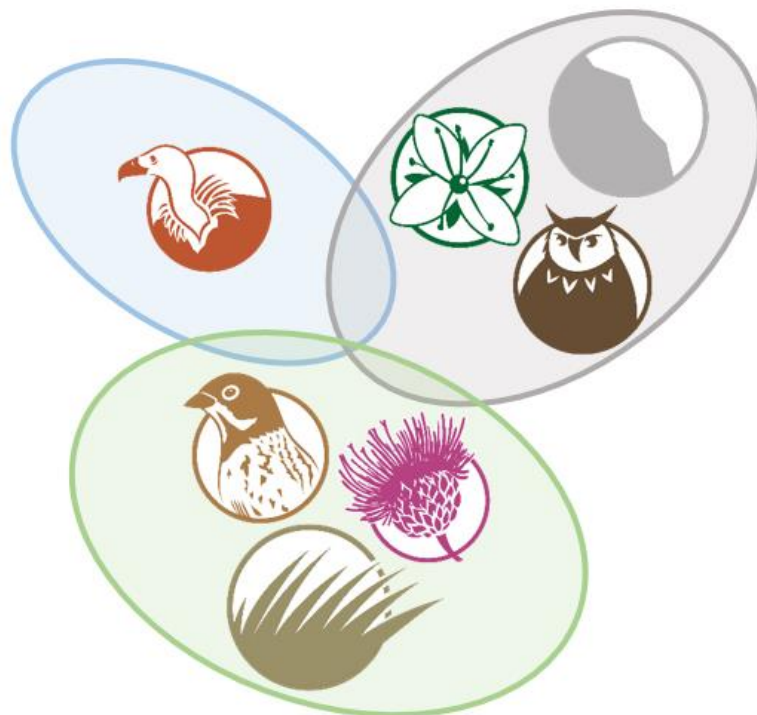


LIKE

Living
on the
Karst
Edge



Educational program

NATURE 2000

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DRY KARST GRASSLANDS

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LIKE (Living on the Karst Edge) project activities are aimed at the Istrian karst edge and sustainable management of that highly valuable and sensitive, yet often neglected space. As the name itself suggest, the karst edge is the name for an area with a developed karst relief spreading from the Trieste hinterland through the Slovenian part of Istria in the Koper hinterland, and all the way to Čičarija and Učka. The main characteristic of the karst relief is the fact that is created through a karstification process, i.e. corrosive activity of water on porous carbonate rocks, which is why the karst relief is characterised by a lack of water on its surface. In addition, processes under the surface are extremely important on the karst where underground drainage network and fissure (secondary) porosity are developed. The other, "edge" part of the name refers to the fact that the karst edge is an area in which a relatively dry limestone plateau over a series of steep, tectonically pre-disposed limestone cliffs turns into lower and wetter flysch hills with a developed surface network of flowing waters.

Today's appearance of this area is a result of a long-term interaction of geological, geomorphological, climate and biological processes. The key role in landscape formation was also played by man with his continuous impact on natural base, whereby many anthropogenic (secondary) habitats were created from natural (primary) habitats. In addition, we can also distinguish semi-natural habitats (e.g. grasslands which are maintained by haying or grazing) and artificial habitats (pools, canals, buildings, mines...). The mentioned human impact has led to the situation in some areas where the habitats diversity has drastically increased with regard to the primary natural state, which has indirectly impacted the increase in biodiversity. Human impact on primary natural state mostly concerns traditional agriculture and the use of grassland surfaces for grazing or haying where the grasslands were efficiently managed which prevented succession as a natural process of spreading forest areas at the expense of grasslands. In all primary forest areas, and at the karst edge as well, grasslands were created with human activity. Through deforestation process, forest vegetation was removed in order to open areas for the purpose of obtaining fodder (hayfields, meadows), or as a product of intensive grazing (pastures). Thus, it is impossible to ensure the survival of grassland habitats if we exclude human impact from a sort of a sustainability equation. Today's landscape of the karst edge has been changed to a large extent in comparison with the same landscape of several years ago. Karst grasslands that used to be a rule, nowadays are more and more becoming an exception. They are mostly limited to the areas where traditional agriculture has been conserved, where the bora's impact can be felt on vegetation development and to those areas where there was no forestation with the black pine (*Pinus nigra*) in the past. In addition, human impact is also visible through miles of drystone walls built and a large number of karst pools which were used as water for cattle, as sources of potable water, for extinguishing fires, or simply as a place for gatherings of local inhabitants. Due to the porosity of limestone base, karst pools are the only significant surface water in the karst, and much like in grasslands, they pose an example of where human activities have a positive impact on biodiversity. Due to the aforementioned, the karst area is researched and protected to conserve the natural, but at the same time significant cultural heritage.

