ADRIATIC FLYWAY -
BIRD MONITORING AND CONSERVATION CHALLENGES ON THE BALKANS

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EURONATUR FOUNDATION

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Cover design by Kalman Moldvai showing Whiskered Terns (*Chlidonias hybrida*), based on a photo by Lorand Vigh

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Proceedings of the Third Adriatic Flyway Conference, 19 – 23 March 2018, Fruška Gora, Serbia

EURONATUR

Photo: Lorand Vigh

Whiskered Tern (*Chlidonias hybrida*), Jegrička fishpond, Serbia, June 2012

Editorial - 3rd Adriatic Flyway Conference

In March 2018, experts in the fields of nature protection and ornithology, representatives of state institutions and national and international civil society organizations gathered on Mt. Fruška Gora, a National Park near Novi Sad, Serbia for **the 3rd Adriatic Flyway Conference**. Over 70 participants from 12 different countries shared their experiences to protect the bird migration route along the Adriatic Flyway.

Behind us are more than 9 years since the first Adriatic Flyway project, with many challenges which were successfully overcome. The doyen of the protection of the migration route across the Balkans, and the initiator of the Adriatic Flyway project was Dr. Martin Schneider-Jacoby. He had a clear vision, to preserve the nature of the Balkans that he greatly respected. His ideas and the partnership of organizations that he created in the Balkans are still supported by EuroNatur and the MAVA Foundation.

The 3rd Adriatic Flyway Conference presented a summary of the hard, but inspiring work of partners from Albania, Bosnia and Herzegovina, Croatia, Serbia, Montenegro, and North Macedonia. Some of the results are presented later in the proceedings. The various papers testify an enormous effort and love for birds, nature, and people. During the Adriatic Flyway project all partners showed great interest and the great importance of the education of children and adults in bird conservation through various workshops, excursions, camps, and educational materials. To create interest and acceptance for badly needed conservation measures it is important to inform the general public on nature, birds and their habitats, and places that are of interest for nature lovers and that can be visited throughout the Balkans. Cooperation with the media is an important thread between citizens and nature. Educated citizens will know how to appreciate nature. And, if we love something, we will protect it.

During the third phase of the Adriatic Flyway project, a special focus was put on the illegal killing of birds and the fight against all illegal activities against nature. The impact of poaching on wildlife leads us to raise the red flag. A significant number of animal species, not just birds, are disappearing around the globe under the influence of poaching and other wildlife crimes. Over the last years all project partners carried out activities in the field to detect cases of poaching and reported them to competent institutions. But the fight took place not just in the field. It proceeded very actively in workshops, public talks, and in many meetings, formal and informal. Meetings were organized with representatives of the police, prosecutor's offices, competent ministries, but also with other organizations interested to resolve the problem of illegal killing of birds. Among them are certainly also the most important hunting associations.

Solving this global problem requires time, energy and patience, of which there is no lack in the Adriatic Flyway partnership. Ultimately, the challenges in protecting nature and birds are numerous, but what is certain is the continuous will of all organizations in our partnership to keep birds and nature safe along the Adriatic migration route.

At the end of the conference partners presented the Fruška Gora Declaration. All participants agreed with what's stated in this Declaration and at the very end, this important document was adopted. This will be our mission for the future.

Peter Sackl, Milan Ružić, Ilka Beermann, Sandra Jovanović and Stefan W. Ferger

Fruška Gora Declaration

Photo: Stefan W. Ferger

The following declaration, to be referred to as "Fruška Gora Declaration", was adopted by the participants of the 3rd Adriatic Flyway Conference, which took place in Fruška Gora National Park, Serbia, on 19-23 March 2018. The EuroNatur Foundation, the Bird Protection and Study Society of Serbia and the participants of the 3rd Adriatic Flyway Conference are

CONCERNED by the large number of mostly migratory species of wild birds in Europe, which are significantly declining in number, some of them very rapidly;

ALERTED by the extent of illegal killing and taking of wild birds along the Adriatic Flyway and therein particularly in Serbia, which contributes to the decline of populations of wild birds in Europe;

ALERTED by the illegal trade of wild birds from the Adriatic Flyway countries[1] into (other) member states of the European Union;

SUPPORTIVE to the ongoing initiatives to tackle illegal killing, taking and trade of wild birds in Europe and the Mediterranean region, including the Roadmap towards eliminating illegal killing, trapping and trade of birds[2] of the European Commission and the Tunis Action Plan 2013-2020 for the Eradication of Illegal Killing, Trapping and Trade of Wild Birds[3] of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention);

AWARE that the Republic of Serbia, together with Bosnia and Herzegovina, are the only two states along the Adriatic Flyway, which are not yet parties to the Agreement on the Conservation of the African-Eurasian Migratory Waterbirds (AEWA);

[1]The Adriatic Flyway covers the countries of Albania, Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia and Slovenia
[2]http://ec.europa.eu/environment/nature/conservation/wildbirds/docs/Roadmap%20illegal%20killing.pdf
[3]https://rm.coe.int/1680746782

AWARE that the Republic of Serbia, together with Montenegro, could be set to join the European Union as early as 2025, according to the European Commission's enlargement plan for the Western Balkans.

The EuroNatur Foundation, the Bird Protection and Study Society of Serbia and the participants of the 3rd Adriatic Flyway Conference therefore

REQUEST the Governments of the countries along the Adriatic Flyway, and in particular the Government of the Republic of Serbia, to stop the illegal killing, taking and trade of wild birds in their respective countries, and to ensure the legal protection of wild birds and their habitats, as well as the proper enforcement of the law, in order to maintain wild bird species and their habitats in a good conservation status, in line with the Bird and Habitat Directives of the European Union[4,5].

SUPPORT the ongoing process of accession of the Republic of Serbia, as well as of Bosnia and Herzegovina, to the Agreement on the Conservation of the African-Eurasian Migratory Waterbirds (AEWA), together with an improved implementation of AEWA in all Adriatic Flyway countries, in order to strengthen the protection of migratory waterbirds in both countries along the Adriatic Flyway.

URGE the Governments of the countries along the Adriatic Flyway to strengthen and extend the coverage of their monitoring schemes for waterbirds and other bird taxa, as well as to comprehensively collect hunting bag data and report them, in compliance with their obligations under AEWA and other international treaties;

REQUEST the Secretariat of the Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS), together with the treaty's Intergovernmental Task Force on Illegal Killing, Taking and Trade of Migratory Birds in the Mediterranean (MIKT), as well as the Secretariat of Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) to assist the governments of their parties in the process of eliminating illegal killing, taking and trade of wild birds along the Adriatic Flyway and particularly in Serbia;

REQUEST the European Commission to address the illegal killing and taking of wild birds in its member states and accession candidates along the Adriatic Flyway, and particularly in Serbia, as well as the illegal trade of wild birds from the Adriatic Flyway countries into (other) member states of the European Union, and to increase its efforts to eliminate the illegal killing, taking and trade of wild birds along the Adriatic Flyway, together with the governments of the respective countries.
Fruška Gora, Serbia, on 22 March 2018

[4]Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds
[5]Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

In memoriam

Davorka Kitonić Dipl.-Arch. †
1947 - 2020

Photo: Margaret Sloan

Davorka Kitonić was born in Špišić Bukovica near Virovitica in 1947, the third child and youngest daughter of master baker Ivan Kitonić (1888 – 1983) and his wife Marija Mavračić (1906 – 1994). She spent her early childhood in the small village of Špišić Bukovica until, in 1957, the family moved to Zagreb where she completed her primary and secondary education. Soon after successfully gaining a place at university, Davorka left Croatia for northern Germany and enrolled at the University of Hamburg, from where she later graduated with a degree in architecture.

It was in Hamburg that she met Knut Koch, who was later to become her husband. Their daughter Ines was also born there. In the 1990s, Davorka gradually prepared to return to her homeland of Croatia for early retirement. Together with Knut she bought a property near to the mouth of the Neretva River in southern Dalmatia. There, in Crepina near Opuzen, they designed and built their own comfortable home with a large orchard. Davorka's friendliness and hospitality made her home a "must" for travelling birdwatchers and nature lovers.

Her fascination for the Neretva Delta is described in her own words in the short documentary "Neretva damned not privileged" produced by Association BIOM in 2020 (https://youtu.be/3lfG_EfV790):

"*I arrived at the Neretva Delta for the first time in 1975 and, I must confess, before that I did not know, and had not heard, anything about the Neretva. Sometime in mid-March, I drove down to the Neretva Delta from Ivan Planina mountain, which was covered with snow and the driving conditions were difficult, and there, the sun is shining, the peach trees are in blossom,* the sky is a deep blue colour, as it can only be in spring*, the grass is tall with yellow dandelion flowers. I have never seen anything as beautiful as this in my life. It was love at first sight and I knew right away: this is where I want to live one day."*

From 1998, Davorka took pleasure in bird watching and in documenting birds with her cameras, particularly at Ušće Neretve (Mouth of the Neretva River) – her preferred observation site. As a result, she published four books about the birds of the Neretva Delta (Kitonić 2007a, 2007b, 2008, 2010). Not only did she compile a huge collection of field data and photographs, she also used these materials for her engagement in environmental issues and bird protection in the Neretva Delta. Several photographic exhibitions about the natural and cultural values of the Neretva Delta were organised (e.g., "Neretva natura 2000" – Metković, 2013; "Šipanske mreže" – Metković, 2006; "Neretva u oku i srcu" – Metković 2005; Sisak, Zagreb, Petrinja 2004; etc.). Davorka was also founder of the Association for the Protection of the Natural and Cultural Heritage of the Lower Neretva "Vodomar". Thanks to the late Martin Schneider-Jacoby of EuroNatur, Davorka became involved in the "Save the Adriatic Flyway" project and participated in bird monitoring at important wetland sites on the Adriatic (Stumberger et al. 2009, 2008; Kitonić 2008; Kitonić & Sackl 2008, Sackl & Kitonić 2008, 2013; Mikuska et al. 2018), as well as at international conferences (Durres 2014, Fruška gora 2018).

Birds were not Davorka's only interest; she was a passionate world traveller, visiting every single continent except Antarctica. Unlike the average tourist, she preferred to visit hard-to-reach and "end of the world" places like Papua New Guinea and the Okavango Delta in Botswana where she spent several months living alone in remote parts of the wetland. From her trips and expeditions, she would bring us numerous stories and pictures of the places, people and traditions most of us would never be able to see, reminding us of the natural historians of the 17th and 18th centuries discovering the Earth's wonders. Several books were written as a result of these expeditions (e.g., Kitonić 2017) and some of them are still seeking a publisher.

Madagascar was Davorka's favourite place; she visited several times, guiding nature lovers and scientists. Her last trip there, in 2019, yielded the discovery of a new species of grasshopper (Skejo et al. 2020).

Davorka was a citizen of the world and a world traveller, naturalist, philosopher, writer and artist who enjoyed every moment of her life. Despite fighting cancer for over a decade, she never showed disheartenment or weakness, nor did she let the disease stop her from making plans and travelling. Always curious about the natural world and culture around her, she tirelessly pursued her dream of exploring new worlds and places.

Through her travels, stories, photographs and art she inspired many of us to pledge "When I grow up, I want to be like Davorka!"

Bon voyage, Davorka! You will stay in our thoughts forever!

Davorka's publications:

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Kitonić D. (2007b) Birds of Neretva Delta. Part 2 – Breeding birds. Gradsko kulturno središte, Metković.

Kitonić D. (2008) Birds of Neretva Delta. Part 3 – Wintering birds. Gradsko kulturno središte, Metković.

Kitonić D. (2010) Birds of Neretva Delta. Part 4 – Migratory birds. Gradsko kulturno središte, Metković.

Kitonić D., Koch K., Petra Sackl T. & Sackl P. (2008) Notes on the bird fauna of Krug mountain and Cincar plateau in the surroundings of Livno. Bilten mreže posmatrača ptica u Bosni i Hercegovini, 4-5: 86-89.

Kitonić D. & Sackl P. (2008) Waterbird counts and spring migration in Mostarsko blato in April 2008. Bilten mreže posmatrača ptica u Bosni i Hercegovini, 4-5: 90-92.

Kitonić D. (2017) Put po Melaneziji / Rituali i obicaji Papue Nove Gvineje /Travel in Melanesia. Rituals and customs of Papua New Guinea/. https://kupdf.net/download/put-po-melaneziji-rituali-i-obicaji-papue-nove-gvineje_5b08056ee2b6f51e62dfe8ba_pdf

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Skejo J., Medak K., Pavlović M., **Kitonić D.**, Miko R.J.C., Franjević D. (2020) The story of the Malagasy devils (Orthoptera, Tetrigidae): *Holocerus lucifer* in the north and *H. devriesei* sp. nov. in the south? ZooKeys 957: 1-15. https://doi.org/10.3897/zookeys.957.52565

Stumberger B., Matić S., **Kitonić D.**, Vernik M., Knaus P., Schneider-Jacoby M., Petra Sackl T. & Sackl P. (2009) Results of waterbird counts in Hutovo blato and adjoining wetlands 2007-2009. Bilten mreže posmatrača ptica u Bosni i Hercegovini, 4-5: 30-37.
Stumberger B., Sackl P., Dervović I., Knaus P.,

Kitonić D., Schneider-Jacoby M. & Kotrošan D. (2008) Observations of bird disturbance and violation of the Hunting Law in karst wetlands of the Federation of Bosnia and Herzegovina. Bilten mreže posmatrača ptica u Bosni i Hercegovini, 45: 97-114.

Contents

Photo: Peter Sackl

Yellow Flags (*Iris pseudacorus*) in flooded forest on Ada Island, Montenegro, April 2012

Land-cover changes between 2008 and 2019 inside the three Adriatic Flyway core areas Livanjsko Polje (Bosnia-Herzegovina), Neretva Delta (Croatia/Bosnia-Herzegovina) and Skadar Lake with Lower Drin and the Bojana-Buna river delta (Albania/Montenegro)

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Summary

Aim of the project was to detect land-use changes within the wetland areas of the three Adriatic Flyway project regions during the past decade. Based on the original high-resolution mapping it was possible to address precise changes in the core areas that allow the comparison with the long lasting development of wetland losses of the wider region.

Keywords

Land cover changes, wetlands, habitat loss, Western Balkan, wetland conservation

1. Introduction

In 2004, in the frame of EuroNatur's Adriatic Flyway (AFW) project a first inventory of land structure and land-use patterns were prepared for the Bojana-Buna Delta (Albania/Montenegro) and between 2007 and 2010 a systematic inventory for Livanjsko Polje (Bosnia-Herzegovina) and the Neretva Delta (Croatia/Bosnia-Herzegovina) was compiled. Based on these former analyses, summarized by Schwarz (2010), now main habitat changes were mapped for all three AFW core areas on the landscape level. Additionally, the results of bird surveys, in 2003 and 2018 - 2019, exemplarily underline the effect of habitat loss and the intensification of land-use on bird populations in a small study area along Velika Plaža and on Ada Island in the Bojana-Buna river delta (cf. the article by Sackl *et al.* in the present publication).

By using high-resolution satellite images it was possible to identify and track polygones of main habitat and land-use changes across all three AFW project areas. Changes were categorized according to several land-use classes, such as agriculture, water management or the alteration of wetlands through gravel and sand exploitation. For a better understanding of the present situation, in addition to the identification of habitat losses during the last 10 years, historic transformations of main landscape features and land-use patterns will be shown. Finally, for all catchment areas the present use of wetlands for hydropower as one of the most important pressures will be discussed.

2. Methods

Based on the results of the first inventory of habitats and land structure within EuroNatur's Adriatic Flyway (AFW) project which was started in 2004 (Schneider-Jacoby *et al.* 2006, Schwarz 2010), the changes of land-use over the last years by using high-resolution satellite data was the focus of the present study.

Analyses were performed mainly by visual interpretation of high-resolution satellite images. The possibility to derive information on land-use changes automatically and the use of the present classification (cf. Tab. 1) for medium-resolution satellite images like Sentinel 2 were considered but patches of land-use changes (by excluding some large polygons, most of it with a size of only some 7 ha) were found to be rather small and, aside of the detection of classical changes such as clear cuts or the enlargements of settlements and infrastructure, the automatic classification of changes would need too much effort for useful results. However, the possibility of automatic interpretation of images should be further investigated for future use. In particular, EU projects, like EnviroLense, for detecting all kinds of land-use changes are promising and will be useful for the continuous monitoring of habitat changes.

After a first run for the identification of "change polygons" the classification for land-use changes, as shown in Tab. 1, was implemented.

3. Results

3.1 Land-use changes in all AFW project areas

3.1.1 Recent changes, 2008 - 2019

In all, 184 patches (polygons) of significant transformations of habitats or land-use were detected. With a range from 0.1 - 1,012 ha and an average size of 26 ha these cover a total area of 4,839 ha. The most significant changes derive from the transformation of former wetlands for agricultural purposes (30%) through drainage and other measures for water management, namely the construction of hydropower plants (HHP) and irrigation canals (24%). The second largest source of habitat changes constitutes the reversible burning of extensive areas of reed beds on the northern banks of Skadar Lake in the Montenegrin part of the lake (27%). More significant than the latter, is the permanent loss of large areas for infrastructure, like new housing estates and roads that amounts to 11% or 509 ha of the whole area. Finally, sites of gravel and sand ex-

Tab. 1: Categorization of land-use changes in the three Adriatic Flyway project areas.

Change category	Description	Occurrence
Agriculture	Conversion of wetlands (wet grasslands) into arable fields or tangerine plantations	All three areas
Development of infrastructure	Mainly housing developments, but also enlargement of settlements	All three areas
Water management and hydropower	Habitat loss through the construction of hydropower plants, flood dikes or drainage canals	All three areas
Sediment exploitation	Gravel and sand exploitation for commercial purposes in river channels	Neretva Delta; Skadar Lake with Bojana- Buna Delta
Burning of reeds	Large areas of frequently burned reed beds	Northern bank of Skadar Lake in Montenegro
Lignite peat exploitation	Exploitation of peat layers	Livanjsko Polje

ploitation (mostly in active river beds) account for 6% and lignite peat exploitation in Livanjsko Polje for 2% of the area (Fig. 1).

The total area of land-use changes represents only 2.3% of the entire project area or 3% of wetland habitats, respectively. However, some changes, such as hydropower and irrigation projects, have the potential to impact other areas along rivers as well as adjoining wetland areas, and to alter main environmental factors like flooding regimes and the exchange between surface and groundwater bodies. Excluding larger areas that were used for the construction of new HPPs, for gravel exploitation and, particularly, extensive areas of reversible reed burning (1,306 ha), the average size of most polygones with land-use changes amounts only to approximately 7 ha.

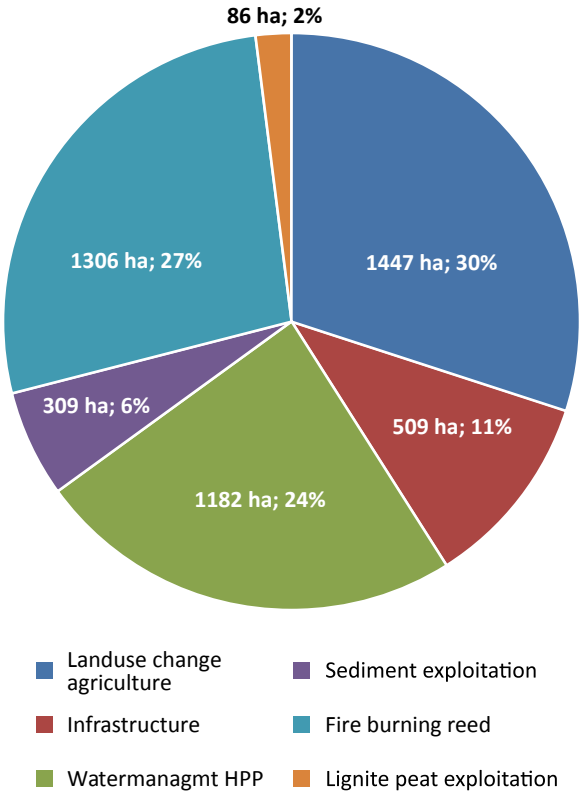

Fig. 1: The amount of different sources of land-use change in the entire project area, i.e. the three core areas of the Adriatic Flyway project in Croatia, Bosnia-Herzegovina, Montenegro and Albania.

3.1.2 Historical aspects of land cover change

On the basis of a study on wetland loss in all Adriatic Flyway countries on the Western Balkans by Schwarz (2017) it is possible to put the numbers for the last 10 years in relation to the overall loss of wetland areas during the last century, i.e. between approximately 1900 and 2010. By including the three project areas of the present study, the Dinaric karst poljes in Bosnia-Herzegovina and the coastal wetlands in Albania the potential flood area in the eastern Adriatic region was reduced from about 392,930 ha to currently 192,650 ha. This is a total loss of 51% of former wetlands since about 1900. Most wetlands were lost to melioration for agriculture and settlement building. In addition the regulation of rivers, as at the lower Neretva River early in the last century, has contributed to a significant loss of former wetland habitats.

For a direct comparison of habitat loss during the past 10 years in the three AFW core areas it is necessary to identify the extension of all relevant wetland habitats in the past. By considering all areas that have been marked as “wetlands” on historic maps of all three core areas a total of former wetland (flood) areas of about 125,740 ha can be assumed.

By excluding the burned reed beds on Skadar Lake as a reversible alteration, overall, 3,518 ha of wetland habitats were lost over the last 10 years. These amounts to some 3% of the original flood area around 1900. In other words if some 50% of wetlands were lost since 1900, the average loss per decennium would amount to more than 4%. This appears to be a realistic proportion and underlines the slow but ongoing loss of wetlands in the region. However, of course, is the proportional loss of wetlands not evenly distributed over the years since 1900. Overall, the transformation of wetlands in the AFW project areas is comparable with the landscape history in Central Europe where the systematic degradation of wetlands started at the end of the 19th century. In eastern Europe, including the Balkans, the drainage of wetlands and the regula-

tion of rivers for melioration purposes and flood protection started only a little bit later, and was, like in other parts of Europe, only interrupted by the First and Second World War. More recently, habitat loss and land-use change slowed down during the Yugoslav Wars in the 1990s and the economic regression in most former Yugoslav countries in the aftermath of the war.

3.2. Skadar Lake with the Lower Drin and the Bojana-Buna Delta (Albania/ Montenegro)

3.2.1 Recent changes, 2008 - 2019

The project area that encompasses the Skadar Lake and its outflow to the Adriatic Sea, the Bojana-Buna River, and that further includes the lower reaches of the Drin River in Albania, covers 135,810 ha. The area comprises 82,435 ha of valuable wetland habitats along the Morača River in Montenegro, Skadar Lake, along the lower Drin in Albania and the Bojana-Buna River and its delta along the border between Albania and Montenegro.

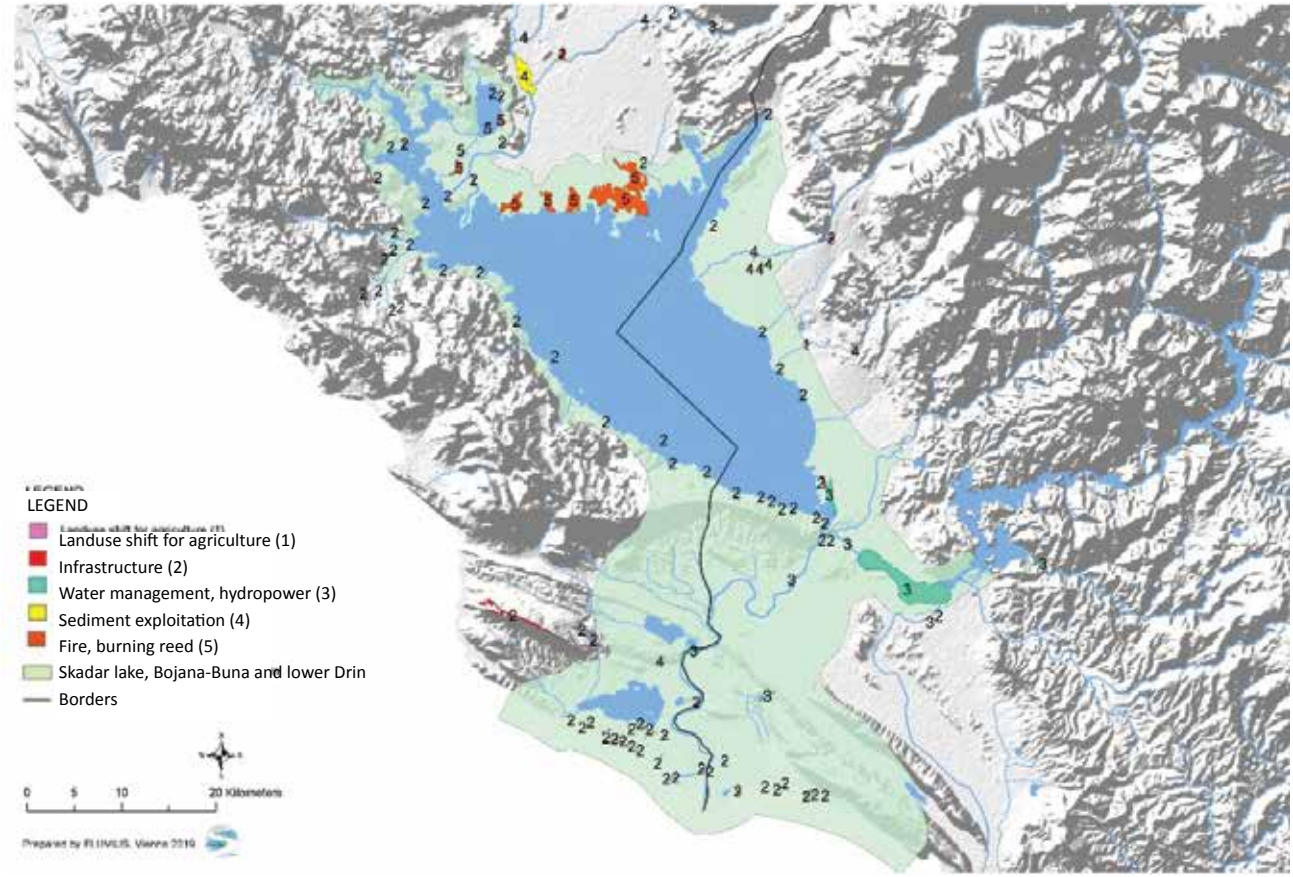

Fig. 2: Recent changes of land-use, 2008 – 2019, in the AFW project area Skadar Lake with the Lower Drin and the Bojana-Buna Delta. Larger patches of land-use change exist on the lower Drin, the Moraĉa River and on Skadar Lake. Due to the small size, many patches are only recognizable in the map by the numbers for the classification of land-use changes.

Core areas of biodiversity and conservation interest encompass the entire northwestern bank of Skadar Lake with its extensive zone of different wetland habitats from floating water plants in shallow waters, reed beds, soft- and hardwood forests to periodically flooded grasslands with hedgerows. Areas of conservation interest further concern the braided lower reaches of the Drin River that are today heavily impacted by the HHPs Ashta I and II implemented in 2012, as well as parts of the Bojana-Buna River and its complex delta with saltwater lagoons, artificial salt-pans and other brackish and freshwater wetlands.

The loss or deterioration of natural and semi-natural habitats applies to 2.3% (3,131 ha) of the total surface area and 2.8% of all wetland habitats, respectively, with some losses concerning only a part of the respective polygon. In general, some severe developments were observed which derive from (1) the construction of additional HPPs, (2) the regulation of Skadar Lake through the dredging of its outflow in Shkodra in Albania and (3), at least partly, from the construction of new tourist developments such as the resorts on the Montenegrin side of Skadar Lake and, in particular, on Velika Plaža in Montenegro and along Velepoja beach in Albania.

