u. 2). Sites with higher moisture are preferably inhabited by thermophilous wetland species (e.g. *Pteronemobius heydenii*, *Tetrix depressa*, *Paratettix meridionalis*). Some species are more opportunistic regarding the degree of moisture of their habitats and only prefer areas with sparse vegetation, like *Aiolopus strepens*, *Melanogryllus desertus* and *Tetrix tenuicornis*. These wetland species, as well as xerophilous species are representative of large riverine systems with altering moisture and temperature conditions and find perfect and extended habitats along the Vjosa river. Only two species (*Anacridium aegyptium*, *Poecilimon* sp.) inhabit later successional stages like shrub and softwood vegetations. These habitats are under-represented in the sampling and need more detailed investigations.



Fig. 3: Open pasture with traces of fire clearances bordering the Vjosa (A), a habitat for well-flying species like the Migratory Locust (*Locusta migratoria*), 24.04.2017 (B) and, in more open parts, also *Acrotylus insubricus*, 28.04.2018 (C). © Gernot KUNZ. – Abb. 3: Offene Weideflächen mit Spuren einer Brandrodung am Rande der Vjosa (A), ein Lebensraum für gut fliegende Arten wie die Europäische Wanderheuschrecke (*Locusta migratoria*) (B) und an offeneren Stellen auch der Ödland-schrecke *Acrotylus insubricus* (C). © Gernot KUNZ.

Implications for conservation

Loss, degradation and fragmentation of natural habitats due to agricultural land use as well as river regulations are declared as the main threats of orthopteran species (HOCHKIRCH et al. 2016) and the broader vicinity of the Vjosa river is faced with such landscape modifications, particularly along the lower courses of the river (see DRESCHER 2018 this volume). Therefore, the Vjosa floodplain should be considered as a refuge area for a great number of species as well as a potential hot spot of regional orthopteran biodiversity. The highly dynamic riverine system of the Vjosa is unique in Europe and offers a wide range of different habitats not only for specialized riverine and wetland species, but also for many other orthopteran species. River regulation is assumed to be another very important threat for Orthoptera species. The currently increasing interest in building dams at the Vjosa River increases the pressure on local biodiversity. It is thus beyond doubt that such river modifications would have strong negative impacts on the geomorphological dynamics and ecological functions of the floodplain, but an environmental impact assessment has not been seriously addressed (SCHIEMER et al. 2018 this volume). Nowadays about 50 % of the European Orthoptera species are classified as threatened or nearly threatened and data is deficient for a further 10 %. For that reason, and considering that the Orthoptera fauna of Albania and the Vjosa riverine system is largely unknown, environmental impact assessments are needed to avoid any harm to threatened Orthoptera from new dam projects (HOCHKIRCH et al. 2016, PUSKAS 2016). Large-scale fire clearances adjoining the Vjosa river will also have a negative effect on some less mobile species (e.g. *Saga* sp.), as well as on larval stages and orthopteran eggs. On the other hand, it prevents scrub encroachment and benefits open grasslands, used by many species as preferred habitat (Fig. 3).

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