When we talk about the karst edge, we are talking about an area in which there is a close encounter of several climate zones, so the impact of Mediterranean climate is felt from the South, whereas the impact of continental climate reaches the Mediterranean Sea from the North. In addition, the karst edge is a contact point for two different geological bases. Impermeable, wet and colder flysch, and permeable, warm and mostly dry carbonate rocks. The mentioned contact climate zone is the very reason why the karst edge is the edge area of distribution for many plants and animals which

is why they are more sensitive to changes in this area than the area with optimal living conditions closer to a more stable part of their range. At the same time, we are dealing with the northern edge of the Mediterranean which is considered one of the focal points of European, but also of the world's biodiversity. Generally, karst habitats belong to the most endangered habitats in the world because, apart from a large surface pressure, they also hide an underground dimension through which contamination and threats may spread to large distances, whereby underground connections and spread vectors are not fully known.

Since carbonate rocks have a relatively low share of insoluble substances (often called "impurities") in their composition, during the karstification process an extremely thin surface layer of the soil is created as an insoluble residue which is very susceptible to erosion and washing out. Karst grasslands are developed on that thin layer, and they belong to the most varied and richest habitats in Europe, even though they are significantly smaller with regard to their surface than other land habitats in Europe. Thus, they are included on the list of habitat types of interest for the European Union (Appendix I, The Habitats Directive) and are protected as habitat type "62A0 – eastern sub-Mediterranean dry grasslands (*Scorzoneretalia villosae*)". These grasslands are developed under conditions where there is a lower impact of the continental climate, so they include many Mediterranean floristic elements in their composition. Apart from the Istrian karst edge, they also prevail in Primorje, Lika, Ravni kotari and Dalmatinska zagora. The loss of suitable habitats poses a threat for the survival of numerous grassland species or flora and fauna, among others, for single-flowered sawwort (*Serratula lycopifolia*) and the ortolan bunting (*Emberiza hortulana*). Thus, LIKE project activities aim at monitoring the state and further research of those species.

Under the term karst grasslands, we can distinguish among karst pastures and karst meadows. Pastures are found in drier and warmer areas with predominantly rocky base whereas meadows are located in somewhat wetter areas where the soil layer is thicker and have a larger share of humus in their composition. As it was mentioned earlier, in both examples we are dealing with semi-natural habitats which were created and survived owing to traditional agricultural practices and local inhabitants who carried them out. Taking into consideration climate and relief limitations, to a significant extent flexible grazing impacts the pastures' plant composition which depends on nitrate availability. A pasture with quality and adjusted management (cattle number and species, grazing time, pasture surface rotation...) regularly results in a more complex and richer plant composition with regard to the species composition in the areas with an advanced succession. By following the state of bioindicators, i.e. certain species which illustrate the environmental condition, it is possible to monitor with quality the impact of certain managing activities on the biodiversity state (e.g. changes in the composition and number of ornithofauna due to pasture overgrowing and the loss of the optimal habitat).

For a long time, the karst edge area was isolated from economic and population development of larger urban centres located at the Adriatic coast, thus the extensive (traditional) agriculture remained in the area for many years. As the time passed by, younger generations decided to look for their place under the sun in the mentioned urban centres, and older generations which remained at the karst edge had no strength and possibility to deal with agriculture to the extent as they had before. The industrialisation process following the World War II, depopulation (especially of younger population) and the related deagrarisation, jointly led to pasture overgrowing and spreading of forest areas. In places where agriculture endured, it has mostly assumed an intensive character and is aimed at high revenues on a small surface, so there is often an excessive use of plant treatment agents, artificial fertilisers, etc. Apart from the direct harmful impact on biodiversity, the existence of a thin soil layer with limited possibilities for filtering harmful substances and karst underground rich in fissures below such agricultural surfaces should also be taken into consideration. It is evident that this form of agriculture can have a negative impact on a wide area. Since a large number of karst pools is neglected and left to succession, today there is a shortage of permanent water sources for dealing with agriculture. Farmers often reach for digging out wells and water boreholes which may have a negative impact on underground water level and the stability of the entire karst eco-system.

We can conclude that the conservation of traditional extensive agricultural practices, with the emphasis on extensive cattle breeding and the adjusted haying regime, are the only way to

conserve dry karst grasslands. Promoting native breeds and sorts, creating recognizable offer of local gastronomy, subsidising farmers for dealing with „nature-friendly“ agriculture and branding agricultural products are only some of the examples of measures and activities which can impact grassland conservation. Close cooperation of agricultural and nature protection sector with the inclusion of local inhabitants is the only way to conserve grasslands and numerous species which depend on them.