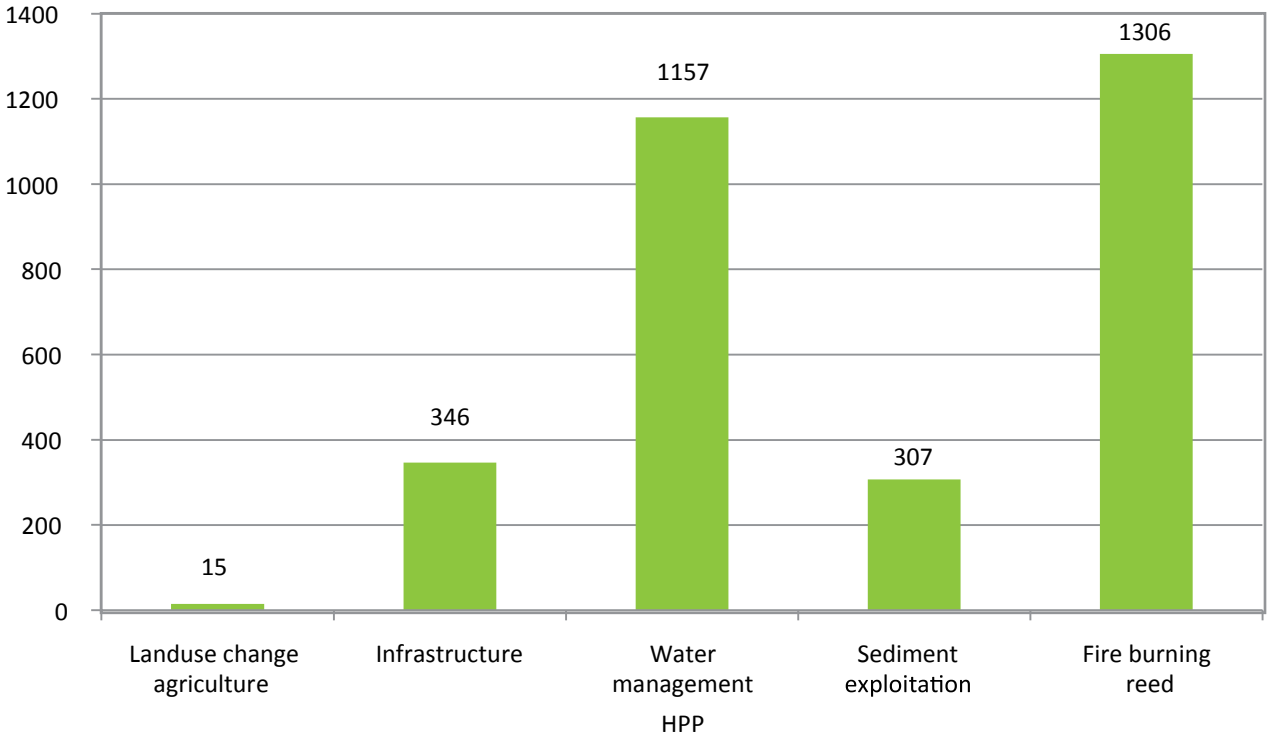

Fig. 3: Amount of different sources for land-use change (in ha) in the Lake Skadar, Bojana-Buna Delta and Lower Drin AFW project area.

Some of the main alterations and destruction of former pristine wetland habitats are illustrated in Fig. 4 – 7. Based on detailed habitat analyses - i.e. for patches > 1 ha within the survey area of 2008 which is not totally identical to the project area in Fig. 2 - the following areas of natural or semi-natural habitats were lost to human interventions:

- 488 ha of the river bed, formerly covered by gravel, of the lower Drin (mainly areas with sediment exploitation) before the construction of the Ashta I and Ashta II HPPs
- 657 ha of softwood forests (dominated by willows) and shrubs; over half of it affected by burning of reeds on Skadar Lake and the rest destroyed by the Ashta HPPs along the lower Drin
- 95 ha of willow-poplar softwood forest, mostly on Skadar Lake affected by the burning of reed beds
- 321 ha of reed beds, mostly inside the burning areas in Montenegro
- 227 ha of wet and 191 ha of moist meadows and pastures, also affected mostly by burning
- 177 ha of rivers through the construction of Ashta I and II HPPs
- 58 ha of floating vegetation and swamps on the northern shore of Skadar Lake to the burning of reed beds
- 55 ha of hardwood and Montenegrin hornbeam-oak forests, mostly in the Bojana-Buna Delta 25 ha of floodplain standing waters
- 37 ha of pioneer vegetation on gravel bars of the Drin and Bojana-Buna River
- 27 ha of stony steppe and dry pastures on the alluvial fan on the northern shore of Skadar Lake in Albania
- 14 ha of the mosaic landscape of dry grasslands and hedgerows in Montenegro
- 17 ha of coastal swamps
- 5 ha of beach swamps and lagoons
- 4 ha of coastal dunes with pioneer vegetation
- 8 ha of sandy beach, all along the coastal strip in Albania and Montenegro, namely on Velika Plaža and Velipoja beach
- 6 ha of Mediterranean woodlands

Not included to the list were polygons outside of the area which has been mapped in 2008, i.e. 260 ha that were destroyed on the lower Morača River and its floodplain for gravel extraction, 22 ha through the regulation of a tributary of the lower Drin and some 130 ha for a windfarm north of Ulcinj as well as some smaller areas (of river channel and floodplain) on the Cijevna, a tributary of the Morača River.

Fig. 4: Construction of new flood dikes in Shkodra (Albania) at the southern end of Skadar Lake will exclude large wetland areas from regular flooding.

Fig. 5: Construction of two hydropower plants with the abstraction of water through a canal and the remaining stretch of residual water on the lower Drin (Ashta I and II). Up to 90% of water that now flows through the sealed concrete canal, is not available for the natural river system and its floodplain. Consequently, the extent and quality of typical riparian habitats was drastically reduced (Google Earth 2019).

Fig. 6: The development of beach infrastructure along Velika Plaža, Montenegro, destroys coastal swamps (locally known as knetas). In addition, the reduction of the sediment load of the Bojana-Buna River drives the regression of shoreline through erosion (Google Earth 2019).

Fig. 7: Destruction of natural riverine habitats through the exploitation of gravel along the lower Morača River in Montenegro just before the river enters Skadar Lake National Park. The 'moon landscape' shown in the pictures seems to be the source of construction materials for the entire Podgorica capital region (Google Earth 2019).

3.2.2 Historical aspects of land cover change

Fig. 8 shows the habitat and land-use pattern around 1900. With the exception of the traffic connection from Virpazar to the coast, the surroundings of Shkodra and along the lower Drin, but also through the intensification of land-use, mainly for agriculture, throughout the Bojana-Buna Delta, including the conversion of the former Zoganjsko Jezero and adjoining marshlands into the Ulcinj Salina, the overall change of the landscape was relatively small till the early 20th century.

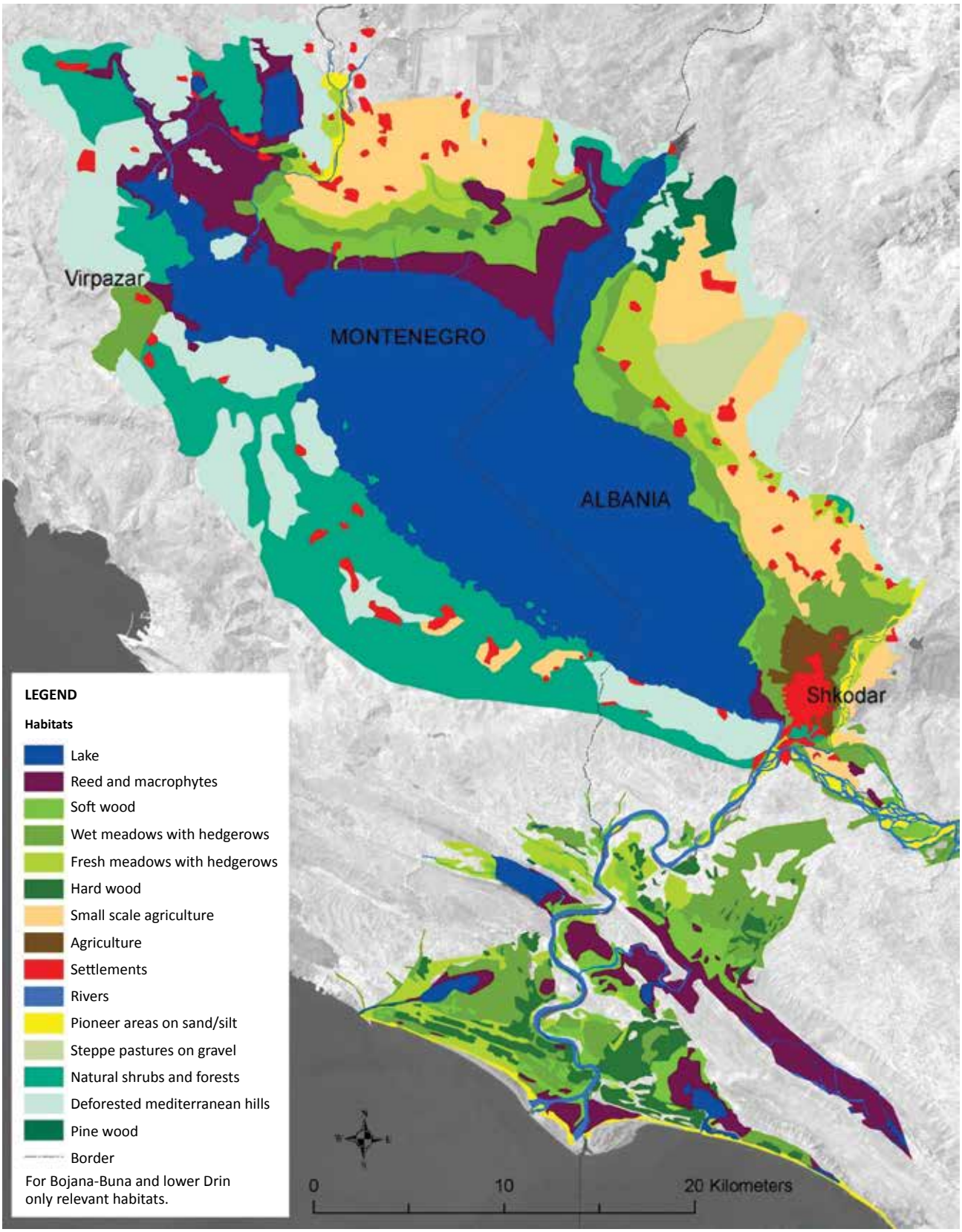

Fig. 8: Landscape structure around Skadar Lake, along the lower Drin and in the Bojana-Buna river delta around 1900.

In contrast to the general reduction of wetland habitats (see 3.1), in the Skadar Lake-Lower Drin-Bojana-Buna Delta AFW project area the flood area increased from the middle of the 19th century onwards. With the breakthrough of the Drin towards the Bojana-Buna River and the outflow of Skadar Lake in the outskirts of Shkodra the hydrographic system of Skadar Lake changed towards more frequent and considerably larger seasonal fluctuations of the water level (the backwater of the Drin floods into the lake) and to the expansion of wetland areas along the lake. Additionally, the construction of huge HPPs on the upper reaches of the Drin, since the 1960s, disrupted the transport and sediment deposition in the lower reaches of the Drin and in the Bojana-Buna River. Reduced sediment delivery from the upper Drin destabilized the sedimentation process, supports the erosion of channels, and changed the flood behaviour, water level and groundwater connectivity of the lower Drin with the Bojana-Buna River. The conversion of extensive wetlands and riverine forests of the geologically young floodplains of the Bojana-Buna, in particular downstream of the last barrier where the river breaks through the karst mountains and feeds the lagoons and other coastal wetlands, started mainly after World War I with the construction of the Ulcinj Salina on the Montenegrin side of the delta. Later drainage and melioration followed throughout the delta region.

Nowadays, the construction of the two HPPs Ashta 1 and 2 near Shkodra has increased pressures on the hydrology of the area by degrading the remaining free-running section of the lower Drin to a tailrace channel, by drying up active channels and the floodplain in the immediate vicinity of the tailrace channel. Flood dykes in the outskirts of the city of Shkodra that were built after the floods in 2010, have further reduced the lake and former river floodplain.

3.2.3 Hydropower development in the river basin

Fig. 10 shows the distribution of all existing and planned HPPs across the whole catchment area of the Morača-Skadar Lake and Drin river system. In Albania the development of hydropower is very dynamic. Also in Montenegro many larger HPPs along the Morača River are again in planning, after the suspension of former plans some years ago. As already mentioned, the chain of large dams on the upper Drin is responsible for sediment deficiencies in the Bojana-Buna and the ongoing regression of the coastline along the delta front.

Fig. 9: Neretva Delta at Opuzen, Croatia

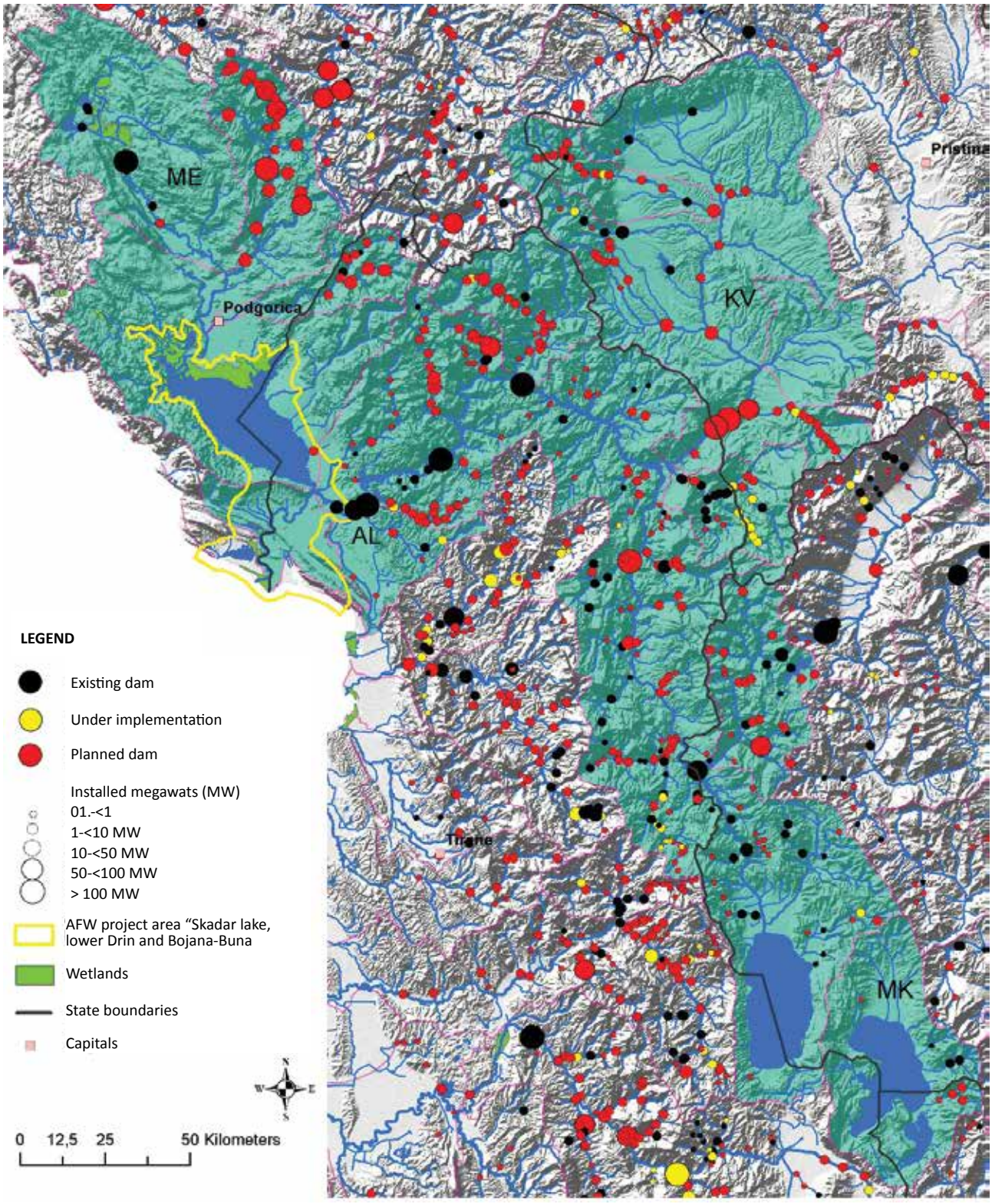

Fig. 10: Existing and planned hydropower plants in the Skadar Lake and Drin River catchment areas. While the middle reaches of the Drin River are already utilized for power generation, a number of new dams (red dots) are planned in its headwaters and on the Morača River, the main tributary of Skadar Lake in Montenegro.

3.3. Neretva Delta (Croatia/Bosnia-Herzegovina)

3.3.1 Recent changes, 2008 - 2019

The AFW project area Neretva Delta comprises 45,649 ha, including 14,862 ha of wetland habitats. Today the Neretva River is regulated in its delta area, but in Croatia large wetlands remain on the bottom of the river valley on both sides of the Neretva. In Bosnia-Herzegovina the project area includes the karst lake and marshes of Hutovo Blato Nature Park as well as the much bigger Svitava reservoir.

The deterioration and complete loss of natural habitats in the Neretva Delta sums up to nearly 1% (383 ha) of the total surface area and 2.8% of wetland habitats, respectively. Former reed beds and wet grasslands that are now used for agriculture and infrastructure, are the most affected habitat types. However, the loss of particularly valuable, natural or semi-natural habitats that are listed below, is comparably low:

- About 100 ha of former salt marshes at the delta front which include already altered areas of fallow land, were lost to harbour development
- 95 ha of different types of reed beds, i.e. pure reeds, reeds intermixed with cattails *Typha* sp., and reeds interspersed by willows *Salix* sp.
- 16 ha of shallow coastal waters, including parts of the sandy beach and coastal sand bars

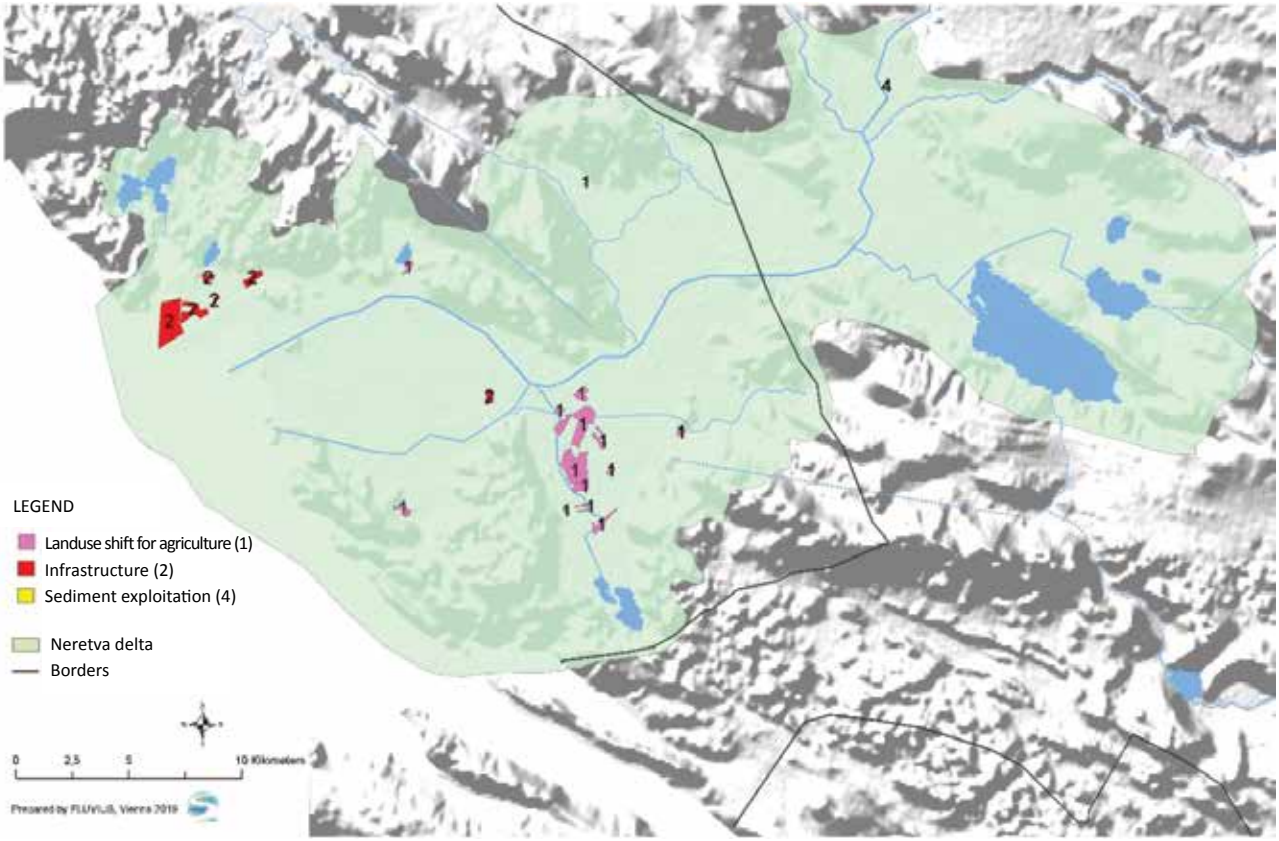

Fig. 11: Recent changes of land-use, 2008 – 2019, in the Neretva Delta AFW project area in Croatia and Bosnia-Herzegovina.

- 11 ha of sedge bult and bush-type sedges
- 3 ha of meadows/pastures
- 3 ha of standing water bodies
- 2 ha of Mediterranean woodlands

All other changes concern arable areas, irrigation canals as well as unused wastelands close to villages and infrastructure. In general, through the further development of the harbour in Ploče and the construction of the approach road between Ploče and the motorway A1 in Mali Prolog the surface area of wetlands in the western part of the delta was significantly reduced. Other considerable alterations derive from the intensification and expansion of agricultural lands (mainly for tangerine cultivation) within former wetland areas (reed beds, wet meadows), in particular in the Croatian part of the delta.

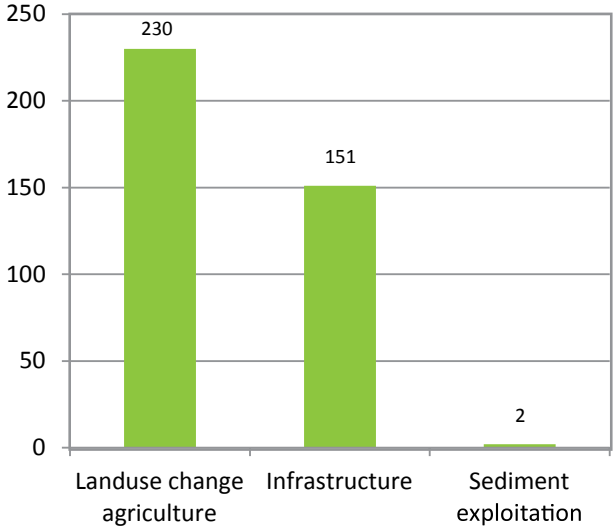

Fig. 12: Amount of different sources for land-use change (in ha) in the Neretva Delta AFW project area in Croatia and Bosnia-Herzegovina.

Fig. 13: Through the construction of the motorway access near Ploče an entire wetland complex was destroyed in the Neretva Delta (Google Earth 2019).

Fig. 14: Drainage and melioration of wetlands for the cultivation of tangerines and other fruits in the Croatian part of the Neretva Delta (Google Earth 2019).

Fig. 15: Neretva Delta at Opuzen, Croatia

3.3.2 Historical aspects of land cover change

Following to the harbour in Ploče and the railway connection between the Dalmatian coast and Sarajevo, the Neretva Delta was of particular strategic importance for the Austro-Hungarian Monarchy. Therefore, the melioration and drainage of the delta started much earlier than in other river floodplains. As part of the Austro-Hungarian Empire the lower reaches of the Neretva River were already completely regulated at the end of the 19th century. The regulation of the river facilitated the massive expansion of agriculture and the further development of the delta region (see Fig. 16). Significant developments, like the construction of a first dam and an accumulation lake for the utilisation of hydropower in the 1970s and the expansion of the harbour and the industrial zone in Ploče proceeded throughout the 20th century.

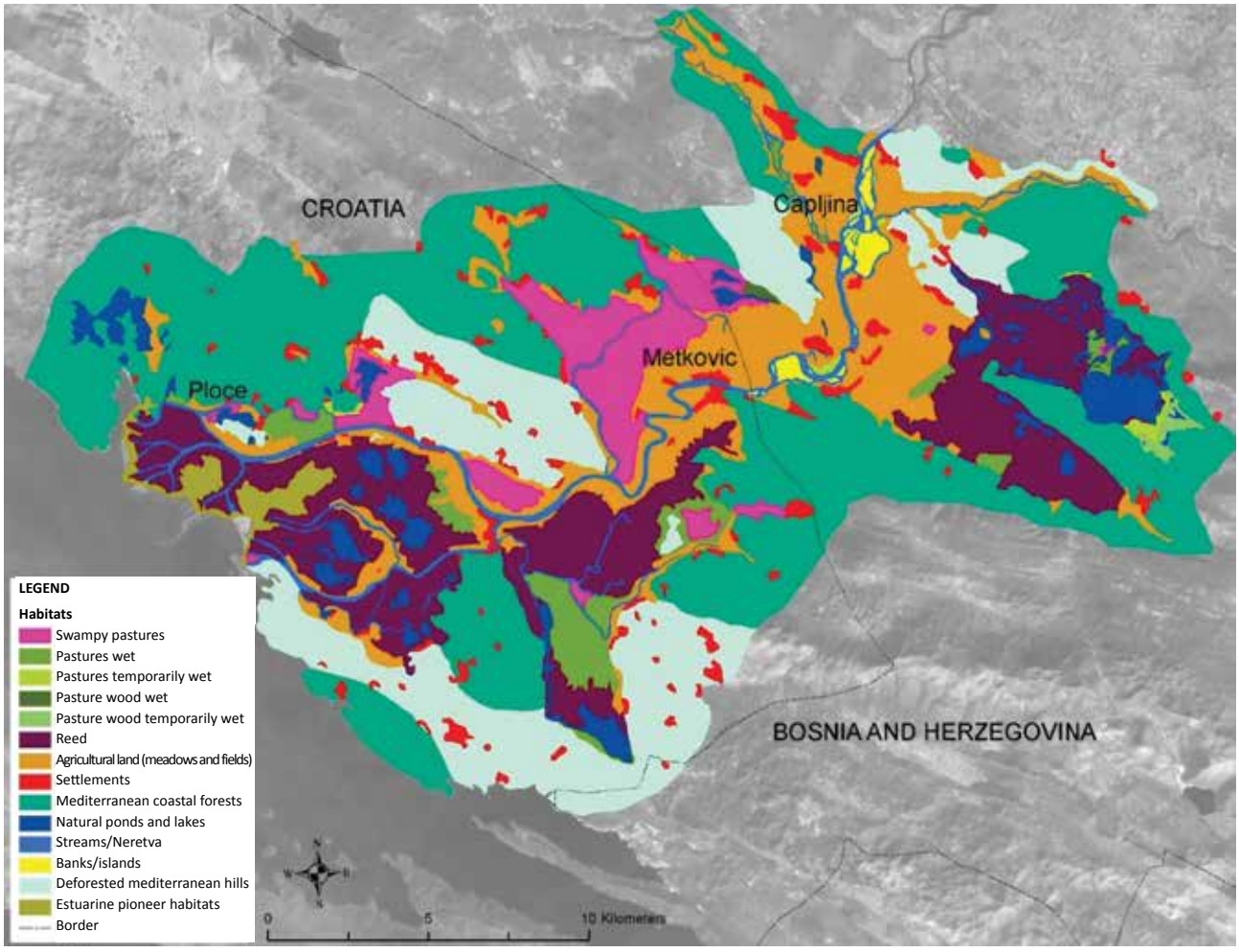

Fig. 16: Land-use patterns in the Nerevta Delta around 1900.

3.3.3 Hydropower development in the river basin

Current plans for the further development of hydropower concern the expansion of the already existing HPP in Mostarsko Polje and plans for a new HPP near Ljubuski in Bosnia-Herzegovina that will harm the famous Kravica waterfalls. In addition, numerous new small and medium-sized HPPs that will hamper the sediment transport and impair the hydrologic balance of the river, are planned on the upper Neretva River.

3.4. Livanjsko Polje (Bosnia-Herzegovina)

3.4.1 Recent changes, 2008 - 2019

The project area Livanjsko Polje encompasses 40,812 ha, including 28,444 ha of ecologically important wetland habitats, namely wet grasslands above karst bedrock.

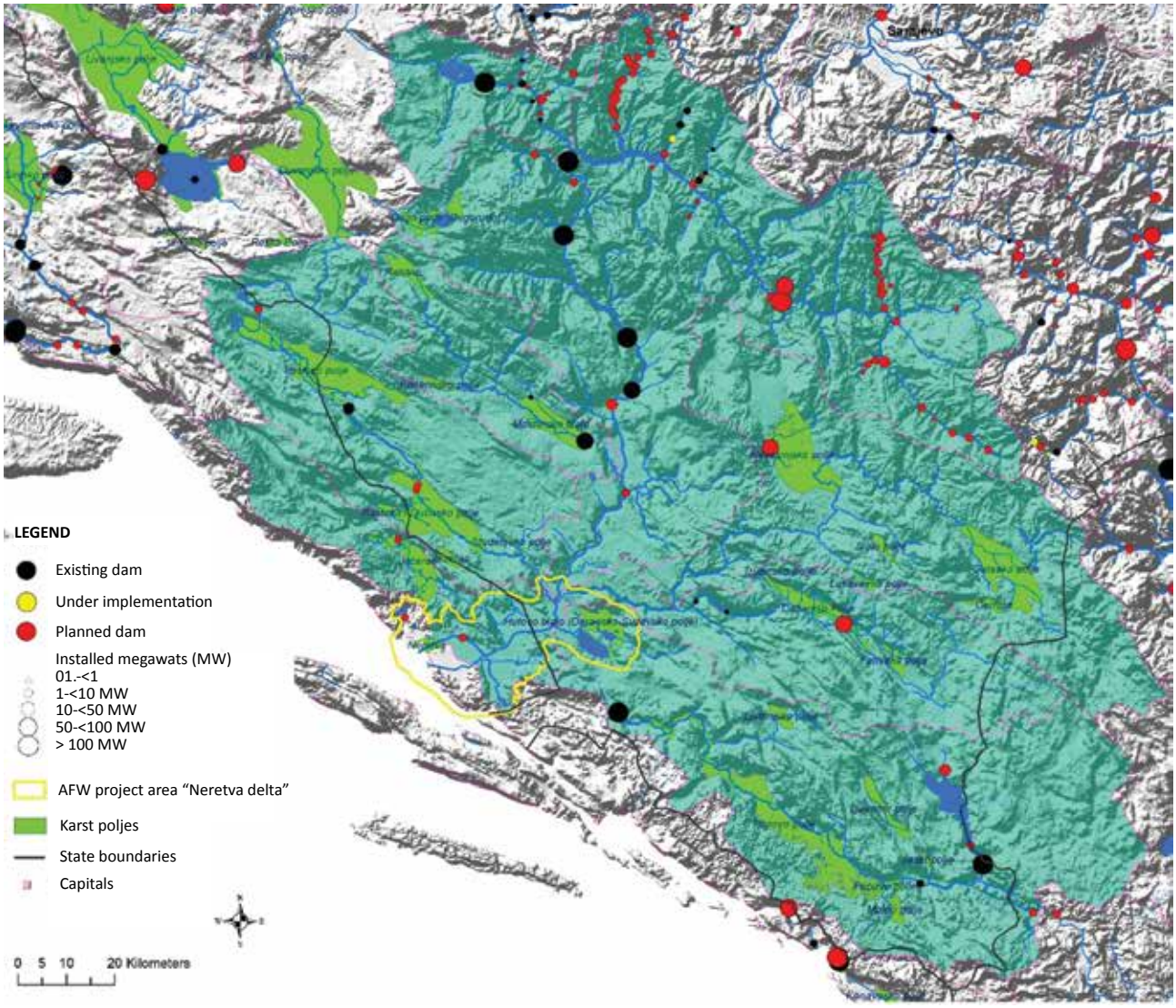

Fig. 17: Existing and planned hydropower plants in the catchment area of the Neretva River. Similar to the Drin in Albania (cf. Fig. 10), the middle reaches of the river are already impaired by huge impoundments. New dams are planned on the upper Neretva and in several karst poljes, including new plants at the coast near Dubrovnik that will use water from the Trebišnjica river.

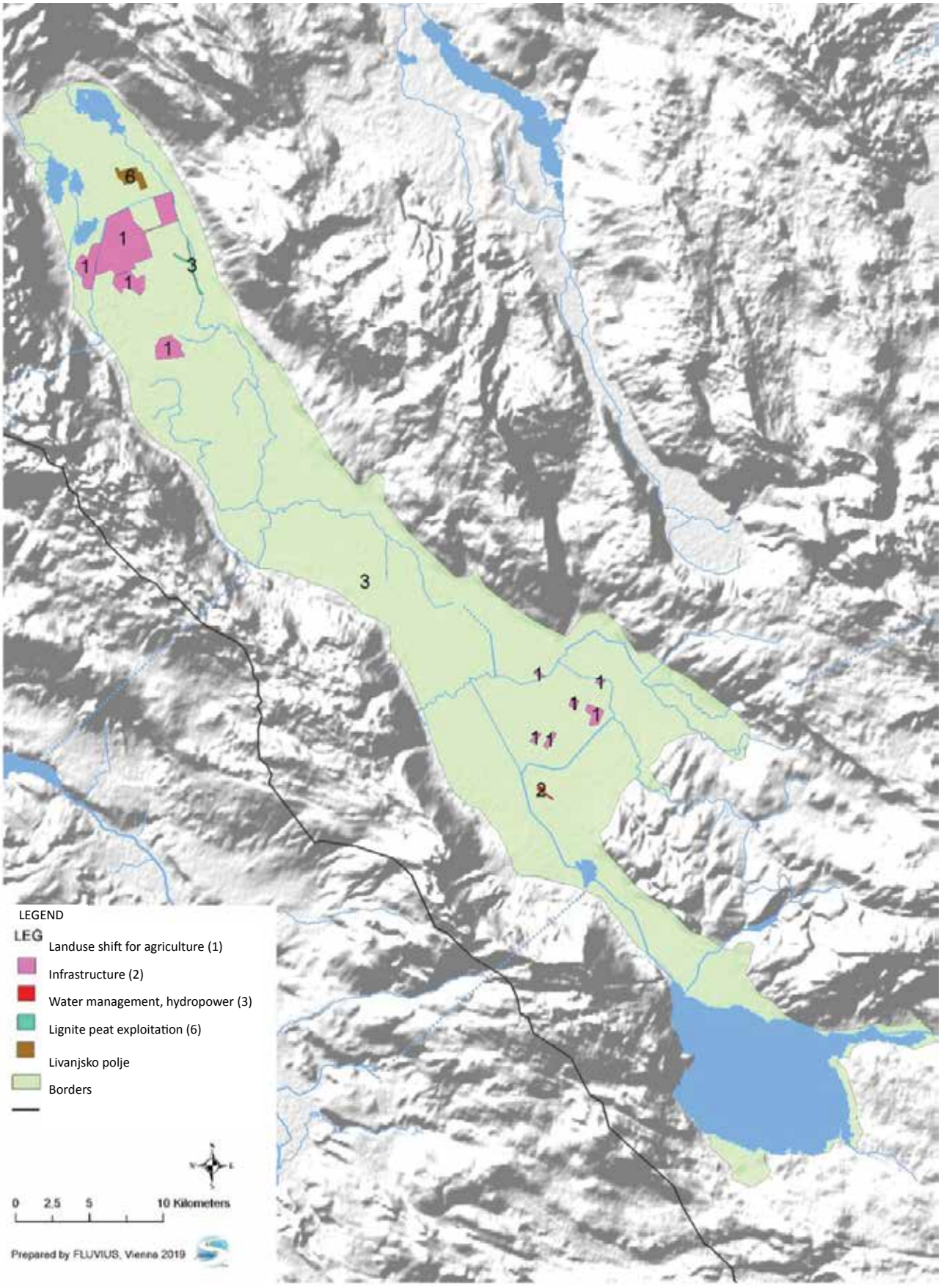

Fig. 18: Recent habitat and land-use change, 2008 – 2019, in the Livanjsko Polje AFW project area in Bosnia-Herzegovina.

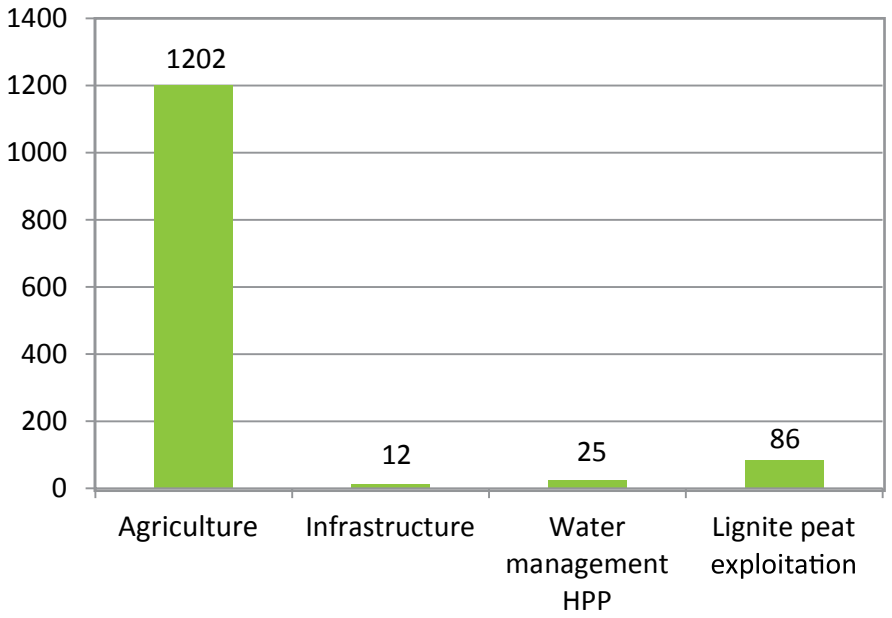

Fig. 19: The amount of different sources of land-use change (in ha) in the Livanjsko Polje AFW project area in Bosnia-Herzegovina.

In Livanjsko Polje the expansion of arable lands is the main driver for the change and loss of valuable wetland habitats. Although the present data include only areas of massive habitat transformations that can be detected on satellite images. Hence, with further verification on the ground, the real extent of the area which is currently used for agriculture might be larger.

However, until now the areas of peat exploitation in the north of the polje has expanded only slightly. Also new infrastructure was built, until now, only around the sporting fields in Livno. Visible rectifications and the deepening of drainage channels were observed only in the northeastern part between Vrbica and Bogdaše, while several smaller ditches and new channels in the southern and northwestern part of the polje were probably not recorded. Around Busko Blato, i.e. the reservoir of the HPP of the same name, no significant changes of land structure were found.

In all, main transformations of land structure in Livanjsko Polje concern 1,325 ha or 3% of the total surface area, including 3.8% of relevant wetland habitats. In comparison to the two other AFW project areas, this is the greatest percentage of wetland losses per surface area.

Based on the habitat map prepared in 2008, main transformations of land-cover over the last decade, till 2019, concern the following habitats:

- 469 ha of drained former wetland areas that were later converted into agricultural fields
- 465 ha of degraded karst fens that were drained for peat reclamation
- 146 ha of wet grasslands (regular flooded for several weeks up to three month)
- 122 ha of moist grasslands (temporarily flooded)
- 85 ha along the edges of karst fen vegetation with succession
- 14 ha of standing water bodies
- 8 ha of karst fen vegetation dominated by sedges
- 5 ha of dry pastures/meadows
- 3 ha of oak forests at the bottom of the polje and
- 1 ha of natural rivers

Fig. 20: Enlargements of peat exploitation in the northern part of Livanjsko Polje (Google Earth 2019).

Fig. 21: Construction of new drainage ditches to gain arable land in Livanjsko Polje (Google Earth 2019).

3.4.2 Historical aspects of land cover change

The historical land-use pattern in Livanjsko Polje around 1900 is shown in Fig. 22. Main transformations of the landscape started in Livanjsko Polje with the construction of the reservoir Busko Blato in the far southern part of the polje during the 1960s (cf. Fig. 22). Further systematic changes such as the partial drainage of some areas in the south and in northern parts and lignite exploitation in the northern peatlands of the polje followed. However, because of the distance of the polje to main urban and industrial centers the overall transformation of the landscape remains still comparably low.

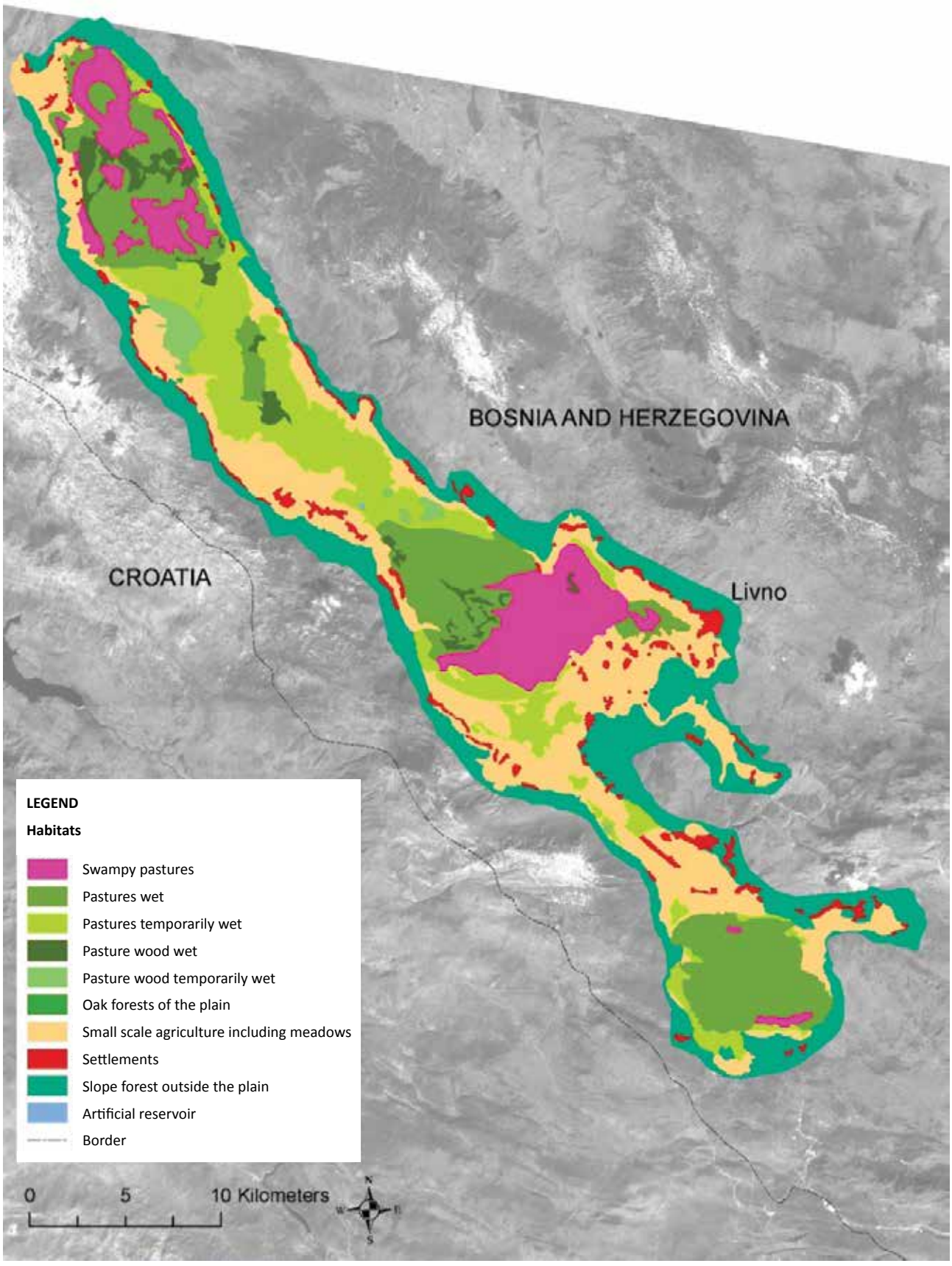

Fig. 22: Historical land-use patterns in Livanjsko Polje around 1900.

3.4.3 Hydropower development in the river basin

The fascinating karst basin of the Cetina River which includes all tributaries that flow through Livanjsko Polje is already impacted by several large HPPs, including the accumulation lake Busko Blato at the southern end of the polje (cf. Fig. 23). Plans for a new HPP in the upper catchment area of Livanjsko Polje as part of a cascade of several HPPs across the karst region of Bosnia-Herzegovina in the frame of the "Upper Horizon" project, constitutes the most severe threat for the hydrology and ecology of the polje. Most recently new plans for several smaller HPPs that are not shown in Fig. 21, along the tributaries upstream of Livanjsko Polje became known. The realisation of these plans - like the construction of a single larger HPP - will deteriorate the water household of the entire polje.

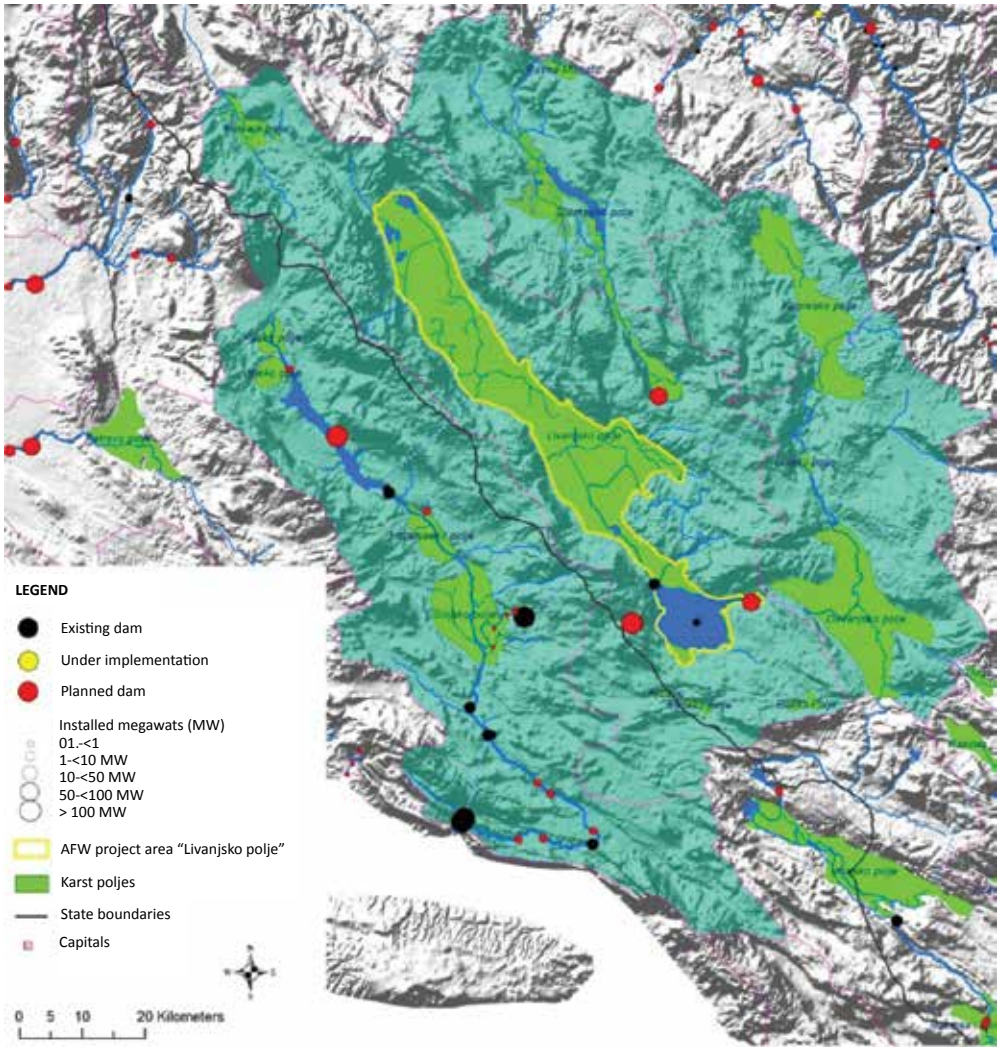

Fig. 23: Existing and planned hydropower plants in the catchment area of Livanjsko Polje. The Cetina river basin, south of the polje, is already heavily affected by operating HPPs. Busko Blato in the south of the polje is already part of this hydropower system. The new dams in Vrlo and Kabic will collect and store the water from karst poljes upstream of Livanjsko Polje.

4. Conclusions

Based on the analyses of land-cover, the transformation of land structure and the economic development in the three AFW project areas in the eastern Adriatic region, since about 2004, some general conclusions can be drawn.

In some areas the loss and deterioration of wetland habitats is considerable, but is not evenly distributed across as well as within project areas. Although land-use practices, in particular farming practices, outside wetland and protected areas intensified over the last years, the loss of 2% of wetland habitats of the total surface area, since about 2004, is smaller than expected.

Nevertheless, in particular the hydromorphology and water regime of river corridors suffered under the boom of hydropower utilization, including extensive and often dried-out residual waters, impoundments, and the alteration of underground karst water hydrology. In addition to hydropower utilization, the sediment deficit of main rivers is currently accelerating through excessive gravel and sand exploitation in the lower reaches of rivers and in estuaries like, e.g., the Drin and Bojana-Buna River. Aside of land reclamation, main transformations concern particularly sensitive sand dune and coastal wetland habitats along the coast of the Adriatic Sea but also on Skadar Lake. Additionally, the development of housing estates and infrastructure for tourism, in particular along the front of the Bojana-Buna Delta in Albania and Montenegro, must be regulated and should be heavily limited.

Overall, more integrated planning that take different demands into account, is urgently needed. Hence, e.g., the first plan for flood management in the wider Shkodra area, Albania, does not include the risks of wetland losses or options for the protection and restoration of valuable wetland habitats. Considering synergies between the need to minimize flood risk, the regulations of the EU Water Framework, the Fauna-Flora-Habitat- (FFH) and Bird Directives could lead to better solutions. In this context, in particular, the planned deepening of the outflow of the Buna-Bojana near Shkodra could have serious consequences for the water table of the lake.

Concerning the further construction of HPPs an Eco-Masterplan should stop the largely unregulated and uncoordinated boom of hydropower in many Central and Western Balkan countries (cf. the Balkan Eco-Masterplan by RiverWatch *et al.* 2018). Namely in Bosnia-Herzegovina, Albania, Kosovo and in North Macedonia numerous new HPPs are in planning. At the same time reclamation of further land for agriculture and road construction increases from year to year. On the other hand, the national and international networks of protected areas become denser. Thus, e.g., first inventories of potential EMERALD Areas of Special Conservation Interest and potential Special Protection Areas (pSPAs) according the EU FFH- and Bird Directive for Bosnia-Herzegovina and Montenegro include many river corridors.

Climate change will increase the frequency and duration of dry periods, but on the other side will most probably also increase flood risks. Intact wetland habitats that will buffer both effects of global warming are the best protection against massive floods and prolonged droughts. Consequently, the conservation of wetlands has to be an integral part of any climate change adaptation strategy in all Balkan countries.

The ecosystem services of wetlands and the ecological function of river corridors and coastal wetlands must be better integrated in spatial planning as green infrastructure and nature-based solutions for ecological and economic problems. In this regard, conservation programmes for attractive and widely known species of fish, birds or mammals could be very useful instruments for arising awareness for the importance of wetland conservation and the protection of other natural habitats.

In general, in all AFW project areas threats for further losses of valuable habitats and the transformation of land-cover through the uncoordinated development of settlements, traffic or tourist infrastructure, the expansion of agriculture and the intensification of farming practices remain. However, the most detrimental threats may arise from the further expansion of hydropower through the alteration of the hydromorphological conditions in whole catchment areas, the obstruction of the sediment discharge of rivers and through the subsidence of the ground water level in the wake of river degradation. To prevent further damages to ecosystem services the remaining wetland areas must be protected as habitats for many endemic aquatic plants and animals as well as important resting and stop-over sites for migratory birds and other wildlife. Support for different activities of integrative river basin management in the frame of international programmes, the help of organizations like GEF, UNDP, IUCN or GIZ as well as the slow but continuous implementation of EU legislation in the eastern Adriatic region should be focused on the long-term protection of river corridors and its adjoining wetlands in all three AFW core areas.

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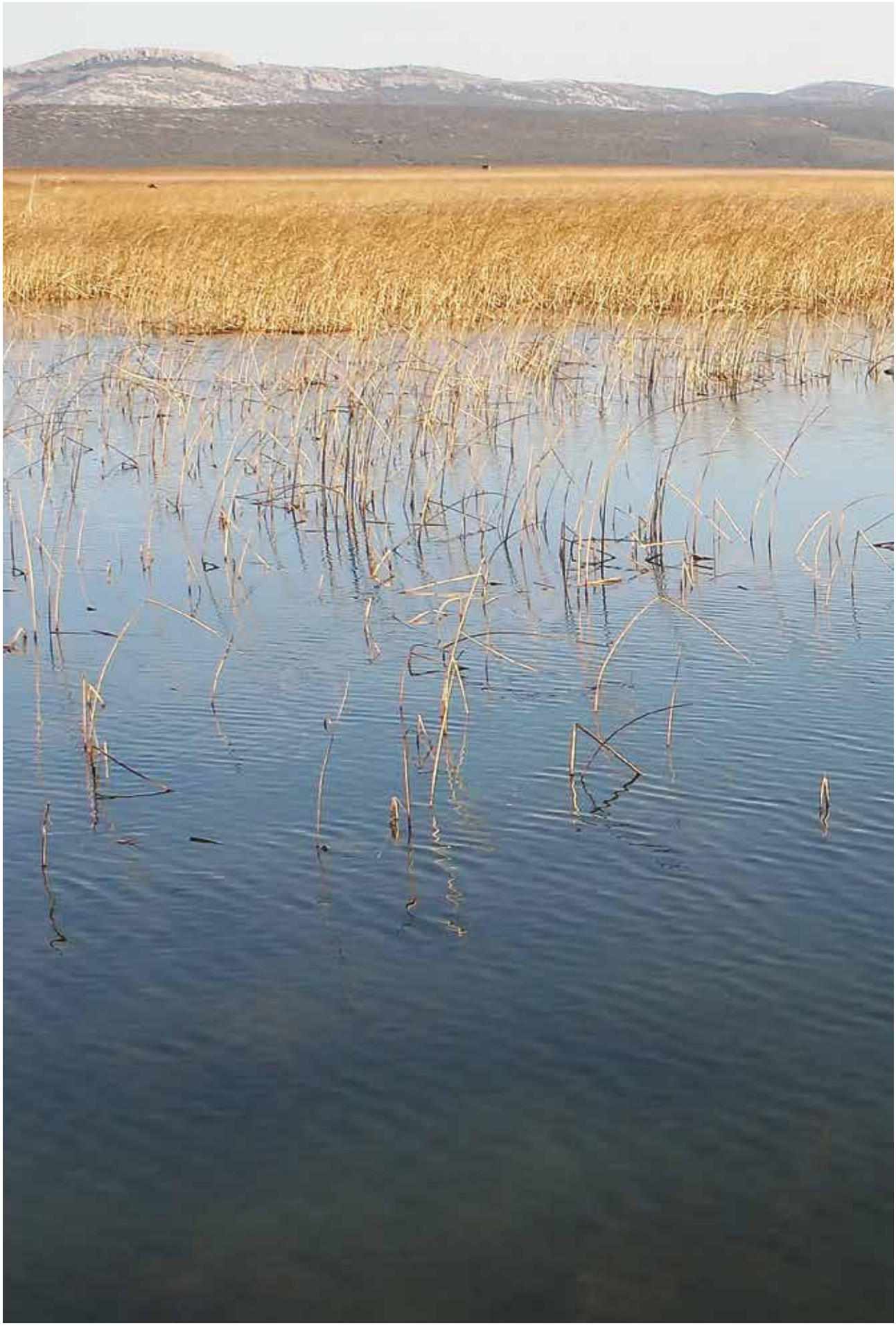

Photo: Tina Petras

Vransko Jezero, Croatia, 29 December 2009

How much are remnants of eastern Adriatic wetlands pristine?