SINGLE-FLOWERED SAWWORT (*Serratula lycopifolia*)

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Single-flowered sawwort (*Serratula lycopifolia*) is a European species with a centre of distribution in eastern Europe. It is found in a wide range from France, central Italy, Slovenia, Croatia, Hungary, Slovakia and the Czech Republic, all the way to Ukraine and Russia. As far as for the Croatian population, the centre of distribution is in Lika and Zadar hinterland, and the most significant populations are also present in Istria where the population in the area of Žbevnice on Čićarija is also located across the border in the Slovenian part of Čićarija. Single findings are also known in Primorje and Gorski Kotar.

The species is related to open karst grasslands and meadows on deeper soils, so it can be found on meadows and pastures of black salsify (*Scorzonera villosae* - *Danthonietum*) and pastures of erect brome and *Danthonia alpina* (*Bromo* - *Danthonietum calycinae*). The species is anemochory, so the fruits are spread by wind following the time of blooming (June - July). In addition, it may also propagate vegetatively with creeping rootstalks. During the time of blooming, it is closely connected with ants which help with the opening of the flower head by feeding with a sticky juice exuded on the membrane scales. Thus, one of the LIKE project activities is also monitoring insects responsible for pollination and blooming of *Serratula lycopifolia*. The species is generally poorly researched, so it is currently listed under the category DD, insufficiently known taxon, in the Red Book of Vascular Flora in Croatia. The implementation of LIKE and similar projects, whose activities are aimed at grassland species and habitats, strives to obtain new data and in such a way conduct protection and conservation of single-flowered sawwort and other grassland species with more quality.

The stated habitats where single-flowered sawwort can be found present a classic example of degradation of semi-natural habitats. We are dealing with grasslands which are endangered due to the absence of human impact and traditional agricultural practices, so ensuring that haying is conducted at least every two or three years is stated as a recommended protection and conservation measure. Establishing regular haying rotations will positively impact succession decrease, prevention of grassland shading and the conservation of open grassland surfaces required for heliophytic plants. In addition, while encouraging rural development (especially tourism), special attention should be paid on uncontrolled construction and spreading of anthropogenic structures. It can be rightfully said that *Serratula lycopifolia* is an ambassador of all grassland species which have been endangered due to the overgrowing of grassland surfaces, so with a detailed elaboration and implementation of protection and conservation measures, as well as conservation of this species, the survival of other endangered and rare plants of Croatian flora (e.g. *Gentiana lutea* ssp *symphyandra* - hayek, *Gladiolus palustris* - gaudin) and cross-border area of the karst edge is also ensured. At the same time, the conservation of grassland areas also has a positive impact on numerous species of birds, butterflies and other animals, which additionally increases the need for grassland conservation and a systematic approach to this complex issue.

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Ortolan Bunting

(*Emberiza hortulana*)

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Species: ortolan bunting (*Emberiza hortulana*)
Order: *Passeriformes* – songbirds
Family: *Emberizidae* – buntings
IUCN Red List: LC (Least Concern) – Europe, Europe 27
Red Book of Birds of Croatia: LC, Red List of Slovenia: EN (base from 2011)
European protection status: SPEC 2

The ortolan bunting is a species in “The Birds Directive” Appendix, as well as in the 3rd Bern Convention Appendix. In Croatia, it is protected under the Nature Protection Act, and in Slovenia under the Nature Conservation Act and the corresponding rulebooks. In special protection areas (SPA) “Kras” (Slovenia) and “Učka and Čičarija” (Croatia), the ortolan bunting is a target species of protection, and both states are obliged to conserve its population in a good condition. Despite a documented fall in the population in the majority of European countries, this species is on the IUCN Red List for Europe listed as least concern since there is a highly large species range and a vast number of population, which is estimated from 6,660,000 to 14,100,000 of adult specimens in Europe.

Distribution

The ortolan bunting is a sub-Saharan migratory bird, the only among our buntings. It overwinters in sub-Saharan Africa. In southern and eastern Europe, the ortolan bunting is distributed locally, but in large numbers, whereas in western, central and northern Europe it is less common and less numerous. In the most northern part of the continent and the British Islands, there is a lack of ortolan buntings. The largest populations in Europe are present in Poland, Romania, Russia and Spain.

In Slovenia, by 1979, when it was relatively numerous in the whole south-eastern Slovenia, the ortolan bunting range had decreased to a single remaining nesting area in dry karst grasslands above the villages of Mvraž and Dvori in Slovenian Istria. The ortolan bunting population in Slovenia is extremely low in numbers. During 2019 we counted only 7 specimens, and there was no proof of nesting (e.g. a nest or food in the beak).

In Croatia the ortolan bunting is more numerous. Based on the research conducted as a part of the LIKE project, on Učka, mostly on the Brgud plateau and south-western slopes of Učka descending toward Čepić polje, there are still between 150 and 200 singing males present. The ortolan bunting is relatively common in the Dalmatian mountain hinterland, e.g. on Velebit or Dinara. The population size of this species in Croatia is estimated from 3500 to 6000 pairs. Recently it was also discovered in the Croatian part of Fruška gora.

Habitat

The ortolan bunting dwells in habitats without or with a few trees, similar to prairies. The layer of herbaceous plants must be rare and allow for certain areas without vegetation since this is where the ortolan bunting feeds. Their singing location is a tree, a bush or a higher rock. It nests on the ground, usually hidden in low vegetation or a smaller bush. It inhabits dry and warm places. Within these requirements, we find the ortolan bunting in various habitats, from dry karst grasslands and forest fire sites in the Mediterranean to mosaic and cultural landscape in

northern Germany or Poland. The ortolan bunting population may rapidly increase locally if an area with suitable habitats is created, e.g. following a forest fire, and in that sense, the bunting is a pioneer species. In the time of nesting it feeds with invertebrates, and in other times it mostly feeds with seeds. Thus, dry karst grasslands with a rich fauna of invertebrates, as well as a plenty of bare soil, which facilitates hunting, are important for this species in the karst edge area. The ortolan bunting males create significant singing groups, whereby males which are paired with females inhabit the central area. The lack of females is significant for isolated populations of this bird as young females usually have a larger dispersion after nesting than young males. Thus, the number of unpaired singing males increases until a local extinction occurs, so some nesting areas eventually have no females at all. The percentage of males in the remaining population in Slovenia is high (15 males and only 5 active nests in the area above Movraž in 2013 means that there are 75% males present in the population). This high percentage of males indicates that the population is facing issues. The ortolan bunting commonly feeds in a habitat different from the one where it nests, which is unusual for songbirds.

In Norway, the feeding and nesting habitats are at a distance of 2.7 km. At the karst edge (on Kras, in Čičarija) the ortolan bunting inhabits dry karst grasslands with sparse trees, away from settlements. The comparison of nesting areas on Kras and Učka shows that Kras grasslands, where the ortolan bunting has already disappeared (Golič region), are significantly higher and denser, and the lower grazing intensity is also important here. On Učka, the ortolan bunting inhabits the areas of active sheep pastures, with a plenty of bare soil.



The ortolan bunting (Emberiza hortulana) on Učka



The difference in vegetation density and height of the grasslands on Golič (below) and on Učka and Čičarija (above).

Species trend

The numbers of the species population are rapidly decreasing on Kras, and it can be expected that in that area, and therefore in the entire Slovenia, the ortolan bunting will become extinct in several years. In addition, due to overgrowing, the bunting has lost a significant part of its nesting areas on Učka. In the moderate range of western Europe, in the period between 1982 and 2008, the ortolan bunting experienced a drop in population numbers as high as 82%, and in many countries it disappeared completely. In eastern Europe its population is stable, and in Catalonia it is even increasing, most likely as a result of numerous fires.

The most important endangerment factors are:

- (1) Habitat overgrowing and fragmentation. In the decades following the World War II, the entire Kras and Čičarija experienced the abandonment of grassland use; extensive haying, small livestock grazing, and transhumance cattle breeding became less profitable compared to other, non-agricultural activities. In addition, the prevailing policy for using Kras area was forestation, and a part of that policy was fighting against fires which are highly favourable for ortolan buntings. After a forest fire, the number of invertebrates rapidly increases, and along with them, the number of ortolan buntings. The result of both processes (the abandonment of traditional use and forestation) is a large fragmentation (size degradation) and a reduction in grassland surfaces suitable for the nesting of the ortolan bunting.
- (2) Abandoning of the Mediterranean cultural landscape. The cultural landscape is a habitat in which the ortolan bunting feeds. Deagrarisation of Istrian land occurred due to the after-war policies. The inhabitants started to gravitate towards employment in larger industrial and administrative centres. Once mosaic cultural landscape with various cultures turned into overgrowing thickets.
- (3) In its migration to sub-Saharan Africa, the ortolan bunting flies over unsafe poaching areas in Italy and northern Africa. The poaching has a large impact as miles of poachers' networks span across the Mediterranean African coasts at that time.