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Summary

The conversion of wetlands in the Adriatic area has been happening for centuries and a great majority of the wetlands is already lost. Small areas of natural habitats are still present, but they are under various direct and indirect pressures. Water regulation has an effect even on a seemingly unaffected area because it changes the water regime of the surrounding area and the water runoff from the natural area is consequently changed. The big issue is how to detect and measure such an influence. This paper compares the extent of open water in two natural wetlands in the Neretva Delta, Croatia, by comparing historical and recent maps and/or aerial footages. The comparison clearly shows that the open water area is rapidly shrinking and that the process started earlier in Desne Lake, which runoff was regulated earlier than a runoff from the Kuti Lake. Such results warn us that conserving the remaining wetlands in a natural state does not work unless the runoff is controlled to imitate natural dynamics or open water habitats are restored by active restoration measures.

Keywords

wetlands, habitat restoration, water regulation

1. Introduction

The conversion of wetlands to arable land is an ancient tradition all across the Mediterranean. A great majority of wetlands are lost and most of the surviving ones are wetlands on brackish habitats, which are not suitable for agriculture. Small areas of pristine wetlands in freshwater habitats are still present but are under ongoing threat from conversion. Some of them are protected to be conserved in natural state but this is often not enough. Eastern Adriatic wetlands are following the same pattern (Schwarz 2017). Only two larger freshwater lakes remain in Neretva Delta area: Desne Lake and Kuti Lake and both are in a mostly natural state. This paper presents changes in open water extent in those two seemingly pristine wetlands, which are under threat because the runoff is regulated and the accelerated water loss from the areas results in a shrinkage of small lakes, which are central parts of both wetlands. Our method does not cover the potential influence of water regulation in surrounding karstic fields that can result in changes in underground water influx on the studied wetlands.

2. Methods

The study area is located in the Neretva Delta in the Dalmatia region of Croatia (Fig. 1). The source of the Neretva River is situated in mountains of Bosnia and Hercegovina and only the last 20 km of its flow passes through Croatia. The Neretva Delta in Croatia represents the largest wetland on Croatian coast that is, in its full extent, designated as a Ramsar site (Ramsar 2014) and Natura 2000 site (European Commission 2020).

Fig. 1: Location of the Neretva Delta in the Adriatic basin and Croatia (right), and a map of the study area (left).

The Neretva Delta area was mapped during the Austro-Hungarian Empire rule in two occasions (Arcanum 2020): The Second Military Survey (1806-1869) (Timar *et al.* 2006) and the Third Military Survey (1869-1887) (Molnar *et al*. 2009). The Third Military Survey was chosen because it shows no significant difference for the chosen sites compared to the second one. The State of Yugoslavia was mapped in the 1960's using orthophoto footages, which were compiled in 1968. Finally, a high quality orthophoto-based mapping was conducted in 2015. Trough comparing maps from those three periods we measured the size of open water habitats on Desne Lake and Kuti Lake and determined the presence of drainage canals and other water regulation actions. Hand-made maps from the Military Surveys were manually overlapped with maps on ARKOD Preglednik (2020), an official Croatian webpage that uses different layers and tools for the year 2015 based on aerial photos. Similar official webpage (https://ispu.mgipu.hr/) was used for measuring aerial photos from 1968 (Republic of Croatia 2020). Thus, polygons and measurement were done manually in those two webpages.

3. Results

Desne Lake has shown much more reduction in size, probably already during the Austro-Hungarian rule (ended 1918). The vicinity of the regulated Neretva River (seen in the lower part of Fig. 2, less than 1 km from the lake) accelerates drainage and the most of the lake was already lost in 1968. The size of the lake was estimated at 68 ha in 1869-87, 28 ha in 1968 and only 7 ha in 2015 (Tab. 1). This means that the extent of the present lake is only 10% of the size the lake had in the 19th century.

Kuti Lake has lost less of its original size and the shrinking process started much later. The lake is 6 km away from the Neretva River and the drainage of the area in between has not started before the 1970's. The drainage canal which can be seen on the 2015 footage (Fig. 3) was not present in 1968. So, the lake was probably preserved in a mostly natural state up to the 1970's, but the drainage in the area north of it has accelerated the succession of vegetation leading to a rapid shrinkage of open water habitat. The present area of the lake is only 50% of its original size (Tab. 1).

Fig. 2: Desne Lake in the period (left to right) 1869-87, 1968, and 2015. The red line indicates the extent of open water.

Fig. 3: Kuti Lake in the period (left to right) 1869-87, 1968, and 2015. The red line indicates the extent of open water.

Tab. 1: Area of open water habitat in Desne and Kuti Lake determined from the maps shown in Fig. 2 and 3.

Locality/period	1869-87	1968	2015
Desne Lake	68 ha	28 ha	7 ha
Kuti Lake	119 ha	94 ha	60 ha

4. Discussion

The map comparison shows a clear and rapid shrinking of the only two remaining freshwater lakes in the Neretva River Delta. Water regulation of the surrounding area and consequently accelerated runoff is an important cause of the open water habitat loss, but there are other potential causes that have not been covered by this research. For instance, water regulation in the adjacent karstic zone is also likely to have a negative effect on the underground water influx to the lakes. A loss of traditional reed collecting for artisan use also potentially accelerates the vegetation succession because of depositing organic matter. Climate change could also be one of the reasons. And, of course, vegetation succession is a natural process of various speed which is often accelerated by the presence of fertilizers from surrounding agriculture. Nevertheless, rapid shrinking of the last open water habitats is a warning that active conservation measures are needed to save them. Conserving small reserves of pristine habitats in a highly managed area is questionable without active conservation that aims to mitigate negative influences from the vicinity.

Local hunters do in fact manage to keep small ponds with open water (*plane* in local dialect), but those ponds are approached by a network of artificially made canals, which are additionally draining the marshland. Also, it is not sustainable nor justified to harvest tens or hundreds of waterfowl on any pond large enough to support no more than 2-3 breeding pairs of different waterfowl species.

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Photo: Peter Sackl

Pygmy Cormorant (*Microcarbo pygmaeus*)

Photo: Peter Sackl

Little Owl (*Athene noctua*), Velipoja, Albania

The avifauna of the Key Biodiversity Area of Vlora Bay – Karaburun – Çika Mountain, Albania

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Summary

Vlora Bay–Karaburun–Çika Mountain is the largest Important Bird Area (IBA) in Albania. The avifauna of the area has been faintly studied. The aim of the present study is to update the knowledge on the breeding and migrating birds, to identify the most important habitats and the major threats for the ornithofauna in the area. Two field expeditions in March and May 2016 were carried out. A combination of point counting and transect count techniques were used for the present study. Counting points and transects were selected in such a way to guarantee an almost total coverage of the natural habitat types found in the area. The aim was to produce a - as far as possible - complete list of the breeding birds of the IBA and to give the numbers of observed pairs or single individuals. A total of 110 bird species were recorded. Of these 80 species were classified as breeders, one species, i.e. European Shag *(Phalacrocorax aristotelis*), as a possible breeder in the area and the rest of 29 species as passage migrants or visitors from adjoining habitats. The number of species which were classified as both, breeders and migrants, amounts to 20. A total of 486 breeding pairs which belong to 11 orders and 31 families were recorded. The most abundant breeding species are Subalpine Warbler (*Sylvia cantillans*), Blackbird (*Turdus merula*) and Common Whitethroat (*Sylvia communis*). In addition, 3,382 individuals from 49 bird species which belong to 12 orders and 25 families, were registered as spring migrants. The species with the highest numbers of migrants were the Barn Swallow (*Hirundo rustica*), Mediterranean Gull (*Larus melanocephalus*) and the Alpine Swift *(Tachymarptis melba).* In the area around the Orikumi Lagoon the highest number of migrating birds was observed. At the same time the strongest evidence for poaching was found in this area. Although the present survey represents the most complete ornithological study conducted in the area, it was, so far, not possible to survey some important sites and special habitats, such as the cliffs and uplands in the south-west part of the Karaburun Peninsular.

Keywords

avifauna, Albania, Vlora Bay, Karaburun Peninsular, breeding birds, bird migration, Important Bird Area, Key Biodiversity Area

1. Introduction

With a surface area of 123,874 ha Vlora Bay–Karaburun– Çika Mountain represents, after Munella Mountain, the second largest Key Biodiversity Area (KBA) in Albania (BirdLife 2017). The majority of the area which consists of two units, lies within the national network of protected areas: the Nature Park Karaburun (IUCN category IV) and the National Park Llogora (IUCN category II). In addition, a significant part of the area belongs to the Emerald Network of Areas of Special Conservation Interest (FZRSH 8, 2016). Last but not least, the whole area is recognized by BirdLife International as an Important Bird Area (IBA) as it triggers the B2 IBA criteria.

The wetland complex of Orikumi, with the open lagoon and dense reed beds is a favourable habitat for wintering waterbirds (Bino *et al.* 2014). Ducks and coots are the dominant species. However, also gulls, herons, and cormorants frequent the area in considerable numbers. During International Waterbird Censuses total numbers of more than 1,000 – 3,000 individual waterbirds from 16 - 22 species were counted in the area (Bino *et al.* 2014, Bino 2016, Bino & Caruggati 2017). The cliffs of the Karaburun Peninsular represent potential breeding habitats for seabirds such as, for instance, the European Shag (*Phalacrocorax aristotelis*). However, this part of the area remains almost unsurveyed for its breeding bird fauna.

Since 25 years the whole area is under constant pressure from uncontrolled construction and tourist developments. As a result land-use patterns and the landscape has changed considerably which can be easily seen by comparing historical satellite imagery in Google Earth. Hence, the challenge is to bring a sustainable socioeconomic development of the area in line with conservation principles and legislation.

The aim of the present study is to update the knowledge of the breeding birds and on bird migration as well as to identify the most important bird habitats and major threats for birds in the area.

2. Study area

The study area includes all key ecosystems such as the Bay of Vlora, the Karaburun Peninsular, the National Park Llogora, the mountain range Rrëza e Kanalit – Çika, the valley of Dukat, the lagoon of Orikumi and the Sazan-Karaburun Marine National Park. It is situated in the south-western part of Albania, bordered by the Protected Landscape Vjosë-Nartë in the north, the Adriatic Sea to the west, the mountain range Kaninë-Shashicë – Çika in the east and the village of Palasë in the south.

The area is characterized by a Mediterranean climate, but due to the diverse and fragmented relief which extends from sea level up to 2,045 m a.s.l. three sub-climatic zones are present from (i) the coastal lowlands, across (ii) the lower hills up to (iii) the high mountains. The average precipitation and temperature are 1,200 mm and 17 °C, respectively (MedWetCoast 2004). In the mountainous sub-climatic zone precipitation occurs also in the form of snow (ASHSH 1991).

The area includes different vegetation types, including Mediterranean maquis, lowland coniferous forests, oak forests, mountain coniferous forests as well as alpine meadows and scrublands. Maquis vegetation is characterized by the following species: Strawberry Tree (*Arbutus unedo*), Tree Heath (*Erica arborea*), Kermes Oak (*Quercus coccifera*), Lentisk (*Pistacia lentiscus*), Holm Oak (*Quercus ilex*), Manna Ash (*Fraxinus ornus*), Common Myrtle (*Myrtus communis*) and the Laurel (*Laurus nobilis*). This vegetation type is widespread in the area from sea level up to 800 m a.s.l. Lowland coniferous forests of Aleppo *(Pinus halepensis)* and Stone Pine *(P. pinea)* cover the lower hills around the valley of Dukat in altitudes from 400 - 500 m a.s.l. The deciduous oak forests belong to the Quercetum frainetto-cerris Rud. association. These forests grow mainly between 300 – 500 m a.s.l. Besides oaks, in altitudes between 500 and 900 m a.s.l. European Hop-hornbeam *(Ostrya carpinifolia),* Oriental Hornbeam (*Carpinus orientalis),* and Montpellier Maple *(Acer monspessulanum)* grow in these forest types. Coniferous mountain forests cover the National Park of Llogora and the rest of the area at altitudes between 750 and 1,300 m a.s.l. They are dominated by Black Pine (*Pinus nigra*) and the Bulgarian Fir (*Abies borigi-regis*). The Qore and Çika Mountains at altitudes from 1,300 – 1,700 m a.s.l. are mainly covered by Bosnian Pine (*Pinus leucodermis*), while at altitudes above 1,700 m the area is covered by alpine meadows and shrubby vegetation (ASHSH 1991). Overall, the area of Vlora Bay – Karaburun – Çika Mountain represents one of the most diverse KBAs in Albania in terms of natural habitats.

Fig 1: Map of the study area

3. Methods

3.1. Bird surveys

During the breeding season 2016 two field expeditions were carried out. The first field visit was conducted from 26 – 30 March, corresponding to the early breeding season, and the second field visit was realized from 20 – 28 May.

During the first visit the shores of Karaburun Peninsular, the Valley of Dukat up to the Tragjasi village, and a forest transect in Llogora National Park were surveyed. During the second visit in May 2016, due to entry restrictions posed by the local military base it was not possible to visit the shores of the Karaburun Peninsular, but we covered the rest of the area up to the alpine pastures (that were not surveyed in March).

Aim of the present study was to identify the breeding birds of the KBA and make a rapid assessment of the population size for each species. For this purpose bird data were collected by a combination of point counting and transect count techniques (Bibby *et al* 2000). The point count technique was implemented in open areas, whereas in shrubby and forested areas, the transect count technique was used. Fig. 1 shows the location of observation points and transects. Counting points and transects were chosen for covering almost all natural habitat types found in the area. Transects followed open hiking or treks used by livestock by which different habitats from the Mediterranean shrub-lands to the alpine pastures could be reached. All birds observed along transects were recorded. Breeding evidence was categorized based on the guidelines of the European Breeding Birds Council.

Most of the surveying work was performed during early morning hours when birds (especially passerines) are most active and easily detectable. Two different field visits in March and May were conducted in order to detect both early breeders and species that in high altitude habitats or due to long-distance migration start breeding later.

Field data were collected using the SmartBirds Pro application for Andorid OS (Popgeorgiev *et al*. 2015). This software allows to register the unique location of each observed individual in the field and also to take notes on the breeding status. Migrants and the numbers of individuals was also noted. Moreover, information on the observed and/or potential threats for the area's biodiversity was also collected during the field expeditions.

3.2 Data analysis

Field data were exported from the SmartBirds Pro application into an Excel spread sheet. From the Excel database we prepared a full list of observed bird species, their status as breeders or migrant passengers and the respective numbers for each group (taxa) and species. In addition, species of special conservation interest at the global, European or national level were identified. Furthermore, the geographical coordinates for all observations from SmartPro allowed to prepare maps and to identify areas of particular importance for birds.

4. Results

4.1 Numbers of species

A total of 110 bird species were observed. Out of them, 80 species (72.7%) were classified as breeders, 1 species (0.9%) as possible breeding and the rest of 29 species (26.4%) as passenger migrants or visitors from outside the study area. 20 species were classified as both local breeders and migrant visitors. Tab. 1 gives a full summary of all observations recorded for this study.

Tab. 1: List of all bird species recorded in the KBA Vlora Bay-Karaburun-Çika Mountain in spring 2016.

Species (scientific name)	Observed number of breeding pairs[1]		Total number of migrating birds or visitors (individuals)		The most important zones for the species
	March	May	March	May	within the KBA
Accipiter gentilis		1			d, e
Accipiter nisus	1	1	1		d, e
Acrocephalus arudinaceus	2				b
Acrocephalus scirpaceus	2				b
Alcedo atthis	2				b
Anas platyrhynchos			7		b
Anthus pratensis			3		f
Anthus spinoletta		1			e
Anthus trivialis			7		f

Species (scientific name)	Observed number of breeding pairs[1]		Total number of migrating birds or visitors (individuals)		The most important zones for the species
	March	May	March	May	within the KBA
Ardea alba			4		b
Ardea cinerea			9		b
Athene noctua	1				c
Bubulcus ibis			4		b
Buteo buteo	4	3			g
Carduelis cannabina	3	2			f
Carduelis carduelis	2	6	9		f
Carduelis chloris	1	1	1		f
Carduelis spinus			10		d, e
Certhia brachydactyla		2			e
Cettia cetti		6	1		b
Charadrius dubius	3		1		b
Circaetus gallicus	3	1			a, c
Circus aeruginosus	2				b
Circus cyaneus			1		f
Cisticola juncidis	10				b
Columba palumbus		1			f
Corvus corax	6				f
Corvus corone	1	1			c
Cuculus canorus		3			f
Delichon urbicum		10	30		c
Dryocopus martius	1	2			d
Egretta garzetta			10		b
Emberiza cia		9			e
Emberiza cirlus		10			f
Emberiza melanocephala		4			f
Erithacus rubecula	3	3			f
Falco tinnunculus	6	4			a, c
Fringilla coelebs	10	6			d, e
Fulica atra			89		b

Species (scientific name)	Observed number of breeding pairs[1]		Total number of migrating birds or visitors (individuals)		The most important zones for the species
	March	May	March	May	within the KBA
Gallinago gallinago			7		b
Gallinula chloropus	1				b
Garrulus glandarius	3	4			f
Hirundo daurica	1	16			a, c
Hirundo rustica		3	1080		f
Lanius collurio		5			f
Lanius senator		4	1		f
Larus melanocephalus			1000		a, i
Larus michahellis			9		I, b
Larus ridibundus			3		I, b
Lullula arborea	1	1			f
Luscinia megarhynchos		9			f
Merops apiaster		4			f
Microcarbo pygmaeus			99		b
Miliaria calandra		12	2		f
Monticola saxatilis		6			c, e
Monticola solitarius		4			f
Motacilla alba	3	1	1		f
Motacilla cinerea	1	3			d, e
Motacilla flava			40		b
Muscicapa striata		1			f
Oenanthe hispanica	2	10			f
Oenanthe oenanthe			1		f
Oriolus oriolus		1			c
Pandion haliaetus			1		a, i
Parus ater	12	10			d, e
Parus caeruleus	3	1			f
Parus lugubris	1				f
Parus major	6	6	9		f
Passer domesticus		4			f
Passer hispaniolensis		20	39		f

Species (scientific name)	Observed number of breeding pairs[1]		Total number of migrating birds or visitors (individuals)		The most important zones for the species
	March	May	March	May	within the KBA
Passer montanus		1			f
Pernis apivorus		1			c, e
Phalacrocorax aristotelis	1				a
Phalacrocorax carbo			2		b
Phoenicurus ochruros		3	1		f
Phoenicurus phoenicurus			5		f
Phylloscopus orientalis	1				c, e
Phylloscopus trochilus			2		f
Pica pica	6				f
Picus viridis	1	1			c, d, e
Podiceps cristatus			1		b
Ptyonoprogne rupestris	20				a, e
Puffinus sp.			50		a, i
Puffinus yelkouan			5		a, i
Pyrrhocorax sp.				6	e
Rallus aquaticus	1				b
Regulus ignicapillus	2				d, e
Regulus regulus	3				d, e
Riparia riparia			8		b
Saxicola rubetra			1		f
Saxicola torquata		6	3		c
Serinus serinus		5	1		d, c
Spatula querquedula			4		b
Streptopelia decaocto		1			c
Streptopelia turtur			2		c
Strix aluco	1				d, e
Sturnus vulgaris	3	1			f
Sylvia atricapilla	4	8	2		f
Sylvia borin	1				a
Sylvia cantillans	4	20	1		a, e
Sylvia communis	4	17			f

Species (scientific name)	Observed number of breeding pairs[1]		Total number of migrating birds or visitors (individuals)		The most important zones for the species
	March	May	March	May	within the KBA
Sylvia curruca		4			f
Sylvia hortensis		3			a, e
Sylvia melanocephala	3	1			a, e
Tachymarptis melba	10	10	800		a
Thalasseus sandvicensis			1		b
Tringa ochropus			5 – 9		b
Turdus merula	5	18			f
Turdus viscivorus		3			e
Upupa epops			7		f
Totals	**179**	**307**	**3,376**	**6**	

Letter codes used to indicate the locations/habitats in the table	
a	Shores of Karaburun Peninsular
b	Orikumi Lagoon
c	Dukati Valley and Tragjasi Village/Agricultural open areas and Mediterranean shrub land
d	National Parka LLogora/forest area
e	Rreza e Kanalit, Cika Mountain/alpine pastures
f	Unspecified
g	Present in the whole KBA
i	Points on the Vlora Bay shore not including Karaburun Peninsular shores

1 When the rows are shaded with colours, it means that the species was categorized as a possible breeder.

Fig. 2: European Bee-eaters (*Merops apiaster*)

4.2 Breeding and possible breeding bird species

The breeding birds belong to 11 orders and 31 bird families. The possible breeder "group" is represented only by the European Shag. The highest number of breeding bird species belongs to the order Passeriformes, represented by 58 species (73%) bird species registered as breeders in the area are the Accipitriformes with 7 species (9%), whereas all the rest of 9 orders are represented by only 1 or 2 species (see Fig. 3).

The Muscicapidae represent the most diverse bird family, with 8 species which were registered as local breeders, followed by the Sylviidae and Accipitridae with 7 species each, the Fringillidae with 5 species, the Emberizid*ae*, Hirundinidae, and the Corvidae with 4 species each. Finally, the rest of all bird families are represented by lesser than 4 species (Fig. 4). The most abundant species observed are the Subalpine Warbler (*Sylvia cantillans*), Blackbird (*Turdus merula*) and Common Whitethroat (*Sylvia communis*) (cf. Tab. 1).

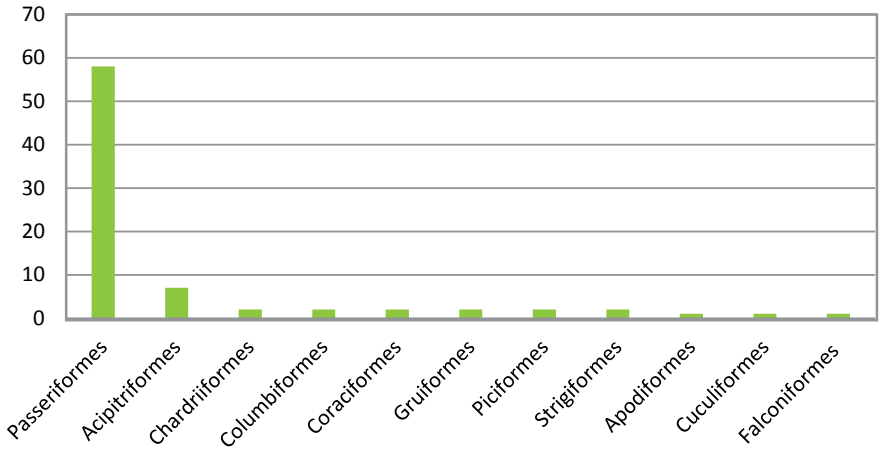

Fig. 3: Number of breeding species per order, KBA Vlora Bay-Karaburun-Çika Mountain, March and May2016.

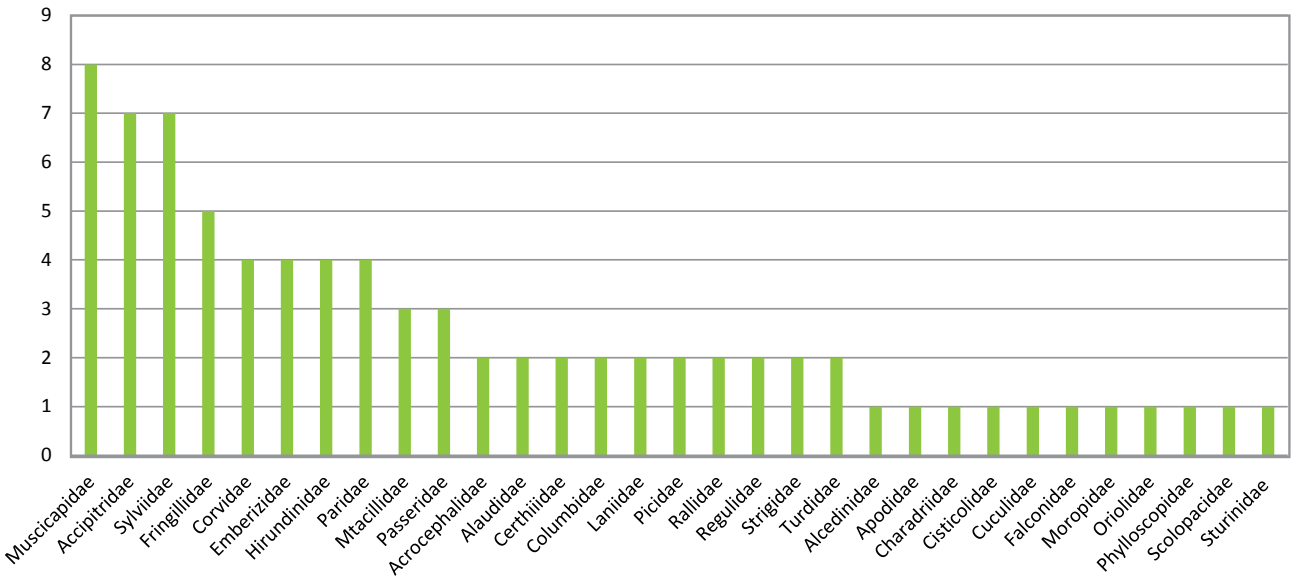

Fig. 4: Numbers of breeding bird species per bird family, KBA Vlora Bay-Karaburun-Çika Mountain, March and May 2016.

4.3 Migratory birds

A total of 3,382 individual birds (ind.) from 49 species which belong to 12 orders and 25 bird families were registered as spring migrants (see Fig. 5 and Fig. 6). The dominant orders are the Passeriformes (51%), followed by the Charadriiformes (14%) and the Pelicaniformes (8%). The species with the highest number of migrants is the Barn Swallow (*Hirundo rustica*), followed by Mediterranean Gull (*Larus melanocephalus*), Alpine Swift *(Tachymarptis melba),* Pygmy Cormorant (*Microcarbo pygmaeus*), Common Coot (*Fulica atra*) and the Yellow Wagtail (*Motacilla flava*).

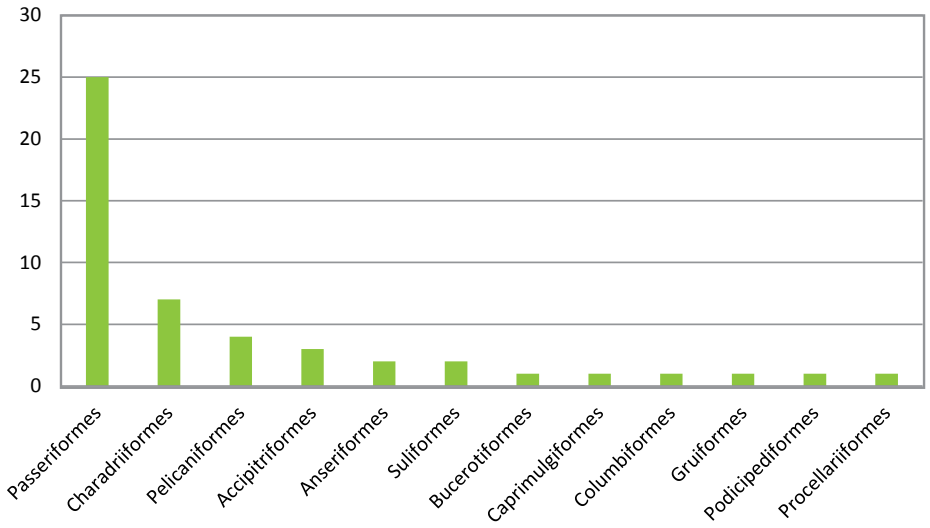

Fig. 5: Total numbers of migratory bird species per order, KBA Vlora Bay-Karaburun-Çika Mountain, March and May 2016.

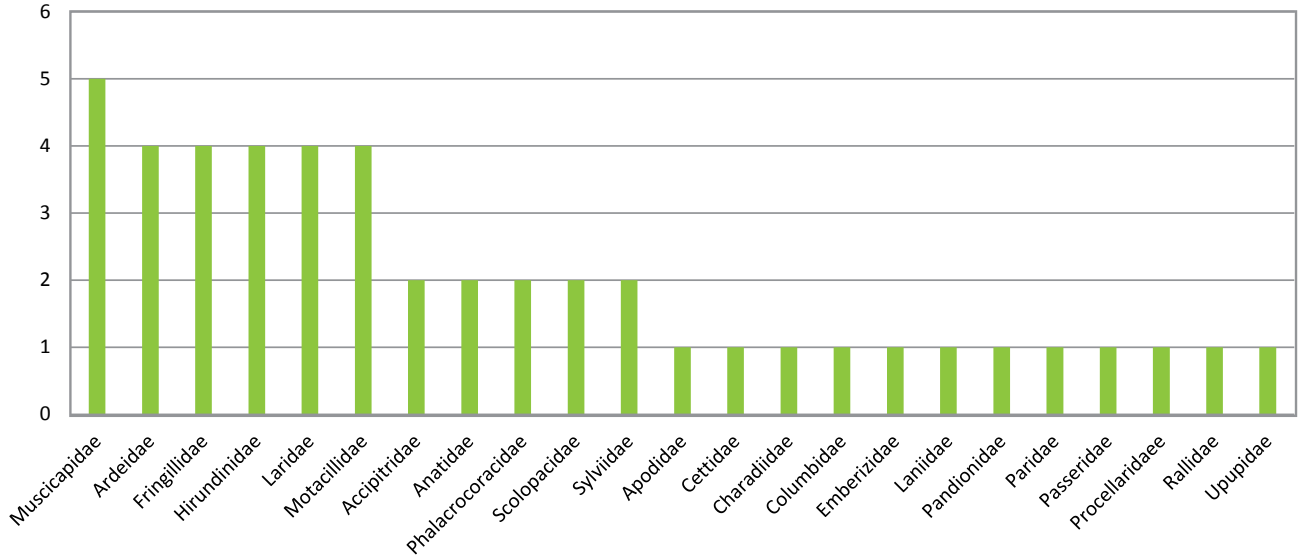

Fig. 6: Total numbers of migratory bird species per bird family, KBA Vlora Bay-Karaburun-Çika Mountain, March and May 2016.

4.4 Important sites and habitats

Orikumi Lagoon, Vlora Bay and the Marine National Park Sazan-Karaburun are particularly important areas for migrating birds. The most abundant migrant species registered in the area of the Orikumi Lagoon are Barn Swallow, Mediterranean Gull and Alpine Swift. In addition, the area of the lagoon which is covered with *Juncus*, seems to harbour a dense breeding population of Zitting Cisticola (*Cisticola juncidis*).

Vlora Bay is an important area for seabird migration, such as the Yelkouan Shearwater (*Puffinus yelkouan*) which was observed regularly feeding in the area between Karaburun Peninsular and Sazan Island.

The National Park of Llogara and Çika Mountain are territories with a mountainous climate and mountain habitats that support a variety of typical mountain, rock and forest species such as the Coal Tit (*Parus ater*), Goldcrest (*Regulus regulus*), Firecrest (*R. ignicapillus*) and Rock Thrush (*Monticola saxatilis*). A pair of Golden Eagle was regularly observed in the area. A calling Tawny Owl (*Strix aluco*) was registered in Llogara National Park in March in an old and well preserved forest which suggests to form a suitable habitat for owls. A group of *Pyrrhocorax* sp. was observed from a very great distance (impossible for identification at the species level) while feeding on the slopes of Çika Mountain.

Karaburun Peninsular and the mountain range of "Rreza e Kanalit" are areas with a typical Mediterranean avifauna. The dominant species are the Subalpine Warbler, Sardinian Warbler (*Sylvia melanocephala*), Black-eared Wheatear (*Oenanthe hispanica*) and Linnet (*Carduelis cannabina*). The area also supports breeding pairs of Golden *(Aquila chrysaetos)* and Short-toed Eagle (*Circaetus gallicus*).

4.5 Threats

The main threats for the avifauna that we noted in the area, are (i) pollution with solid waste, (ii) poaching, (iii) electrocution and (iv) habitat loss. In the lowland habitats of the area (coastline, sea, arable fields, channels, etc.), considerable pollution with trash were noted, particularly, with plastics. Cartridges constituted clear evidence for illegal hunting even during the time when a total hunting ban in Albania was in power. In addition, electric poles and pylons dangerous for birds are present all over the area, exposing many species of birds to electrocution and collision. Moreover, habitat loss due to the construction of tourist infrastructure poses a serious threat, particularly for coastline habitats.

5. Discussion

Although the KBA Vlora Bay – Karaburun – Çika Mountain is known to shelter a high biodiversity, no detailed and systematic study of the breeding bird fauna existed. The present paper represents the most complete study so far conducted on the breeding bird fauna by adding new data to the knowledge of the biodiversity of the area (MedWetCoast 2004, Borghezi 2013, Iankov *et al*. 2014, Rajkovic & Kromidha 2014).

The area holds a number of species of national and international conservation concern. Out of the total number of 110 bird species which we have recorded in the area, 5 species (4.5%) are of global conservation concern, i.e. 3 species which are classified as "Vulnerable" and 2 species as "Near Threatened" in the IUCN Red List of Threatened Species. Moreover, 9 species (8.1%) are "Threatened" or "Near Threatened" according to the European Red List of Threatened Species (BirdLife International 2015). 37 species are listed in the annexes of the European Union's Birds Directive (17 species in annex I, 5 species in annex II/A, 11 species in annex II/B, 2 in annex III/A and 2 species in annex III/B). Additionally, a total of 103 species are listed in the annexes

of the Bern Convention. In the appendixes of the Convention for Migratory Species (CMS) and of the African-Eurasian Waterbird Agreement (AEWA) 49 and 19 species are listed, respectively. All the raptor species which were observed in the area, are part of the Raptor Memorandum of Understanding (Raptor MoU) list of species and 69 species are in the list of the African-Eurasian Migratory Landbirds Action Plan (AEMLAP). In the appendixes of the CITES convention 12 species and, last but not least, 22 species of national conservation concern are listed in the Red Book of the Albanian Flora and Fauna.

The first group of globally threatened species is represented by the European Turtle-dove (*Streptophelia turtur*), Common Kingfisher (*Alcedo atthis*) and the Yelkouan Shearwater. The first two species breed in the area, whereas more research on the status of Yelkouan Shearwater in the area is needed. "Near Threatened" species on the global scale are the Meadow Pipit (*Anthus pratensis)* and Hen Harrier (*Circus cyaneus)*. "Vulnerable" species according to the European Red List are Common Kingfisher, Meadow Pipit (*Anthus pratensis)*, Corn Bunting (*Miliaria calandra)*, Yelkouan Shearwater, Garganey (*Spatula querquedula)*, and European Turtle-dove. "Near Threatened" according to the European list are the Goldcrest, Common Coot and European Shag.

Although the current survey is a valuable contribution to the knowledge of the breeding bird fauna of the area, there are still some gaps. In particular, the cliffs in the western part of Karaburun Peninsular should be checked for the nesting of seabirds, like European Shag, Yelkouan Shearwater and gulls. Moreover, Orikumi Lagoon was visited only early in the breeding season in late March. Hence, additional research in the area later in the breeding season is needed. Furthermore, additional research is needed on Çika Mountain and in the higher areas in the south-western part of the Karaburun Peninsular for upland bird species.

The major part of the area lies within the Albanian National Network of Protected Areas (NAPA 2018) and, consequently, has some level of protection and management by the authorities. However, illegal activities such as poaching still occur. In addition, electric poles and pylons show a high risk for electrocution and collisions by birds. These problems need to be addressed. Overall, the area shows great potentials for the development of sustainable nature tourism (Iankov *et al*. 2015) which will provide an alternative to the encroachment of natural habitats by the construction of massive tourism infrastructure.

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Waterbird Count Nov 2017 Velika Plaza

Waterbird counting on Velika Plaža, Ulcinj, Montenegro, November 2017

Trends of wintering waterbirds in the eastern Adriatic

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Summary

In 2017, Wetlands International produced flyway population trends from the start of reliable International Waterbird Counts up to 2015, based on producing first national trends and using the available information to produce flyway trends. The results of these trend analyses inform the listing of various waterbird species on Table 1 of the African-Eurasian Migratory Waterbird Agreement (AEWA) but the national trends are also highly relevant for national decision-makers. This paper presents the results of the analysis for the eastern Adriatic region in the context of the results for the whole Black-Sea Mediterranean Flyway.

Keywords

waterbirds, population trends, flyway

1. Introduction

Reliable estimates of waterbird population status and trends are the basis of informed conservation and management actions. These depend on comprehensive and consistent monitoring programmes, such as the International Waterbird Census (IWC), a global site based count held every January from the late 1960's to present. In 2017, Wetlands International produced flyway population trends from the start of reliable IWC counts of a species until 2015 (Nagy & Langendoen 2017). The results of these trend analyses are of international significance as they inform the listing of various waterbird species on Table 1 of the African-Eurasian Migratory Waterbird Agreement (AEWA). Flyway trends are also highly relevant for national decision-makers, providing important context for national or regional trends. This paper presents the trend results for the eastern Adriatic in the context of the results for the whole Black-Sea Mediterranean Flyway and examines the conservation and management implications for the northern Adriatic countries.

Tab. 1: Results of the trend analyses for the 19 study species in the northern Adriatic and the Black Sea-Mediterranean flyway.

	Northern Adriatic trends					
	Long-term trend			Short-term trend		
Species	*Period*	*Annual rate of change*	*Classification*	*Period*	*Annual rate of change*	*Classification*
A. acuta	1993-2015	0.9321 (SE 0.0374)	uncertain	2006-2015	1.0067 (SE 0.1359)	uncertain
A. crecca	1993-2015	0.9252 (SE 0.0199)	steep dec	2006-2015	0.941 (SE 0.0688)	uncertain
A. platyrhyn.	1988-2015	0.9734 (SE 0.014)	uncertain	2006-2015	0.8696 (SE 0.0674)	uncertain
A. ferina	1987-2015	0.9699 (SE 0.0263)	uncertain	2006-2015	0.8775 (SE 0.1105)	uncertain
A. fuligula	1990-2015	0.9606 (SE 0.0311)	uncertain	2006-2015	1.0317 (SE 0.1218)	uncertain
B. clangula	1997-2015	0.8965 (SE 0.0277)	steep dec	2006-2015	0.7986 (SE 0.0728)	steep dec
C. minuta	1993-2015	0.9913 (SE 0.0042)	moderate dec	2006-2015	0.998 (SE 0.0094)	uncertain
F. atra	1987-2015	1.0117 (SE 0.027)	uncertain	2006-2015	0.9553 (SE 0.1147)	uncertain
L. ridibundus	1992-2015	1.0161 (SE 0.0266)	uncertain	2006-2015	1.0248 (SE 0.0834)	uncertain
M. penelope	1993-2015	0.9564 (SE 0.0324)	uncertain	2006-2015	0.9682 (SE 0.1047)	uncertain
M. strepera	1987-2015	1.0227 (SE 0.0475)	uncertain	2006-2015	0.9777 (SE 0.1597)	uncertain
M. albellus	1997-2015	0.9271 (SE 0.0813)	uncertain	2006-2015	0.9968 (SE 0.2522)	uncertain
M. serrator	1993-2015	0.961 (SE 0.0045)	steep dec	2006-2015	0.914 (SE 0.0145)	steep dec
M. pygmaeus	1991-2015	0.9845 (SE 0.0323)	uncertain	2006-2015	1.1417 (SE 0.1271)	uncertain
Ph. carbo	1991-2015	1.0391 (SE 0.0559)	uncertain	2006-2015	1.041 (SE 0.178)	uncertain
P. cristatus	1992-2015	0.9593 (SE 0.0217)	uncertain	2006-2015	0.9434 (SE 0.067)	uncertain
R. avosetta	1993-2015	0.8809 (SE 0.002)	steep dec	2006-2015	0.8317 (SE 0.0063)	steep dec
S. clypeata	1993-2015	0.8926 (SE 0.0256)	steep dec	2006-2015	0.8789 (SE 0.0791)	uncertain
T. ochropus	2002-2015	0.9476 (SE 0.0336)	uncertain	2006-2015	0.8882 (SE 0.0523)	steep dec
Multi spp.	1992-2015	0.9609 (SE 0.0074)	moderate dec	2006-2015	0.9472 (SE 0.0249)	moderate dec

	Black Sea-Mediterranean Flyway trends					
	Long-term trend			Short-term trend		
Species	*Period*	*Annual rate of change*	*Classification*	*Period*	*Annual rate of change*	*Classification*
A. acuta	1993-2015	1.0002 (SE 0.0105)	uncertain	2006-2015	0.9256 (SE 0.0313)	steep dec
A. crecca	1993-2015	1.0365 (SE 0.009)	strong inc	2006-2015	1.0609 (SE 0.0298)	moderate inc
A. platyrhyn.	1998-2015	1.0159 (SE 0.0137)	uncertain	2006-2015	1.0294 (SE 0.0288)	uncertain
A. ferina	1987-2015	0.9779 (SE 0.007)	steep dec	2006-2015	0.9884 (SE 0.0327)	uncertain
A. fuligula	1990-2015	0.9722 (SE 0.0089)	steep dec	2006-2015	0.967 (SE 0.034)	uncertain
B. clangula	1997-2015	0.9333 (SE 0.021)	steep dec	2006-2015	0.8436 (SE 0.0499)	steep dec
C. minuta	1993-2014	0.9506 (SE 0.0118)	steep dec	2006-2014	0.9107 (SE 0.0406)	steep dec
F. atra	1987-2015	1.009 (SE 0.0061)	stable	2006-2015	0.9826 (SE 0.0248)	uncertain
L. ridibundus	1992-2015	1.013 (SE 0.0155)	uncertain	2006-2015	1.0304 (SE 0.0528)	uncertain
M. penelope	1993-2015	0.9886 (SE 0.0073)	uncertain	2006-2015	0.9813 (SE 0.0226)	uncertain
M. strepera	1987-2015	1.029 (SE 0.0109)	strong inc	2006-2015	1.0021 (SE 0.0446)	uncertain
M. albellus	1997-2015	0.9566 (SE 0.0225)	uncertain	2006-2015	0.964 (SE 0.062)	uncertain
M. serrator	1993-2015	0.9315 (SE 0.0216)	steep dec	2006-2015	0.9586 (SE 0.072)	uncertain
M. pygmaeus	1991-2015	1.031 (SE 0.0293)	uncertain	2006-2015	1.0838 (SE 0.1002)	uncertain
Ph. carbo	1991-2015	1.0272 (SE 0.008)	strong inc	2006-2015	1.0123 (SE 0.0272)	uncertain
P. cristatus	1992-2015	1.0246 (SE 0.0106)	moderate inc	2006-2015	1.0482 (SE 0.0342)	uncertain
R. avosetta	1993-2015	1.0087 (SE 0.0115)	uncertain	2006-2015	1.0011 (SE 0.0352)	uncertain
S. clypeata	1993-2015	1.0158 (SE 0.0077)	moderate inc	2006-2015	0.9878 (SE 0.0243)	uncertain
T. ochropus	2002-2015	1.0168 (SE 0.0304)	uncertain	2006-2015	1.0151 (SE 0.0465)	uncertain
Multi spp.	1992-2015	1.0007 (SE 0.0031)	stable	2006-2015	0.9892 (SE 0.0108)	stable

Tab. 2. Trend classification (modified from Soldaat *et al.* 2017). D = multiplicative annual rate of change, CL = confidence limit.

Category	Trend criteria/description
Strong increase	lower CL > D+ (significant increase of more than D+ per year)
Moderate increase	1.00 < lower CL < D+ (significant increase, but not significantly more than D+ per year)
Stable	CI includes 1.00 AND 1 - D- ≤ lower CL AND upper CL ≤ 1 + D+ (no significant increase or decline, likely that changes are smaller than D± per year)
Uncertain	lower CL < 1 - D- AND 1 + D+ < upper CL (no significant increase or decline, unlikely that changes are smaller than D± per year).
Moderate decline	D- < upper CL < 1.00 (significant decline, but not significantly more than D- per year)
Steep decline	upper CL < D- (significant decline of more than D- per year)

2. Methods

The eastern Adriatic encompasses Slovenia, Serbia, Montenegro, Croatia, North Macedonia, Bosnia & Herzegovina, and Albania. These countries fall within the Black Sea-Mediterranean flyway (hereafter: the flyway), which extends from Arctic Russia to West Africa and is centered on the Black and Mediterranean seas.

Long-term trends were calculated for the flyway and eastern Adriatic region from the earliest year possible (often 1991) until 2015 and short-term trends from 2006-2015. The trends were based on counts collected under the IWC. To reduce the influence of sporadically or inconsistently counted sites, counts were only used from sites visited both before and after 2003, i.e. approximately the midpoint of the long-term trend. Sufficient count data were available for 19 species (Tab. 1), predominately Anatidae (11 species), from 2785 sites across the flyway, including 280 sites in the eastern Adriatic. Trends were produced for each species, as well as a multispecies trend combining all species. We used the R-version of TRIM (Bogaart *et al.* 2016) and smoothed the index values with the MSI-tool (CBS 2017, Soldaat *et al.* 2017), following the procedure established for the 7th edition of the African-Eurasian Conservation Status Review (Nagy & Langendoen 2017).

3. Results

In the eastern Adriatic, 6 species had statistically significant declining long-term trends with a further 9 species showing a declining tendency (Tab. 1). In contrast, none of the 19 analyzed species showed a significantly positive long-term trend and only 4 species showed a positive tendency. In the flyway, 5 species had significantly declining long-term trends and 2 species showed a declining tendency. The remaining flyway trends were either stable (1), increasing (5) or fluctuating with a positive tendency (6).

The short-term trends showed on average a more negative trend than the trends over the overall, both for the eastern Adriatic (average short-term trend = 0.9518, average long-term trend = 0.9604) and the flyway (average short-term trend = 0.9891, average long-term trend = 0.9968).

The eastern Adriatic multispecies trend was a statistically significant moderate decline both in the long-term (0.9609, SE 0.0074) and in the last 10 years (0.9472, SE 0.0249). The flyway multispecies trend was stable both in the long-term (1.0007, SE 0.0031) and in the last 10 years of the trend (0.9892, SE 0.0108).

The combined species trends show no discernible spatial pattern, with countries both to the north and south of the eastern Adriatic having a mix of increasing, decreasing and stable trends (Fig. 1).

Fig. 1: National multispecies trends across 19 waterbird species (see Tab. 1) for the countries along the Black Sea-Mediterranean Flyway. Country codes as follows: AL=Albania, AT=Austria, BA=Bosnia & Herzegovina, BE=Belgium, BF=Burkina Faso, BG=Bulgaria, BJ=Benin, CH=Switzerland, CI= Côte d'Ivoire, CM=Cameroon, CY=Cyprus, CZ=Czechia, DE-CE=Germany (Central European), DE-NW=Germany (North-western Europe),DZ=Algeria, EG=Egypt, ES=Spain, FR-CE=France (Central Europe), FR-NW=France (North-western Europe), FR-WM France (West Mediterranean), GB=United Kingdom, GE=Georgia, GH=Ghana, GN=Guinea, GR=Greece, GW=Guinea-Bissau, HR=Croatia, HU=Hungary, IE=Ireland, IL=Israel, IT=Italy, JO=Jordan, MA=Morocco, ME=Montenegro, MK=Northern Macedonia, ML=Mali, MR=Mauritania, NE=Niger, NG=Nigeria, NL=Netherlands, PT=Portugal, RO=Romania, RS=Serbia, RU-EM=Russian Federation (East Mediterranean), SI=Slovenia,, SK=Slovakia, SL=Sierra Leone, SN=Senegal, TD=Chad, TG=Togo, TN=Tunisia, TR=Turkey, UA=Ukraine.
X-axis: time; Y-axis: imputed number of birds across all analyzed sites in country for the given year.

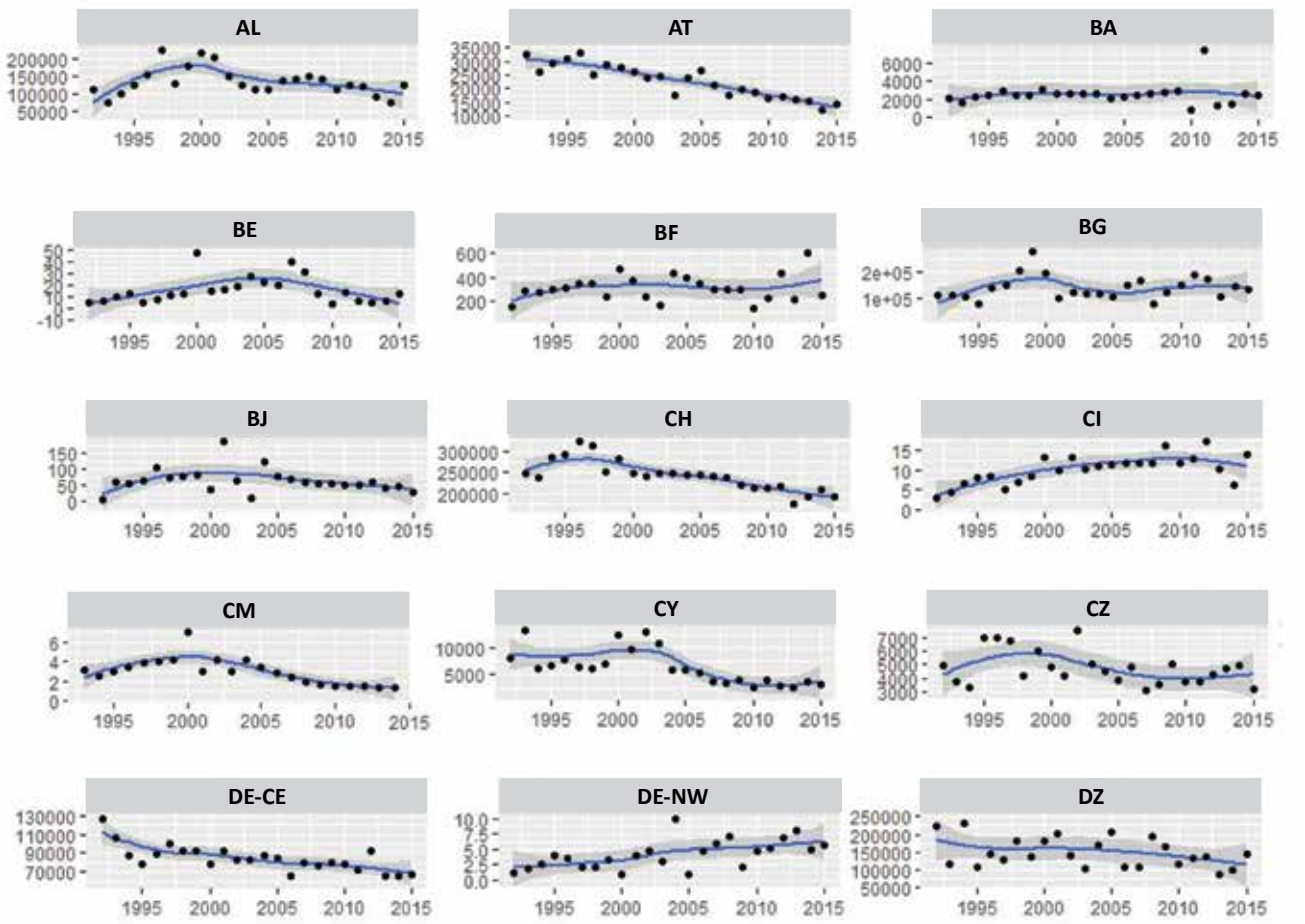
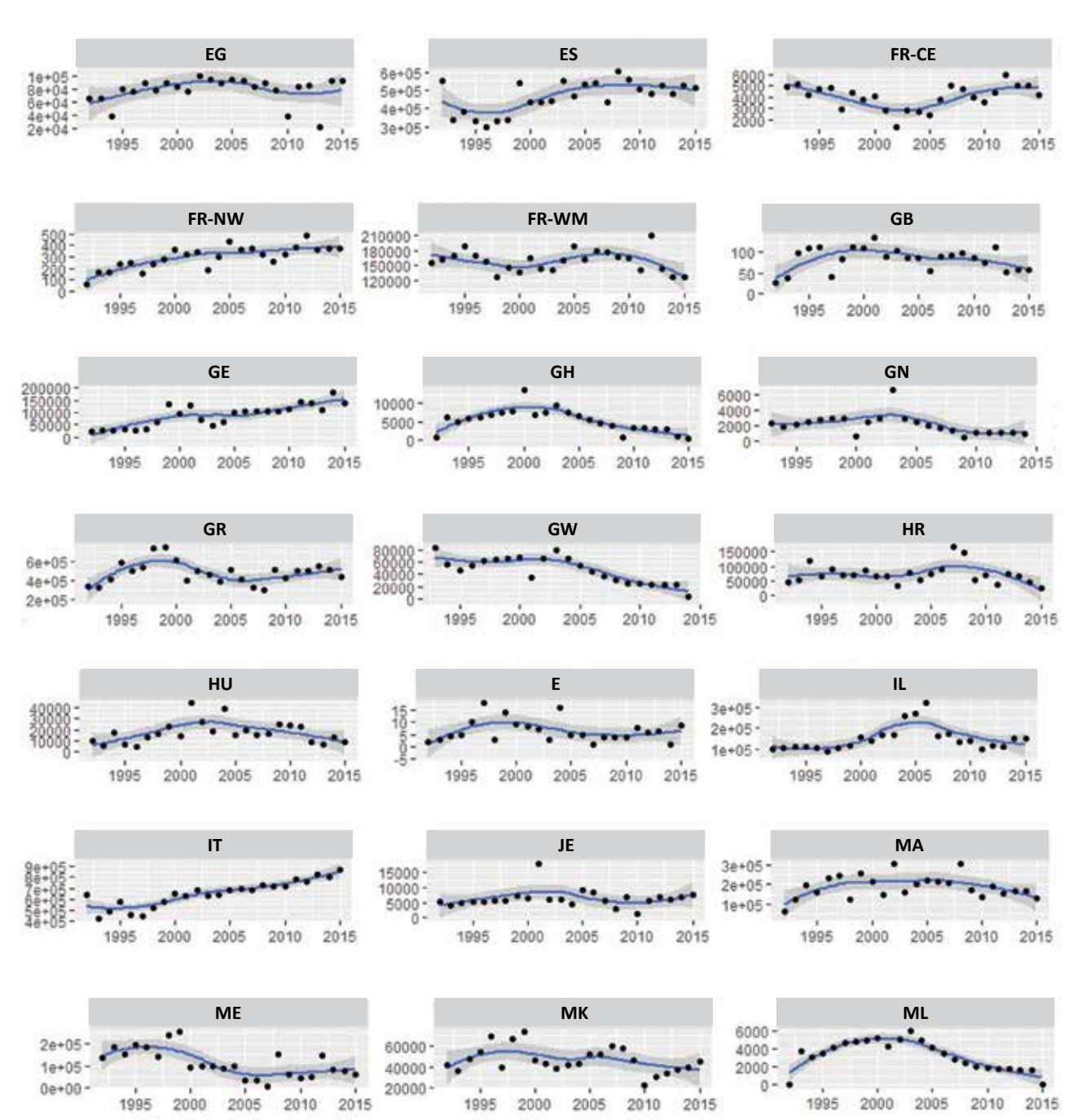
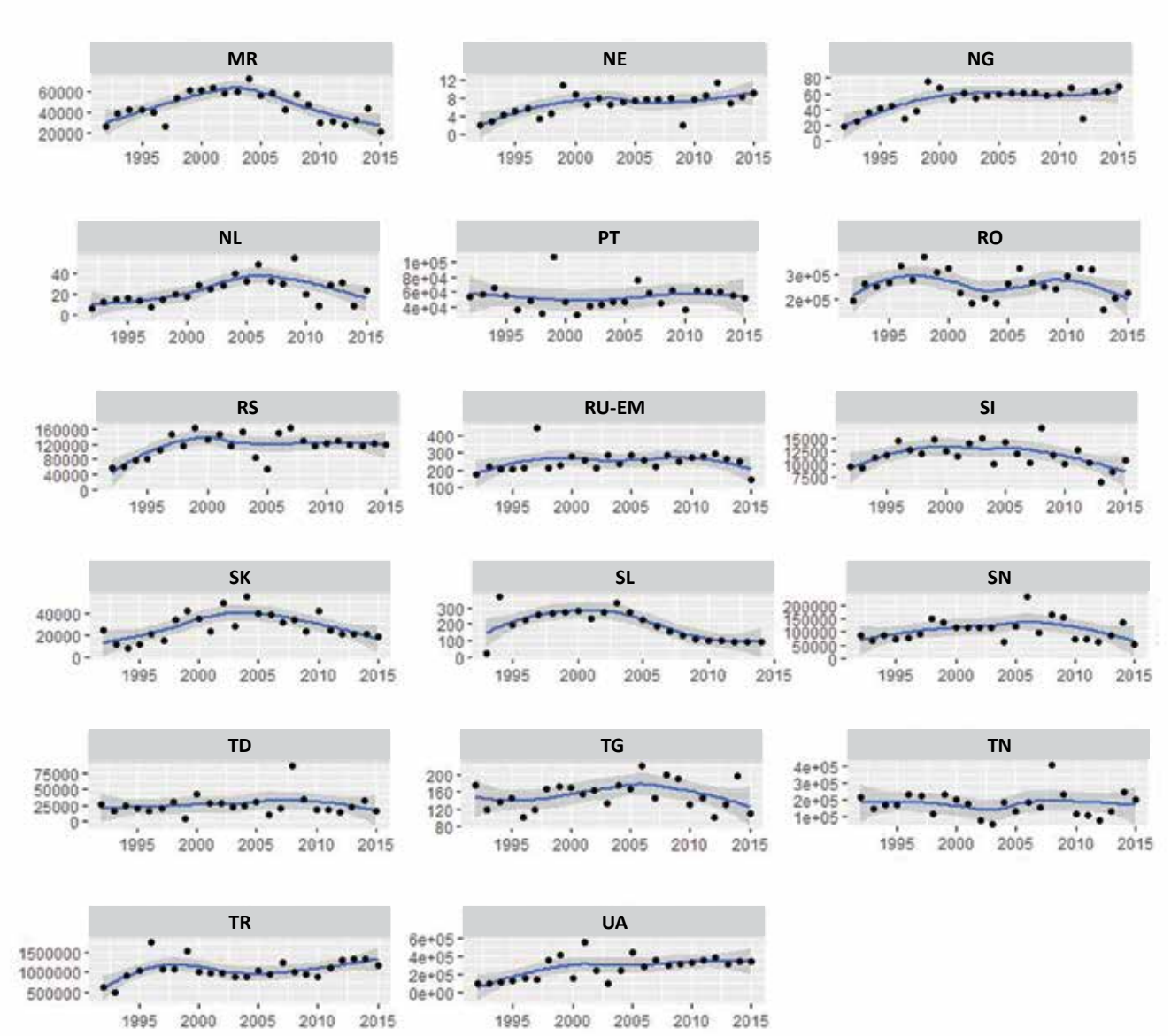