The most efficient measures for protecting the ortolan bunting are:

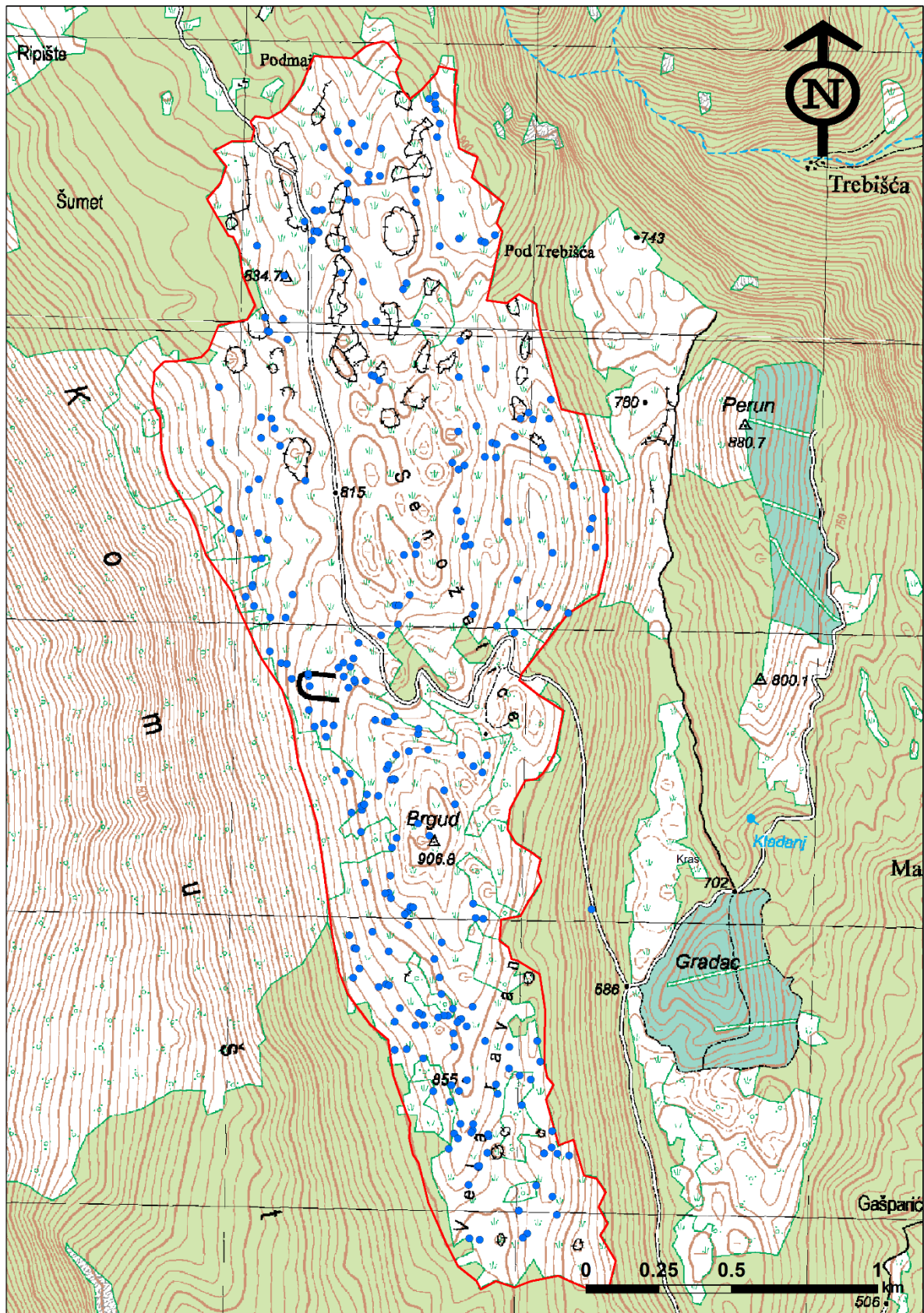
- (1) suitable agricultural offsets, which encourage grazing and haying in dry grassland areas inhabited by the ortolan bunting
- (2) clearing thickets and forests, which would ensure a suitable connection among the remaining nesting areas, as well as additional dry grasslands for nesting, possibly with controlled fires with the purpose of nature protection
- (3) international activity and fight against poaching birds on their migratory routes



Distribution of the ortolan bunting in Europe (according to BirdLife International 2019)



Distribution of the ortolan bunting in Slovenia between 2012 and 2017. In 2019 we recorded only 7 single singing males above the villages Movraž and Dvori in Slovenian Istria



Recordings of ortolan bunting specimens in the researched area on Učka during 2018 and 2019 (red line), recordings are marked with blue circles – the LIKE project results.

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