Fig. 1 (continued)

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Discussion

On a multispecies level, the counts from the IWC show a declining trend in the eastern Adriatic for the 19 study species, which appears to have accelerated in the last 10 years of the trend, and contrasts with an long-term stable trend for the Black-Sea Mediterranean flyway. This result is in line with a previous study that found that the conservation status of 77 populations with known population trends is less favorable along the Adriatic Flyway compared to other parts of Europe (Nagy *et al* 2010). Based on the pattern of national trends across the flyway, there is no indication from the IWC that the northern Adriatic declines are caused by a shift in distribution. This suggests that the drivers of decline in the region are local factors which will require local action.

This study demonstrates the importance of the IWC in providing international context for local trends and estimates of annual change rates for populations. Whilst monitoring schemes such as the IWC cannot directly explain the drivers behind these diverging trends, they can identify internationally and nationally important sites for waterbirds and alert managers to site or national level population changes. These are important steps to prioritise and inform management actions such as the establishment of protected areas or non-hunting areas or the adaptation of the list of huntable species and their respective hunting seasons. Further studies and data collection efforts would then be needed to investigate the local drivers of these changes. One topic requiring more study and information is the extent and impact of legal and illegal waterbird harvest in the region (but see Schneider-Jacoby & Spangenberg 2010, Durst & Mikuška 2017). Many of the species in this study are important quarry species across the eastern Adriatic region, such as the Common Teal *Anas crecca*, a steeply declining species in the eastern Adriatic but strongly increasing across the flyway. Bag statistics and estimates of the numbers killed illegally (see e.g. Brochet *et al.* 2016, Mikuška *et al.* 2017), together with waterbird monitoring data could contribute to adaptive harvest management and constructive collaboration with responsible hunting organisations.

Given the value of national waterbird monitoring schemes like the IWC for informed management, strengthening these schemes must be a high priority. The IWC is a low cost monitoring programm, with counts in the easternb Adriatic relying heavily on small networks of dedicated volunteers and NGOs to cover large and complex wetland sites. This reliance can leave a national counting effort vulnerable to loss of qualified personnel, shortage of equipment or insufficient funding to travel to the count areas. Improved and ongoing support from governments in the region is needed to ensure the strengthening and continuation of this scheme, increase capacity across the region for waterbird monitoring and expand monitoring efforts into other seasons.

These actions will not only provide essential management-relevant information for governments in the eastern Adriatic but also be important steps to meet international obligations and improve the effectiveness of governance, a key determinant for successful conservation of waterbird populations (Amano *et al.* 2018). Currently 5 of the eastern Adriatic countries are signatories to the African-Eurasian Waterbird Agreement (AEWA), a treaty which requires contracted parties to work towards the conservation and sustainable management of migratory waterbirds. Furthermore, all countries in the region are either members, candidates or potential candidates for the European Union which requires reporting for both huntable and protected species under the Birds Directive. Closer collaboration and engagement with such international bodies will ultimately support eastern Adriatic countries in their efforts to reverse the declining trends for waterbirds in the region.

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Photo: Đurđe Đuković

Broad-billed Sandpiper (*Limicola falcinellus*), Labudovo Okno, Serbia, 2020

An analysis of the International Waterbird Census (IWC) results in the IBA Labudovo okno, Serbia, between 2012 and 2018

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Summary

In the period from 2012 – 2018 annual International Waterbird Censuses (IWCs) were carried out in the IBA Labudovo okno, Serbia (RS033). Counts were conducted between 10 and 30 January in 14 subareas of the IBA (bays, river islands, main flow, secondary branche) on the Danube River. Not all localities could be visited each year due to various reasons (weather conditions, availability of vessels). In total 49 waterbird species were recorded in Labudovo okno during seven years of waterbird counting together with an additional 9 species of birds of prey and passerines that were also attracted to water habitats. Labudovo okno is one of the areas with the most diverse and abundant fauna of wintering waterbirds in Serbia. Following to count numbers a slight majority of waterbird species were rare and irregular visitors (28 species or 57%) with less than 50 birds per count. In contrast, 21 species were numerous and regular (43%) with more than 50 birds recorded at least during one count. All other non-waterbird species were also rare and irregular. The most numerous and important wintering species are Great White-fronted Goose (*Anser albifrons*), Graylag Goose (*Anser anser*) and Mallard (*Anas platyrhynchos*), followed by Black-headed Gull (*Larus ridibundus*), Pochard (*Aythya ferina*), Tufted Duck (*Aythya fuligula*), Pygmy Cormorant (*Microcarbo pygmaeus*), Coot (*Fulica atra*), Common Goldeneye (*Bucephala clangula*) and Smew (*Mergellus albellus*). From the conservation perspective the most important and internationally threatened species that overwinter in the IBA Labudovo okno are Red-breasted Goose (*Branta ruficollis*), Ferruginous Duck (*Aythya nyroca*), Black-throated Diver (*Gavia arctica*), Red-throated Diver (*Gavia stellata*), Smew, Horned Grebe (*Podiceps auritus*), Long-tailed Duck (*Clangula hyemalis*) and Velvet Scooter (*Melanitta fusca*) and from birds

of prey Greater Spotted Eagle (*Clanga clanga*). The IBA was the most important wintering site of Greylag and Great White-fronted Goose in Serbia during the survey period from 2012 - 2018. Significant fluctuations of bird numbers and the presence of different species were observed between years. These differences probably result from weather conditions during winters in Serbia, Northern and Eastern Europe as well as some other uncertain factors. The present paper demonstrates the significance of data about site coverage and ice coverage as crucial for quantitative and qualitative analyses of IWC sites, but, if possible, other factors like weather conditions (fog, wind, snowfall) and disturbances (hunting) should be also taken into account.

Keywords

IWC, waterbirds, Danube River, Serbia, bird fauna, IBA Labudovo okno

1. Introduction

The Internatinoal Waterbird Census (IWC) is a monitoring programme that operates in 143 countries. Its aim is to collect information on the numbers of wintering and migrating waterbirds in wetland sites. Five separate regional schemes of the IWC represent the major flyways of the world: Africa-Eurasia, Asia-Pacific, Caribbean, Neotropics and Central America. The major contributors to waterbird monitoring are volunteer birdwatchers who participate in the IWC because they find counting birds enjoyable and rewarding. Many thousands of volunteers join the count every year, making it one of the largest citizen science programmes in the world. In most countries the census is coordinated by professionals and in many countries professionals also carry out much of the fieldwork (although often on a voluntary basis). Various waterbird populations require different monitoring schemes. The IWC requires a single count at each site that should be later repeated every year. The precise counting dates vary slightly from region to region but take place in January or February (Wetlands International).

In Serbia IWCs are conducted with varying intensity since 1982. Until 2010, the counts focused on the Danube River (the most important and greatest winter gathering area for waterbirds in Serbia). Since 2012, the focus was expanded to all categories of aquatic habitats, including also slums and landfills where waterbirds, mainly gulls, also gather during winter. Since the start of the IWC in Serbia counting results are published occasionally (Puzović *et al.* 1988, Paunović *et al.* 1994, Barjaktarov *et al.* 2004). The only recent complete reports and analyses of the results were published in the magazine *Ciconia* in 2012 and 2013 (Šćiban *et al.* 2011, 2012a).

The Important Bird Area (IBA) Labudovo okno (IBA No. RS033) is one of the most important roosting and feeding site for waterbirds in Serbia (e.g., Puzović *et al.* 2009). Following to its importance for waterbird conservation the area was protected as a part of the Special Nature Reserve Deliblato Sands in 2002. Labudovo okno was also declared as an IBA in 1989 and as a Ramsar site in 2006 (Puzović *et al.* 2009). Additionally, in recent years interesting ornithological findings were published for the area (e.g., Brinkhuizen 2007, Đorđević *et al.* 2009, Puzović *et al.* 2009, Stojnić *et al.* 2010, Šćiban *et al.* 2012, Olajoš 2013/14, Šćiban & Stanojević 2013/14, Đorđević *et al.* 2015/16, Vučanović 2015/16), but a general and complex ornithological analysis is still missing for the area.

2. Study area

The IBA and Ramsar site Labudovo okno are not of the same size. The area of the Ramsar site (3,733 ha) is twice as small as the IBA (6,488 ha). The study area, i.e. the IBA, is situated between river kilometer 1090 and 1070 in the southeastern Banat region, northern Serbia. The IBA is further situated in

the vicinity of the villages Dubovac, Stara Palanka, Kličevac, Ram, Bazjaš and Zatonje. Besides the Danube River and its bays, the IBA also covers Ram hill (part of the Ramsko-golubačka sands), the mouth of the Nera River and the Vršački channel. The present paper analyses only data for the aquatic habitats of the IBA as well as for that part of the Danube shared with Romania between the mouth of the Nera River (Bazjaš village) and Zatonje village.

Labudovo okno is a unique partially flooded area characterised by wide slow-flowing waters and large river islands in the Danube River who is in some parts more then 3.3 km wide (Fig. 1). The flooded area was created in 1971 by the rising waters of the Danube after the completion of the hydropower plant "Đerdap 1". Large parts of the river islands, of alluvial forests and the mouths of tributary rivers were flooded upstream of the hydroelectric plant, while also the riverbed increased considerably along the left bank of the Danube (Puzović *et al.* 2009). All that created numerous sites where waterbirds can hide from the main river flow or the mainland, thus a multiple counting methodology is needed. The area includes 3 river islands (Žilava, Čibuklija and Zavojska ada), 1 wetland (Dubovac), 2 secondary river branches (Žilava and Ram Dunavac), 2 patches of floodplain forests (Veliki rit foreland and Rečica forland) and 4 bays (Đurica, the Nera river mouth, Bazjaš and Marina). The study area is also famous for very strong southeast winds, called *Košava*, an additional complication for the counts that reduces the number of "safe" days for counting.

Photo: Marko Šćiban

Fig. 1: View of the Danube River in Labudovo okno, Serbia, 21 January 2016

3. Methodology

The basics of the IWC methodology as used in Labudovo okno are simple. Various wetland habitats are separated into one or more monitoring areas which are defined by boundaries (polygons). IWC counts are conducted in January. During counts each site should be visited at least once. Because the IBA Labudovo okno is very large, we separated the total wetland area into 14 monitoring subareas (Fig. 2) that should be at least once visited on the same day. With the help of this methodology we can precisely calculate coverage and the quality of each count. Some sites within the research area can be reached only from the water by boats, while some subareas can be approached only from the ground (embankments) during the same day of fieldwork (Fig. 3). Therefore at least 2 counting teams are necessary per count, one from water and one or two from the ground for the left and right side of the river.

Counts were conducted during the day but also as evening or morning counts along flight corridors towards/from roosting sites which were crucial for estimating the population numbers for some groups of waterbids. Roost counts were challenging for organization due to specific methodologies and more counters which are neccessary. In the IBA Labudovo okno 3 different roost count methodologies were used – for geese, gulls and cormorants. For estimating the species composition of flocks, geese roost counts were organized from at least 4 observation points on the ground and from river island / boat (Fig. 4). Geese numbers per count were estimated on their night roost according to observations of species composition of roosting flocks. Gulls roosted in an area which was difficult to approach and did not overlap with geese counts. They were counted during the day and later during the flight towards roost site (Fig. 6). Two species of cormorants used separated roosting sites: Great Cormorant (*Phalacrocorax carbo*) roost within their breeding colonies on Žilava and Čibuklija river islands, while a huge roosting site of Pygmy Cormorant (*Microcarbo pygmaeus*) existed in Bazjaš bay on Romanian territory (Fig. 5). Figs 1 – 4. were created with help of Google Earth.

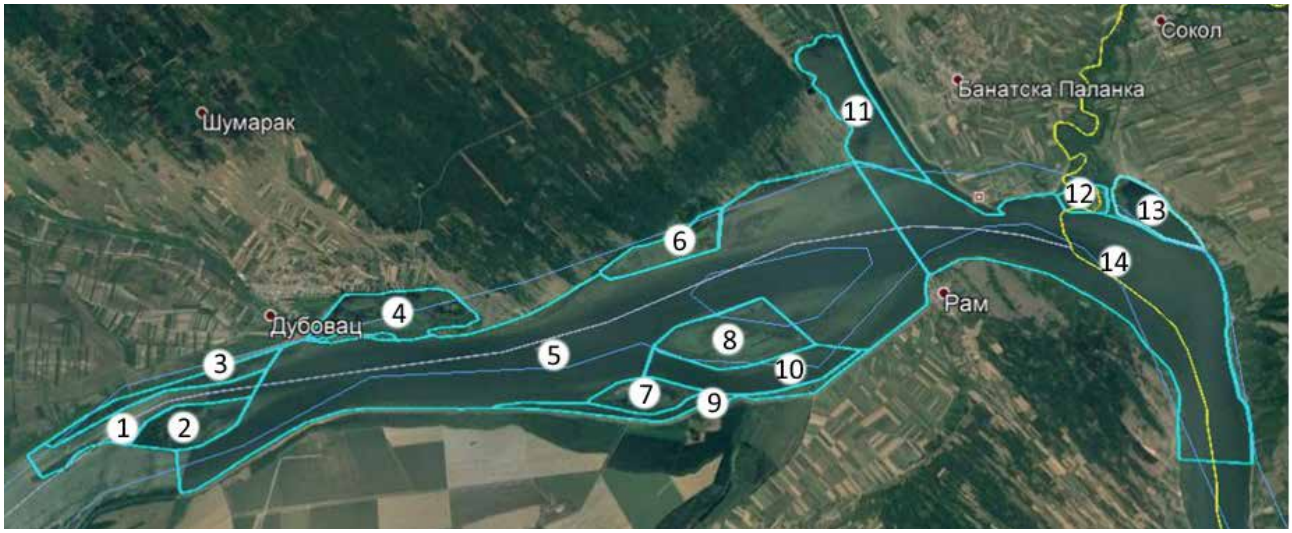

Fig. 2: Monitoring sites (subareas) used for IWC counts in the IBA Labudovo okno at the border between Serbia and Romania: 1 – Žilava Dunavac branch, 2 – Žilava river island, 3 – Veliki rit forland, 4 – Dubovac wetland, 5 – main Danube flow (river km 1090 – 1080), 6 – Marina bay, 7 – Zavojska ada river island, 8 – Čibuklija river island, 9 – Rečica forland, 10 – Čibuklija Dunavac branch, 11 – Đurica bay, 12 – Nera river mouth (Romania), 13 – Bazjaš bay (Romania), 14 – main Danube flow (river km 1080 – 1070) with the borderline to Romania in the middle of the river.

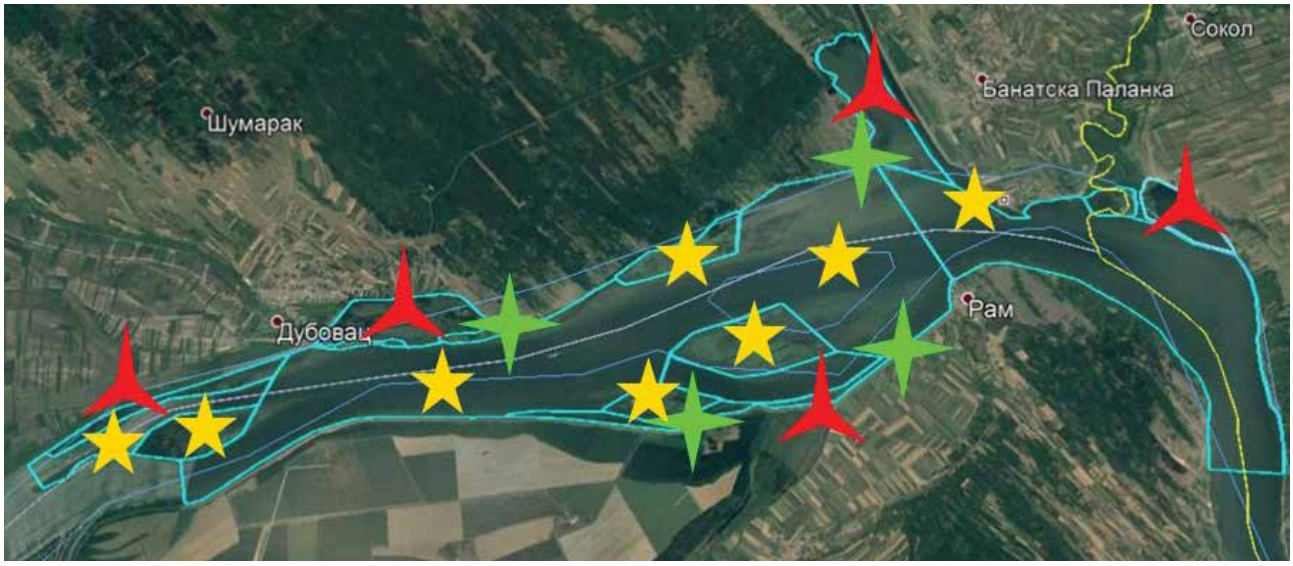

Fig. 3: Count areas that need specific methodologies: Red triangular stars – sites that are possible to count only from the ground (embankments), yellow stars – sites that are possible to count only from the water (boats), green quadruple stars – observation points for geese roosting counts.

Fig. 4: Location of observation points for evening roost counts of geese from the ground (red stars) and from inside of Čibuklija river island (blue star). The later was used only when the area was unfrozen.

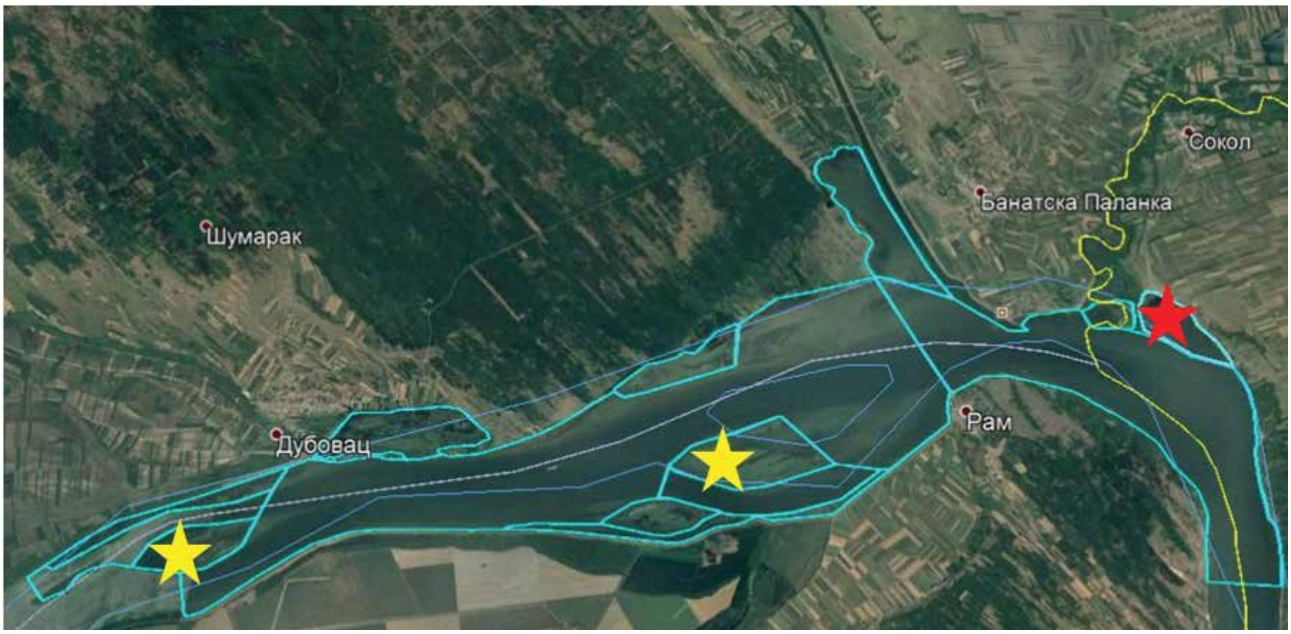

Fig. 5: Locations of observation points used for evening roost counts of Great Cormorant *Phalacrocorax carbo* (yellow stars) and Pygmy Cormorant *Microcarbo pygmaeus* (red star).

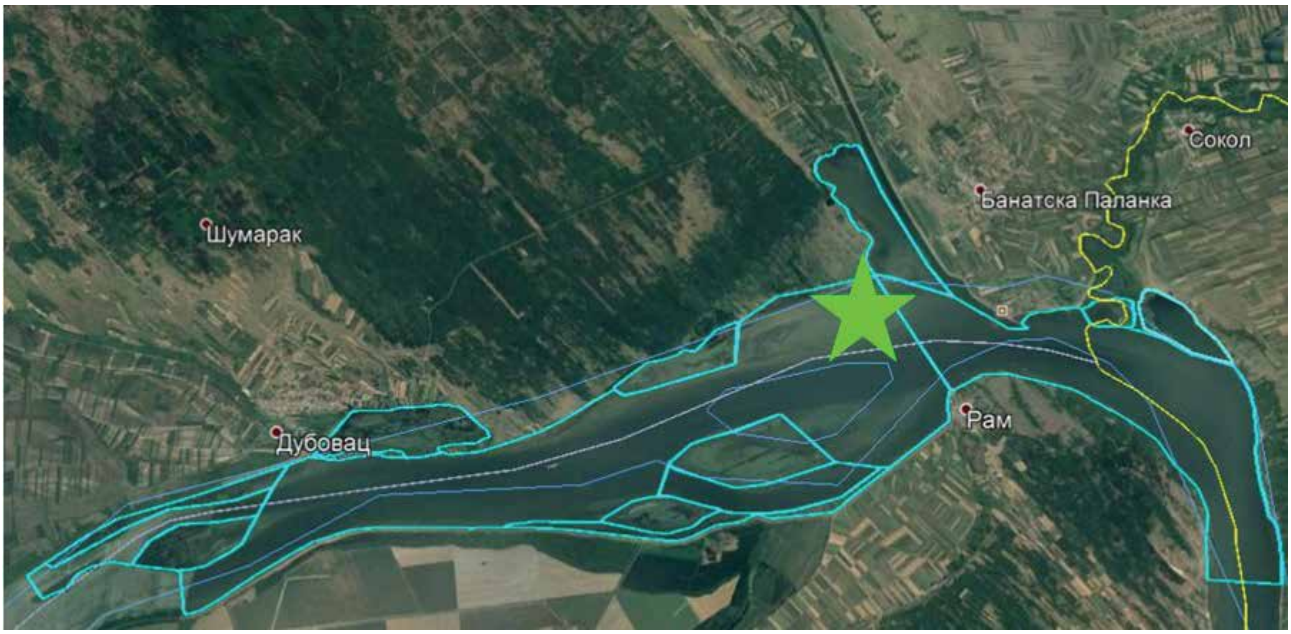

Fig. 6: The location of the gull roost site (green star).

Because it is necessary to count from both, the water and from the ground, and because multiple roosts have to be counted Labudovo okno is methodologically the most complicated area of all IWC sites in Serbia. Unfortunately, that resulted in different levels of coverage and differing accuracy of roost counts from year to year (Tab. 1). Data on bird numbers were collected by direct counting and in cases of high numbers of birds with the block method (Tucakov & Simić 2003). Fieldwork was mainly done by transect countings from boats or ships and by counting from the spot (Bibby *et al.* 1992). Besides waterbird numbers, the observers noted the coverage of the monitoring sites, quality of the count (direct counts, block methods, estimations), methodology used, water level, ice coverage and disturbances. Counts were comitted always during days with calm weather without strong winds, fog or precipitation (snow, rain). Telescopes were used on all occasions. Information on ice conditions and the coverage of different subareas were crucial to understand waterbird numbers and their changes from year to year. Ice cover and the general coverage of monitoring sites for the period 2012 – 2018 are shown in Tab. 1. Sites along the border with Romania were counted as complete waterbodies as shown in Fig. 1 because birds do not recognize political boundries and are constantnly on the move.

Tab. 1: Ice conditions and estimates of the coverage of different areas during IWC counts in the IBA Labudovo okno, Serbia, 2012 – 2018. Ice conditions: N – unfrozen, P – ice cover < 90%, C – 100% covered by ice. Coverage of area per count: E 100 - 75%, G 75 - 50%, M 50 - 25% and B 25 - 1% of the area covered by the count. NC marks areas that were not counted.

Site / year	2012	2013	2014	2015	2016	2017	2018
Žilava Dunavac	N, E	N, E	NC	NC	N, E	NC	N, E
Žilava island	N, E	N, E	NC	C, G	P, E	C, M	N, G
Veliki rit	NC	N, M	NC	NC	N, E	C, E	N, G
Dubovac wetland	N, G	N, E	N, E	N, E	P, E	C, G	N, E
Danube 1090-1080km	N, E	N, E	N, E	N, E	N, E	P, G	N, E
Marina bay	N, G	N, E	N, E	NC	N, E	NC	N, E
Zavojska island	NC	N, G	N, G	C, G	P, E	NC	N, G
Čibuklija island	N, E	N, E	N, E	C, G	C, E	C, G	N, E
Rečica forland	NC	NC	NC	N, G	NC	P, G	N, G
Čibuklija Dunavac	N, E	N, E	N, E	N, E	N, E	C, E	N, E
Đurica bay	N, E	N, E	N, E	N, E	C, G	C, E	N, E
Nera mouth	NC	N, E	NC	N, E	N, E	C, E	N, E
Bazjaš bay	NC	N, B	NC	N, G	NC	P, E	N, B
Danube 1080-1070km	NC	N, M	NC	N, E	N, M	P, E	N, M
Coverage (% sites)	**57%**	**95%**	**50%**	**85%**	**90%**	**90%**	**100%**
Ice coverage	**0%**	**0%**	**0%**	**10%**	**20%**	**95%**	**0%**

Results

During the period from 2012 – 2018 a total of 49 species of waterbirds were recorded during the IWC counts in the IBA Labudovo okno. An additional 9 species were attracted to water habitats (birds of prey, passerines) and were also almost annually recorded during the counts. The numbers of all species per year are presented according to the classification of Birdlife International (2014) in Tab. 2.

Tab. 2: Results of IWC counts in the IBA Labudovo okno, 2012 – 2018.

Species	2012	2013	2014	2015	2016	2017	2018
Cygnus olor	41	38	142	41	110	139	281
Cygnus cygnus	0	0	4	0	0	0	0
Branta bernicla	0	0	0	0	0	1	0
Branta ruficollis	0	0	15	4	0	3	0
Anser anser	7,650	2,306	1,641	27,900	1,329	21,705	111
Anser fabalis	4	0	0	0	2	0	0
Anser albifrons	14,902	37,507	725	17,408	16,841	17,109	473
Anser / Branta sp.	0	0	10,000	0	5,650	300	0
Clangula hyemalis	0	1	0	0	0	0	0
Melanitta fusca	0	3	7	0	0	0	0
Bucephala clangula	591	744	663	2,131	1,579	891	668
Mergellus albellus	281	539	220	2,091	406	441	384
Mergus merganser	0	0	0	13	35	31	6
Mergus serrator	0	0	0	2	0	0	0
Tadorna tadorna	6	0	2	0	49	0	1
Aythya ferina	1,045	2,254	2,593	1,695	1,322	922	3,715
Aythya nyroca	0	3	1	0	4	0	0
Aythya fuligula	71	133	515	1,478	239	681	157
Aythya marila	0	13	10	0	3	1	3
Aythya sp.	0	0	0	94	0	0	0
Spatula clypeata	10	0	0	0	1	0	0
Mareca strepera	514	323	145	53	880	2	139
Mareca penelope	53	12	1	12	221	0	22
Anas platyrhynchos	4,948	811	2,654	7,628	11,835	247	1,133
Anas acuta	3	1	2	0	37	0	10
Anas crecca	674	126	35	150	1,776	3	133
Anatidae (ducks)	0	0	0	0	0	1,000	0
Tachybaptus ruficollis	50	0	2	12	70	2	11
Podiceps cristatus	39	66	36	55	83	0	59
Podiceps auritus	0	0	0	0	0	0	4

Species	2012	2013	2014	2015	2016	2017	2018
Podiceps nigricollis	2	0	0	0	6	0	6
Rallus aquaticus	0	0	2	2	7	0	5
Galinulla chloropus	5	1	0	1	1	1	1
Fulica atra	1,555	1,328	1,443	3,224	3,115	1,029	2,354
Gavia stellata	1	0	0	0	1	1	3
Gavia arctica	6	0	2	0	1	1	1
Gavia sp.	0	0	0	3	1	0	0
Platalea leucorodia	0	0	3	0	0	0	0
Botaurus stellaris	0	0	0	0	0	0	1
Ardea cinerea	40	28	72	15	78	6	42
Ardea alba	111	23	83	12	50	1	42
Microcarbo pygmaeus	527	155	420	117	973	463	1,631
Phalacrocorax carbo	505	376	204	176	289	164	443
Recurvirostra avosetta	0	0	0	0	0	0	1
Vanellus vanellus	0	0	0	0	0	0	16
Gallinago gallinago	11	0	0	0	1	0	3
Actitis hypoleucos	1	0	0	0	0	0	0
Tringa ochropus	17	1	0	0	0	0	3
Larus ridibundus	427	609	905	855	128	150	206
Larus canus	6	123	65	3	393	0	66
Larus fuscus	0	0	0	0	0	0	1
Larus cachinnans / michahellis	54	413	344	113	3155	3,962	294
Alcedo atthis	5	2	1	3	0	0	4
Waterbirds Σ	**34,155**	**47,939**	**22,957**	**65,291**	**50,671**	**49,256**	**12,433**
Additional species							
Clanga clanga	2	2	1	0	2	1	5
Haliaeetus albicilla	14	23	12	21	30	9	13
Circus aeruginosus	0	10	0	0	10	0	5
Remiz pendulinus	0	0	1	0	0	0	1
Panurus biarmicus	0	5	0	0	0	0	19
Motacilla alba	2	1	1	0	0	0	0
Motacilla cinerea	1	0	0	0	0	0	0
Anthus spinoletta	0	4	0	0	0	1	0
Emberiza schoeniclus	15	15	1	0	13	0	3
Additional species Σ	34	60	16	21	55	11	46
Total Σ	**34,189**	**47,999**	**22,973**	**65,312**	**50,726**	**49,267**	**12,479**

Discussion

The data presented in Tab. 2 show that the annual totals of waterbirds fluctuated from nearly 23,000 to around 65,000 birds. When we compare overall waterbird numbers with the coverage of different count areas and ice cover in Fig. 7 we can see that there is only a weak relationship between the numbers of recorded waterbirds, the coverage of different monitoring sites and ice cover or the harshness of winter. Considering the size of the flowing waterbody and that it was not completely frozen even when we had a very harsh winter in January 2017 (small unforzen areas were preserved where birds congregate, birds were sleeping on icebergs in big numbers), that is the reason why that did not affect very much overall count numbers. The highest numbers of waterbirds, in 2015, 2016 and 2017, coincide with medium count coverages and the presence of ice (Tab. 1, Fig. 7). In comparison to that, in 2018 we had the best coverage, but the least number of waterbirds were counted even less then in 2014, the year with the least coverage of the whole survey period (only 50%). Opposite to that, the 2017 season had nearly total ice coverage, but that did not affect the overall numbers so strong as it affected species composition and the numbers of different species (cf. Fig. 7). Hunting and poaching did not affected the countings during this survey.

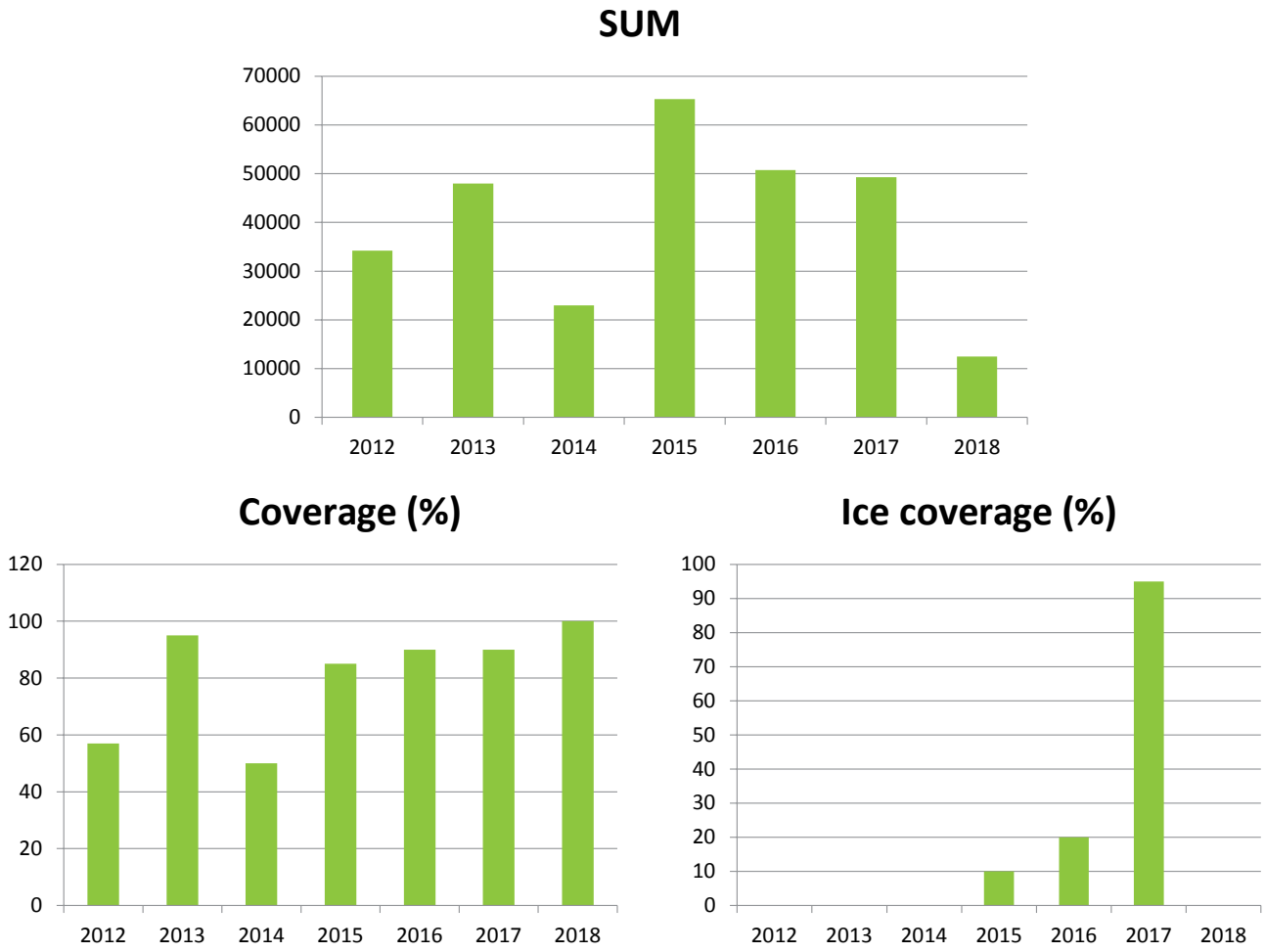

Fig. 7: Annual totals of waterbirds (SUM) in the IBA Labudovo okno during January counts (IWC) between 2012 and 2018, estimates of the coverage of the total area of wetlands in the IBA and of the ice cover during counts.

When we compare different species or different groups of species, the results are even more interesting. Mallard (*Anas platyrhynchos*) was the most numerous duck species in the IBA Labudovo okno (Fig. 8). Their numbers fluctuated between nearly 12,000 (2016) to around 1,000 birds (2018). During both the warmest (unfrozen) and the coldest winters (nearly complete ice cover) there were very low numbers of Mallards. The highest numbers were counted when there was just a small amount of ice in the study area, in 2016 and 2015. When taking other dabbling ducks into account (*Mareca strepera, M. penelope* and *Anas crecca*) again 2016 was the year with the highest numbers (Fig. 8). This was the case also with some other dabbling duck species (e.g., *Anas acuta*) not shown in Fig. 8.

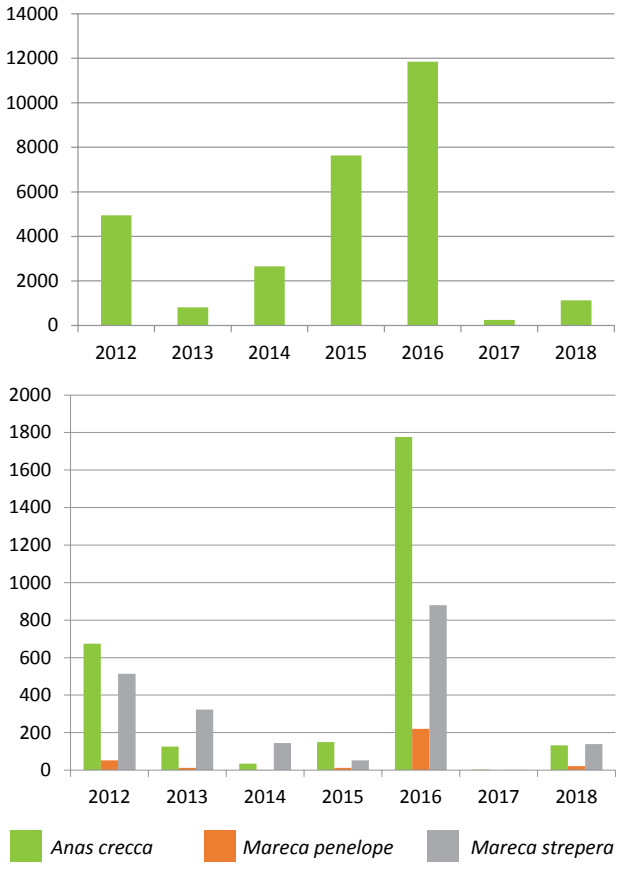

Fig. 8: Comparison of the numbers of Mallard (*Anas platyrhynchos*) above, and of other dabbling duck species in Labudovo okno, January IWC 2012 - 2018.

Besides dabbling ducks, the IBA Labudovo okno is one of the most important wintering sites of various diving duck species in Serbia. The most numerous with > 100 birds p.a. are *Aythya ferina, A. fuligula, Bucephala clangula* and *Mergellus albellus*. From the numbers shown in Fig. 9 it is obvious that 2015 was the year with the highest numbers for the majority of the diving duck species (except for *A. ferina*), while 2016 - so important for dabbling ducks - was not significant at all (Fig. 9). Even within the group the trends differ between species as *A. ferina* shows an overall slightly increasing trend, while the numbers of all other species fluctuated simultanuously without any clear trend. There was further no correlation with the presence or absence of ice and the maximum numbers of birds. Also, there were little differences between years with nearly complete ice cover (2017) and completely unfrozen waterbodies, like in 2013 and 2018.

Fig. 9: Comparison of the numbers (x-axis) of various diving ducks in Labudovo okno, January IWC 2012 - 2018.

Geese constituted the most numerous group during the whole survey period. Although 5 species of geese were recorded only two were present in significant numbers (Fig. 10). As in dabbling and diving ducks there were little differences between years with nearly complete ice cover (2017) and when wetlands were completely unfrozen or only partially frozen (e.g., 2012, 2015, and 2016). The lowest numbers of geese were recorded in 2014 and 2018, respectively. In January 2018 geese were almost absent from the area (counted on the night roost), while in 2014 more geese were recorded during the day then in 2018 on the night roost. The count in 2014 was the only one when we didn't manage to count the birds during night roosting, so the real numbers on the night roost, in 2014, were certainly much higher. The present data show that the presence of geese is closely correlated with weather conditions. While the IBA Labudovo okno is mainly a refuge during cold periods, the area is not so much a favourable site for longer overwintering. When almost all water bodies were nearly completely frozen in 2017 geese roosted during the night in all unfrozen sites within the area between Žilava river island and the Nera river mouth, and not just as usual in their well known night roost on Čibuklija island and its vicinity. These has to be taken into account in future counts at the night roost of geese, especially when there is nearly a complete ice cover on the Danube.

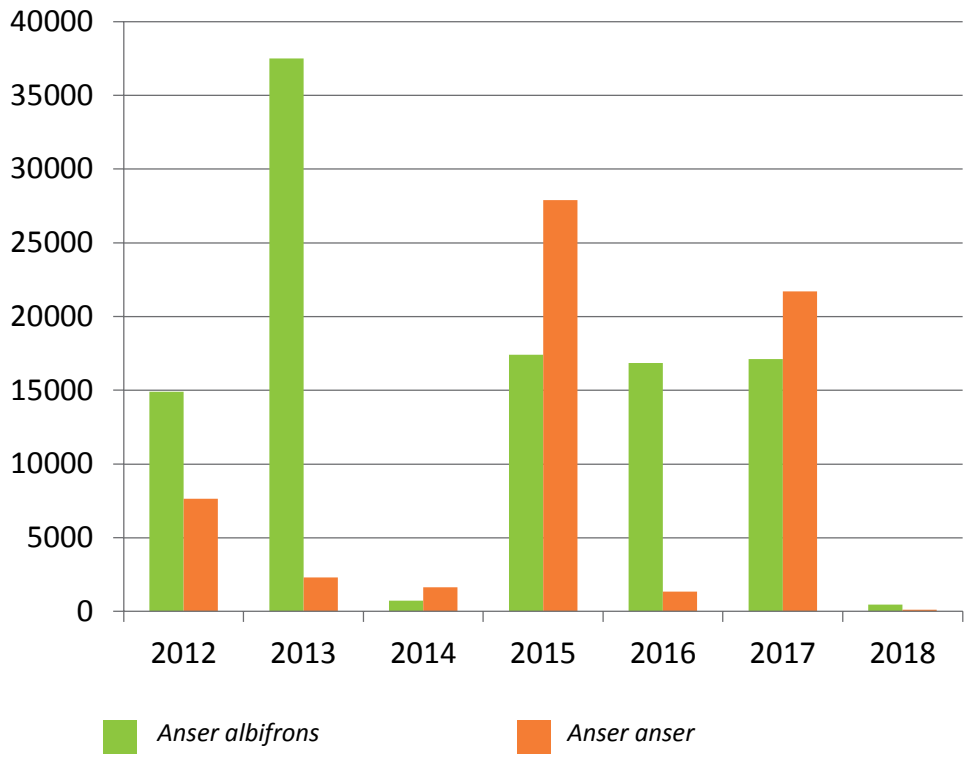

Fig. 10: The numbers of geese in Labudovo okno during the survey period between 2012 and 2018 (January IWC).

Apart of ducks and geese the results for *Fulica atra* are also interesting (Fig. 11). The numbers of coots show no correlation with any other group (dabbling ducks, diving ducks, geese). The species was most abundant during counts with a small percentage of ice cover, in 2015 and 2016. In the same years good numbers of dabbling (2015) and diving ducks (2016) were present. There were also no obvious differences between nearly complete ice cover (2017) and completely unfrozen waters (e.g., in 2012, 2013, and 2014), although ice cover probably caused the lowest number of birds recorded in 2017. In addition, in comparison to ducks and geese, coots tend to frequent shallow waters and flooded forest and can be therefore easily overlooked.

Although an overall analysis of IWC counts and a comparison of IWC monitoring sites in Serbia is missing, it is well known that the IBA Labudovo okno is one of the most diverse areas for wintering waterbirds in Serbia (Puzović *et al.* 2009). When we compare the numbers of all recorded species (waterbirds, birds of prey and passerines attracted to water habitats) with the results from two published national IWC reports with a total of 84 species (Šćiban *et al.* 2012, Šćiban *et al.* 2013), we found that the majority (58) were recorded in the IBA Labudovo okno (69%). In addition, of all 49 waterbird species that were recorded in Labudovo okno during the IWC, a slight majority were rare and irregularly occurring species. (28 species or 57%). In this category rank species that were recorded with lesser than 50 birds p.a. in the survey area. All other non-waterbird species were also rare and irregular (9 species). In comparison to them, 21 species were numerous and regular visitors (43%), i.e. species for which a total of > 50 birds were recorded in the IBA at least once during the survey period. The most numerous wintering species were *Anser albifrons, A. anser*, *Anas platyrhynchos*, followed by *Larus ridibundus*, *Aythya ferina*, *A. fuligula*, *Microcarbo pygmaeus*, *Fulica atra*, *Bucephala clangula* and *Mergellus albellus*. From the conservation perspective the most important species were *Clanga clanga*, *Branta ruficollis*, *Aythya nyroca*, *Gavia arctica*, *G. stellata*, *Mergellus albellus*, *Podiceps auritus*, *Clangula hyemalis*, and *Melanitta fusca*.

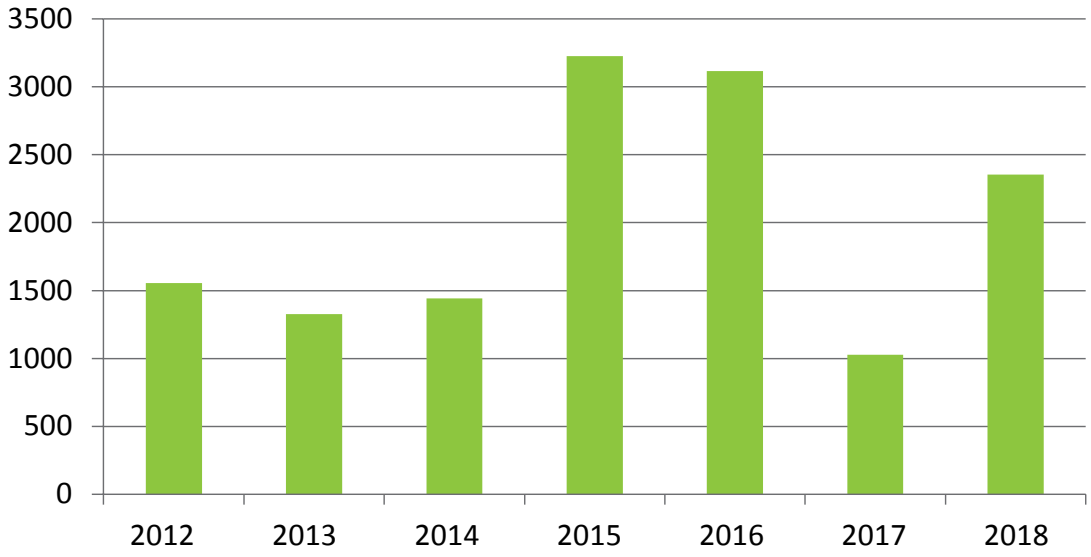

Fig. 11: The numbers of Common Coot (*Fulica atra*) in Labudovo okno during the survey period between 2012 and 2018 (January IWC).

We observed significant fluctuations of bird numbers and of the presence of different species between years within this large portion of the river Danube (20 km of its flow). While these differences are probably the result of weather conditions during winter in Serbia, but also in northern and in eastern Europe, it is still unknown which are the main drivers of these seasonal changes for various groups of waterbirds (which may also include food availability, hunting, disease, lack of site coverage, etc.). Additionally, recordings of rare and scarce species are always a challenge as well as the organization of counts on multiple night roosts within this large area. The present paper demonstrates the significance of data about site coverage and ice coverage as crucial for quantitative and qualitative analyses of IWC sites, but other factors like weather conditions (fog, wind, snowfall) and disturbances (hunting) should be also taken into account if possible. Following to the constant lack of counters, equipment (good telescopes) and adequate observation points or hides data quality and the coverage of monitoring sites in Labudovo okno varies and was not as good as it should be for very precise analyses. A general increase of site coverage, the organization of counts of all roost sites within the IBA and a closer search for the presence of rare species is needed. For future analyses, results should be more precise, indisputable, and lesser equivocal and questionable.

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Photo: Peter Sackl

Ruff (*Calidris pugnax*), Salina Ulcinj, Montenegro, March 2014

The diversity of shorebirds (Charadriiformes) of the alkaline Rusanda Lake, Serbia

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Summary

This paper presents the list of shorebirds, i.e. all waders, terns and gulls in the order Charadriiformes, which were recorded at alkaline Rusanda Lake (UTM DR44) in the Banat region in Serbia between 1950 and 2017. The research area covers 5.32 km^2 and includes Rusanda Lake and the wet pastures in the vicinity of the village Melenci. In total 48 species of shorebirds were recorded. Among them, only two - Bar-tailed Godwit (*Limosa lapponica*) and Slender-billed Curlew (*Numenius tenuirostris*) - were not recorded during recent ornithological studies from 2004 – 2017, while two species were found only once in Serbia, i.e. Pectoral (*Calidris melanotos*) and Terek Sandpiper (*Xenus cinereus*). The lake is a significant stop-over site for migrating Charadriiformes. The most numerous and important species (with maxima of > 500 individuals per day) are Black-headed Gull (*Larus ridibundus*), Northern Lapwing (*Vanellus vanellus*), Ruff (*Calidris pugnax*), Eurasian Curlew (*Numenius arquata*) and Whimbrel (*Numenius phaeopus*). So far, seven species were recorded as confirmed or possible breeders at the lake: Black-winged Stilt (*Himantopus himantopus*), Pied Avocet (*Recurvirostra avosetta*), Northern Lapwing, Black-tailed Godwit (*Limosa limosa*), Common Redshank (*Tringa totanus*) and Black-headed Gull. Kentish Plover (*Charadrius alexandrinus*) bred in the area only before the recent studies since 2004. Historical changes of species diversity and abundances are discussed.

Keywords

Rusanda Lake, alkaline lake, Melenci, Serbia, bird fauna, waders, gulls, terns, shorebirds

1. Introduction

This paper presents the first detalied overview and analyses of the occurrence and diversity of shorebirds on Rusanda Lake, Serbia, including data from 1950 onwards. In the middle of the 20th century the first researchers were Marčetić (1960), Šoti & Dimitrijević (1974) and Dimitrijević (1977, 1983a, 1983b, 1984). Further research nearly halted in the middle of the 1980s and remains sporadically until the beginning of the 21st century. After a break of roughly 20 years, since 2004, the lake is again regularely visited and intensively studied by ornithologists. Until now many ornithological papers were published for Rusanda Lake and Melenci village. These include reports of individual findings, various analyses and general papers on bird diversity (Marčetić & Antal 1961, Šoti & Dimitrijević 1974, Dimitrijević 1977, Dimitrijević 1983a, Dimitrijević 1983b, Dimitrijević 1984, Garovnikov 1988, Lukač 1990, Garovnikov 1998, Šćiban 2004, Šćiban & Radišić 2007, Šćiban & Janković 2008, Ružić *et al.* 2009, Šćiban 2009, Vučanović *et al.* 2009, Radišić 2010, Šćiban *et al.* 2010, Čuturilov 2015/2016).

2. Description of the study area

According to Bogdanović & Marković (2003) the alkaline Rusanda Lake represents a shallow, ellipsoid depression west of Melenci village (UTM DR44). The lake is a former oxbow of the Tisa River that is around 5.5 km long, 200 – 600 m wide and covers approximately 4 km^2. The south-western part of the lake is shallower and separated from the main part of the lake basin by a 150 m long embankment that splits the lake in the smaller Mala Rusanda (southern, smaller branch) and the larger Velika Rusanda (larger, northern branch). The depth of the lake dependents on precipitation and fluctuates between 0.5 m and 1.5 m. The shallow western and southern shores of the lake fall often dry during summer, while the central part is usually under water throughout the seasons. The main characteristic of the lake is its high salinity due to saline soils and springs underneath it.

According to Stanković (1982) salinity is usually between 40 – 60‰, but according to precipitation varies from season to season. Since 1886 mud from the lake is used for medicine purposes. Even a sanatorium has been built next to the lake. The resarch area additionally covers pastures and periodically flooded depressions west and northeast of the lake as well as agricultural fields which surround the lake. In its eastern part the lake is bordered by the village Melenci and the park of the sanatorium, SPA "Rusanda", mentioned above. In this area the lake's shores are covered by extensive reedbeds which in some parts are even more then 110 m wide. The total survey area which includes the lake, the adjoining pastures and periodically flooded depressions amounts to 5.32 km^2.

For this paper we analysed the presence of shorebirds in the following sites: A – alkaline pastures northwest and north of Velika Rusanda; B – the whole area of the lake's Velika Rusanda branch; C – the whole area of the lake's Mala Rusanda branch; and D – alkaline pastures and periodically flooded depressions west of the Mala Rusanda branch (Fig. 1).

3. Methods

3.1 Field effort and methods

In the period between 2004 and 2017 in all more then 300 field days were spent on Rusanda Lake and its closer vicinity. Because no fixed framework for bird surveys has been defined there were days when only the lake was visited and days during which only its vicinity was surveyed. From all months October is the month with the highest number of visits due to bird ringing activities in the area, while June is the month with the smallest number. In the same way numbers of visits fluctuated heavily between years.

Fig. 1*:* Map of the study area showing the two parts of Rusanda Lake – Mala (C) and Velika Rusanda (B), and the alkaline pastures and periodically flooded depressions around the lake (A, D).

Data on bird numbers we collected by direct counting, counting blocks of approximately 100 individuals in cases of very high bird numbers, i.e. the block method according to Tucakov & Simić (2003). During research we mainly used the transect method and counting from the spot (Bibby *et al.* 1992). In addition, but rarely, birds were caught with nets. On all occasions total counts/estimates were compiled for the lake, including evening roost counts (curlews). Aside of birds which were caught during bird ringing, observations were made with binoculars and telescopes.

3.2 Interpretation of field data

Due to the poor quality of observations obtained from the literature, all data on the breeding status, the number of breeding pairs, the location/habitat where the birds were observed as well as maximum numbers during migration were analysed only for the period between 2004 and 2017. The breeding status, aside of non-breeders, is indicated following to the categorization of the EBCC. The numbers of breeding pairs are presented as minimum and maximum numbers due to fluctuations between years.

4. Results

In Tab. 1 all species of the order Charadriiformes which were recorded in the study area are listed. Overall, since 1950, a total of 48 species were observed at Rusanda Lake and in adjoining wet grasslands. Seven species were recorded as confirmed or possible breeding birds (Tab. 1), while breeding numbers fluctuated considerably from year to year.

The presence and absence of migrants as well as annual fluctuations of breeding numbers are, most probably, the result of fluctuations of habitat characteristics, like the amount of precipitation, change of water level, etc. The maximal numbers of different shorebirds observed during the research period since 2004 indicate the rarity/importance of the species and the significance of the site for migration.

Tab.1: List of all shorebirds (suborders Charadrii and Larii, Charadriiformes) recorded at Rusanda Lake and in its immidiate surroundings, their breeding status, population numbers, the localities/habitats where the birds were observed, numbers of observations for all vagrants with lesser then 10 sightings and the maximum numbers/species recorded in the study area during the period 2004 – 2017. Key: NBP – estimated numbers of breeding pairs; C – confirmed breeder, Pr – probable breeding, Po – possible breeding, N – non-breeder, EX – former breeder (extinct before 2004); * – not estimated; X – not found by the current authors, data from literature; / - no data.

Species	Breeding status	NBP	Localities	Number of observations (vagrants)	Maximum numbers
1. Himantopus himantopus	C	0–18	B, C		120 (5. 7. 2009)
2. Recurvirostra avosetta	C	0–10	B, C		427 (21. 6. 2009)
3. Burhinus oedicneums	N	/	B	1	1 (7. 10. 2007)
4. Glareola pratincola	N	/	B	4	1 (20. 6. 2009)
5. Charadrius dubius	N	/	A, B, C		30 (27. 9. 2008)
6. Charadrius alexandrinus	EX	/	B	2	2 (1. 4. 2006)
7. Charadrius hiaticula	N	/	B, C		60 (27. 9. 2008)
8. Vanellus vanellus	C	15–20	A, B, C, D		1,450 (12. 8. 2008)
9. Pluvialis squatarola	N	/	B, C		21 (14. 10. 2008)
10. Pluvialis apricaria	N	/	A, B	4	1 (18. 9. 2010)
11. Calidris minuta	N	/	B, C		90 (27. 9. 2008)
12. Calidris alpina	N	/	B, C		160 (27. 9. 2008)
13. Calidris temminickii	N	/	B, C		19 (21. 8. 2011)
14. Calidris alba	N	/	B, C	9	3 (27. 9. 2008)
15. Calidris ferruginea	N	/	B, C		12 (30.4.2013)
16. Calidris canutus	N	/	B	2	1 (18. 9. 2007)
17. Calidris melanotos	N	/	B	1	1 (27. 9. 2008)

Species	Breeding status	NBP	Localities	Number of observations (vagrants)	Maximum numbers
18. Calidris falcinellus	N	/	B	4	2 (3. 8. 2011)
19. Calidris pugnax	N	/	A, B, C, D		1,393 (18. 3. 2012)
20. Gallinago gallinago	Po	0–1	A, B, C, D		180 (17. 9. 2010)
21. Lymnocryptes minimus	N	/	B	2	2 (27. 10. 2009)
22. Limosa limosa	Po	0–1	B, C		346 (24. 3. 2012)
23. Limosa lapponica	N	/	X	X	X (Marčetić & Antal 1961)
24. Numenius phaeopus	N	/	A, B, C, D		560 (7. 4. 2014)
25. Numenius tenuirostris	N	/	X	X	X (Garovnikov 1988)
26. Numenius arquata	N	/	A, B, C, D		1,000 (22. 9. 2007)
27. Tringa erythropus	N	/	B, C, D		242 (21. 6. 2009)
28. Tringa totanus	Pr	0–4	A, B, C, D		49 (13. 6. 2009)
29. Tringa stagnatilis	N	/	B, C		32 (21. 6. 2009)
30. Tringa nebularia	N	/	A, B, C, D		9 (14. 8. 2010)
31. Tringa ochropus	N	/	A, B, C, D		10 (27. 6. 2011)
32. Tringa glareola	N	/	A, B, C, D		94 (25. 7. 2010)
33. Actitis hypoleucos	N	/	A, B, C, D		23 (28. 7. 2010)
34. Arenaria interpres	N	/	A, B		4 (21–25. 8. 2011)
35. Phalaropus lobatus	N	/	B, C	9	9 (29. 8. 2015)
36. Xenus cinereus	N	/	C	1	1 (9. 5. 2013)
37. Larus ridibundus	Pr	0–5	A, B, C, D		15,000 (18. 9. 2007)
38. Larus minutus	N	/	B, C		3 (29. 9. 2007)
39. Larus melanocephalus	N	/	B	2	3 (27. 4. 2010)
40. Larus canus	N	/	B		9 (8. 1. 2011)
41. Larus michahellis	N	/	A, B, C, D		*
42. Larus cachinnans	N	/	A, B, C, D		*
43. Larus fuscus	N	/	B	4	1 (24.10.2008)
44. Sterna hirundo	N	/	B, C, D	2	2 (10. 6. 2010)
45. Sterna caspia	N	/	B	7	3 (12. 8. 2008)
46. Chlidonas hybrida	N	/	A, B, C, D		23 (3. 8. 2011)
47. Chlidonas nigra	N	/	A, B, C		30 (15. 5. 2013)
48. Chlidonias leucopterus	N	/	A, B, C, D		15 (21. 8. 2010)

5. Discussion

5.1 Breeding species

Of all 48 species of shorebirds (Charadriiformes) observed at Rusanda Lake, 6 species were recorded as breeders. Of these *H. himantopus, R. avosetta* and *V. vanellus* are regular, confirmed breeders. For *T. totanus* (regular) and *L. ridibundus* (only in 2011) strong breeding evidence (multi-day courtship behaviour, birds attacking intruders) were found, but nests or fledglings were never seen. The breeding of *G. gallinago* and *L. limosa* could never be confirmed although there are good habitat requirements and adult birds were present during the reproductive period. Courtship calls of *L. limosa* were noted only in 2017. *Ch. alexandrinus* bred only before our recent ornithological studies. Even with only 6 – 7 breeding species of shorebirds Rusanda Lake represents one of the sites which are most diverse in breeding shorebirds in Serbia (cf. Dimitrijević 1977, 1984, Gergelj & Šoti 1990, Lakatoš 1992, Lukač & Lukač 1992, Dević 1995, Gergelj *et al.* 2000, Agošton 2004, Gergelj & Barna 2010).

5.2 Importance for migration

From the overall number of 48 shorebirds, 41 species were recorded only as non-breeders (85%). Hence, aside for breeding species, Rusanda Lake is a very important site for migrating waders and other shorebirds. Depending from the season and from year to year, different species used the lake for roosting and for feeding – obviously, there is no clear pattern. The numbers of some species which stop-over in the area during migration, are among the highest recorded in Serbia. Consequently, Rusanda Lake is one of the most important resting sites for waders in the country (cf. Marčetić & Antal 1961, Antal *et al* 1971, Dimitrijević 1977, 1984, Gergelj & Šoti 1990, Lakatoš 1992, Lukač & Lukač 1992, Dević 1995, Gergelj *et al.* 2000, Agošton 2004, Gergelj & Barna 2010).

The numbers of migrants that are important on the national level concern the following species: *H. himantopus, R. avosetta, V. vanellus, P. squatarola, C. temminickii, C. ferruginea, C. pugnax, G. gallinago, N. phaeopus, N. arquata, T. erythropus, T. stagnatilis* and *T. glareola*. The numbers of these species represent 27% of the overall number across all species which were recorded in the area. In addition, the site is the most important, known stopover site in Serbia for 3 species, i.e. *R. avosetta, N. arquata* and *N. phaeopus*. With the particularly high numbers of *R. avosetta* Rusanda Lake should be considered as an internationally important site for the species (Delany *et al.* 2009).

We further found no significant differences between the numbers of various species between the recent ornithological studies (2007 – 2017) and previous historic data (e,g. Dimitrijević 1977, 1984). It is interesting to note that for some species the highest numbers were recorded during recent surveys (*L. limosa, N. arquata, N. phaeopus, C. pugnax, Ph. lobatus*).

Additionally, we analysed the maximum numbers of species in different months. By including vagrants (i.e. the months with only or the highest number of observations), in all, the data for 43 species were analysed. The results in Fig. 2 show which months are the most important for shorebird migration at Rusanda Lake. The most significant month is September, followed by August, which means that during late summer and the beginning of autumn the lake provides adaquate habitat conditions for more then the half of all species analysed (51%). While this is the crucial period for shorebird migration, late autumn and the winter months are the least important. The only regularly wintering shorebirds are gulls and, occasionally, *N. arquata* during milder winters.

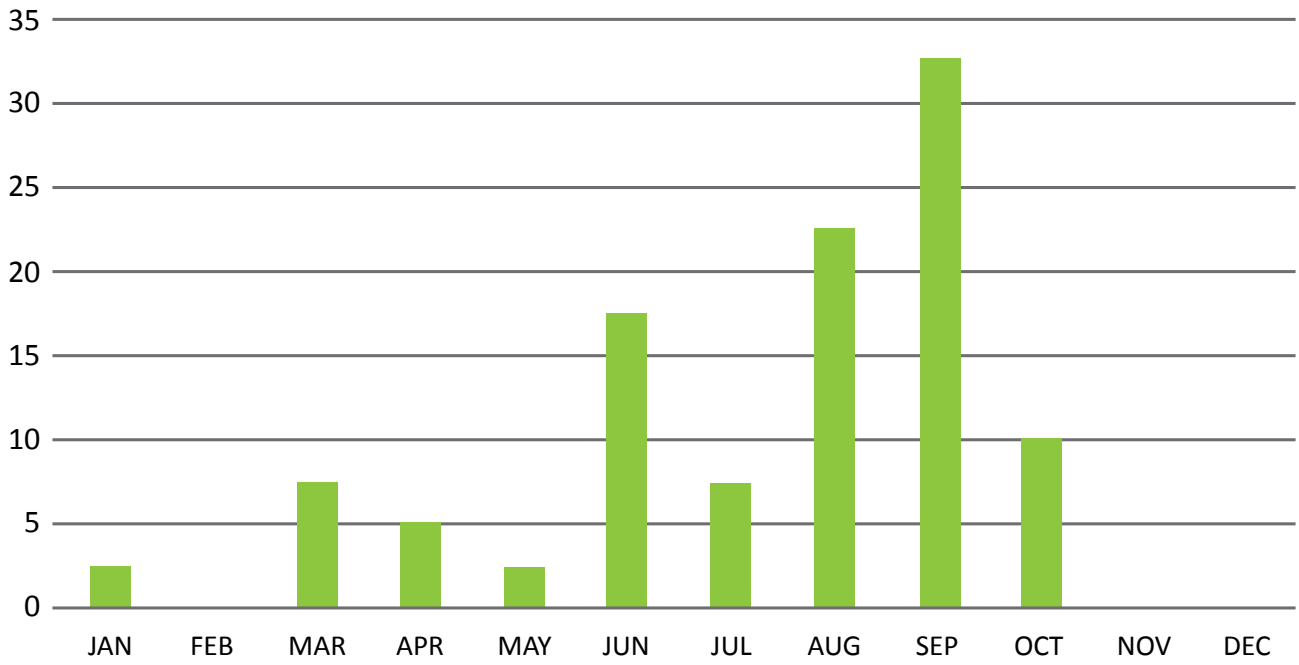

Fig. 2: Month in which we recorded the maximum number per species (on the y-axis); each species was counted only once for the month with its maximum recorded number for the period 2004 – 2007.

5.3 Habitats and species diversity

Of all 48 species of shorebirds (Charadriiformes) that were recorded on Rusanda Lake and in its close vicinity, only 2, i.e. *L. lapponica* and *N. tenuirostris*, were not recorded in the period 2004 – 2017. As shown above, Rusanda Lake is an important roosting and feeding habitat for various shorebird species during migration.

Fig. 3 shows the diversity of species in different habitat types/localities during recent ornithological surveys from 2004 – 2017. The most important area following to species numbers is the Velika Rusanda branch of the lake followed by the Mala Rusanda branch. In addition, the wet pastures and periodically flooded wetlands also provide important feeding and roosting sites for many species.

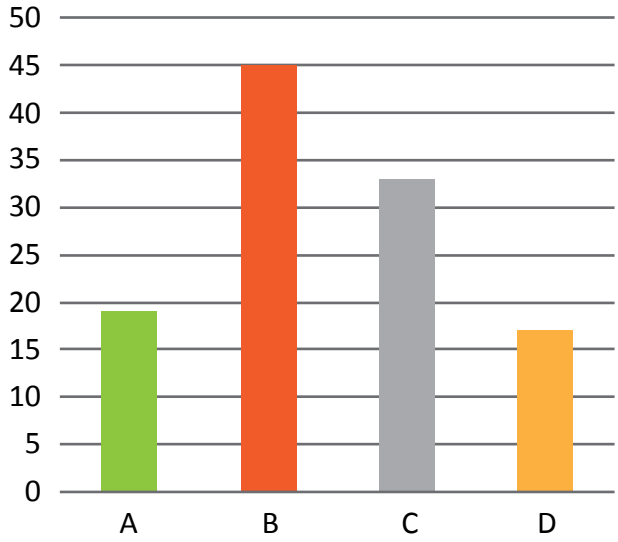

Fig. 3: Numbers of shorebird species (y-axis) in different habitat types/localities at Rusanda Lake in the period 2004 – 2017. A and D = wet pastures and periodically flooded wetlands, B = Velika Rusanda, C = Mala Rusanda.

5.4 Presence

For 44 species their abundances and presence were analysed (*L. cachinnans, L. michahelis, L. lapponica, N. tenuirostris* were not analysed). The species were categorized according to the highest recorded numbers into scarce (less then 100 birds) and numerous species (more then 100 individuals). The majority of species are scarce (75%). Of these 42% were regular (14 species), while 58% were irregular and very rare (19 species). Two species were recorded only once in Serbia on Rusanda Lake, i.e. *C. melanotos* and *X. cinereus*. Only 11 species were categorized as numerous (25%), all of it in numbers which are significant on the national level: *V. vanellus, H. himantopus, R. avosetta, C. alpina, C. pugnax*, *G. gallinago, N. arquata, N. phaeopus, L. limosa, T. erythropus* and *L. ridibundus*. The threshold of 500 individuals surpassed only 5 species (*L. ridibundus, V. vanellus, C. pugnax, N. arquata, N. phaeopus*).

In conclusion, the high diversity of shorebirds of the order Charadriiformes on Rusanda Lake most probably results from the availability of various types of shallow waters, of alkali and fresh waters (the latter resulting from percipitation) which are responsible for a highly diverse aquatic invertebrate fauna – the main diet for waders and many other waterbirds.

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Photo: Peter Sackl

Collared Pratincole (*Glareola pratincola*) nesting in dried-out evaporation basin, Salina Ulcinj, Montenegro, July 2015

Breeding bird populations of the Ulcinj Salina, Montenegro, and their significance for waterbird conservation

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Summary

With 1,492 ha the Ulcinj Salina, Montenegro, is one of the largest salt-works in the Adriatic basin. The salina, which was known as one of the main shorebird nesting sites in former Yugoslavia, was privatised and introduced into bankruptcy in 2005. Since then the condition of the Ulcinj Salina degraded gradually and salt production was abandoned in 2013. After a recent analysis of land structure and flood conditions, annual surveys of breeding waterbirds are conducted since 2016. Aside from the particularly low breeding numbers following to the large-scale floodings in spring 2016, overall waterbird populations varied from 524 - 582 breeding pairs (bp.) in 2017 and 2018. Collared Pratincole *Glareola pratincola* (176 – 187 bp.), Kentish Plover *Charadrius alexandrinus* (95 – 134 bp.), Little Tern *Sternula albifrons* (89 – 105 bp.) and Black-winged Stilt *Himantopus himantopus* (43 – 80 bp.) are the most abundant breeding birds. For 10 waterbird species Ulcinj Salina is the only or at least the most important breeding site in Montenegro and with a total of 16 breeding bird species, listed under Annex I of the European Union's Birds Directive, the area holds one of the highest breeding concentrations of estuarine waterbirds on the Balkan Peninsular. Furthermore, with a permanent population of around 1,000 birds, Ulcinj Salina constitutes an important site for Greater Flamingo *(Phoenicopterus roseus)*. The salina is further a particularly important breeding site for Collared Pratincole, as it currently harbours more than 2% of its European breeding population. However, the ineffectiveness of the water management after the salina's abandonment led to a reduced influx of seawater and increased the incursion of freshwater. Subsequently, the temporary breakdown of the pumping system between 2013 and 2017 favoured the breeding of waterbird species, in particular, Little Grebe *(Tachybaptus ruficollis)*, Mallard *(Anas platyrhynchos)* and Common Coot *(Fulica atra)*, that are normally associated with freshwater habitats. This process is turning the salina gradually into a freshwater ecosystem and poses a serious risk to its significance as a main shorebird breeding habitat in the eastern Adriatic region.

Keywords

Ulcinj Salina, Montenegro, shorebirds, breeding populations, water management, waterbird conservation, Balkan Peninsular

1. Introduction

The low tidal amplitudes of the Adriatic Sea, of usually less than 40 cm, in combination with steep and rocky shores prevent the formation of extensive coastal wetlands. Subsequently, along most of the eastern Adriatic coast adequate nesting habitats for waterbirds are restricted to a handful of large river deltas, inland freshwater lakes and flood areas in adjacent karst poljes of the Dinaric Alps. Only the coastal plains of Albania which are entirely made up of river sediments, harbour extensive inland lagoons and sandy shores as potential shorebird habitats (Stumberger & Sackl 2010, Schwarz 2017).

At the northern edge of the Albanian floodplains the Bojana-Buna river delta is long known for its rich waterbird fauna. In the late 19th century Reiser & von Führer (1896) reported the breeding of different wader species and, in particular, large breeding colonies in the former inland lagoon, known as Zogajsko Blato (Zoganjsko Jezero), and in nearby coastal areas at the delta front of the Bojana-Buna River (cf. also Vasić 1979).

Even after the construction and successive transformation of the lagoon and adjoining marshlands *(kneta)* into salt-pans for commercial salt production between 1926 and the 1980s (Radović 2008), the area retained its significance as a major bird habitat (e.g., Vasić 1979, Ham 1986, Puzović *et al.* 1992). However, although Montenegro was not directly affected by military action during the last Yugoslav Wars, following to the inadequate management of the salina in Ulcinj and uncontrolled bird shooting, the breeding numbers of waterbirds declined considerably in the 1990s (Saveljić 2002). Nevertheless, a first assessment of the ecological value of the Bojana-Buna Delta, 2003 – 2004, a few years after the collapse of the former Republic of Yugoslavia, revealed that the salina has remained an important breeding site for estuarine waterbirds (Schneider-Jacoby *et al.* 2006, Stumberger *et al.* 2008).

After the privatisation in 2005 and the bankruptcy of the salina company, i.e. the former public enterprise Solana „Bajo Sekulić“ AD in Ulcinj, the salt production was abandoned in 2013 and the salina's infrastructure, like canals and embankments, started to deteriorate gradually. The temporary breakdown of the pumping system and the water management between 2013 and 2017, and the successive change of habitat conditions (Schwarz & Sackl 2017) have the potential to impair the nesting success and the population status of the salina's breeding birds.

Following to pressure from conservationists and the European Union, the Montenegrin government has recently restored the pumps for the influx ('Djerane pump') and outflow of water ('pump 16'), in order to regulate the water level and to pump seawater into the evaporation basins. At the same time, since 2016, the Center for Protection and Research on Birds of Montenegro (CZIP) and EuroNatur organize annual breeding bird surveys to supplement the ongoing waterbird counts in the frame of the International Waterbird Census (IWC) and to monitor the effect of the recent management measures on the breeding bird populations. Here we present data on current population numbers and the significance of Ulcinj Salina for shorebird conservation in the eastern Adriatic region and on the Balkan Peninsula.

Photo: Peter Sackl

Fig. 1: Little Ringed Plover (*Charadrius dubius*) chick

2. Study area

With a surface area of 1,492 ha Ulcinj Salina is one of the largest salt-works in the Adriatic basin. Besides a 16.6 km long outer canal that surrounds almost the whole area, the salina is limited along its south-western edge by the northern banks of Porta Milena, i.e. the inlet from the Adriatic Sea into the former inland lagoon. The dams and other embankments are grazed by domestic cattle and sheep. Depending on water level and soil salinity, the evaporation and crystallisation basins are covered by bare mudflats and scattered stands of halophytes, like *Salicornia herbacea* agg., *Suaeda maritima, Salsola soda* and others (Fig. 2). The far western and considerably smaller part of the area harbours the salina's former warehouses, processing and administration buildings (hereafter called 'company ground'). Apart from the company ground, where only occasional observations from main access roads were noted, each breeding bird survey covered the whole area of the salina, including the outer embankments, the surrounding outer canal and the reed beds along the banks of Porta Milena.

For further information on the history of construction, salt production and habitat conditions in Ulcinj Salina see Schneider-Jacoby *et al.* (2006), Vuksanović & Petrović (2007), Radović (2008) and Stumberger *et al.* (2008).

Photo: Peter Sackl

Fig. 2: Lower dykes and mudflat habitats in the evaporation basins of the Ulcinj Salina, Montenegro, 4 May 2018

3. Methods

Aiming at the establishment of a long-term monitoring of waterbird breeding populations, a first breeding bird survey was conducted from 14 – 17 June 2016. Subsequently two complete breeding bird surveys have been organized from 29 April – 1 May and 10 – 14 June 2017, and from 1 – 7 May and 26 – 30 June 2018.

Depending on weather conditions, morning field surveys started around sunrise and lasted until 11 – 13 h. In particular in June, when air temperatures usually exceed 28° C and birds become inactive, the morning surveys were finished earlier. In addition, late afternoon and evening surveys were performed between 16 – 18 h and dusk, but sometimes lasted well into darkness. Play-backs were used carefully and only occasionally to register crepuscular species like Eurasian Bittern *(Botaurus stellaris)*, Common Little Bittern *(Ixobrychus minutus)*, Eurasian Thick-knee *(Burhinus oedicnemus)* and European Nightjar *(Caprimulgus europaeus)*.

Surveys were conducted by 1 – 4 teams of observers by walking slowly along all accessible dams, along canals or through dried-out basins. Each team consisted of an experienced field ornithologist and 1 – 2 volunteers, who helped with bird counting and field protocols. To minimize disturbances, bare mudflats, islets and active breeding colonies were counted from safe distances with scopes wherever this was appropriate.

Observations of territorial or nesting birds or any other evidence for breeding were marked on field maps. To distinguish between neighbouring breeding territories/pairs particular care was taken in the field on simultaneous observations of courtship and distraction displays, singing males, etc. Field observations were digitized and breeding evidence was categorized for all observations following criteria of the European Ornithological Atlas Committee (EOAC), shown in Tab. 1, and annual breeding numbers were later derived as conservative estimates after deleting possible double-counts of breeding pairs/territories during the same or different surveys.

For the preparation of the present report, the final analysis after digitisation of the 2018 surveys was not yet available. Hence, breeding numbers for the year 2018 are provisional, but lie within ranges given in Tab. 2.

Besides the breeding birds, all non-breeding waterbirds have been counted per basin during the surveys. The latter mainly concern different non-breeding waders, gulls and ducks that spend the summer months in the area as well as feeding flocks of herons, ibises and cormorants that nest outside the salina. Passerines that are closely associated with wetland habitats were sampled in the same way as waterbirds (cf. Tab. 2). On the other hand breeding evidence for most passerines, many of them common in the wider area, are noted non-systematically.

Photo: Peter Sackl

Fig. 3: Juvenile Kentish Plover (*Charadrius alexandrinus*)

Tab. 1: EOAC breeding codes for categorizing breeding evidence from field observations.

Breeding Status Codes

Non-breeding	
F	**F**lying over
M	Species observed but suspected to be still on **M**igration
U	Species observed but suspected to be s**U**mmering non-breeder
Possible breeding	
H	Species observed in breeding season in suitable nesting **H**abitat
S	**S**inging male present (or breeding calls heard) in breeding season in suitable breeding habitat
Probable breeding	
P	**P**air observed in suitable nesting habitat in breeding season
T	Permanent **T**erritory presumed through registration of territorial behaviour (song etc) on at least two different days a week or more part at the same place or many individuals on one day
D	Courtship and **D**isplay (judged to be in or near potential breeding habitat; be cautious with wildfowl)
N	Visiting probable **N**est site
A	**A**gitated behaviour or anxiety calls from adults, suggesting probable presence of nest or young nearby
I	Brood patch on adult examined in the hand, suggesting **I**ncubation
B	Nest **B**uilding or excavating nest-hole
Confirmed breeding	
DD	**D**istraction-**D**isplay or injury feigning
UN	**U**sed **N**est or eggshells found (occupied or laid within period of survey)
FL	Recently **FL**edged young (nidicolous species) or downy young (nidifugous species). Careful consideration should be given to the likely provenance of any fledged juvenile capable of significant geographical movement. Evidence of dependency on adults (e.g. feeding) is helpful. Be cautious, even if the record comes from suitable habitat.
ON	Adults entering or leaving nest-site in circumstances indicating **O**ccupied **N**est (including high nests or nest holes, the contents of which can not be seem) or adults seen incubating
FF	Adult carrying **F**aecal sac or **F**ood for young
NE	**N**est containing **E**ggs
NY	**N**est with **Y**oung seen or heard

Tab. 2: Number of breeding pairs in Ulcinj Salina, Montenegro, based on annual breeding bird surveys 2016 – 2018 (data from 2018 are provisional, see methods for details), and maximum breeding status since 2016 according to EOAC criteria. P* and/or English species names in italics (light grey) = species present but not counted. Hence, in these cases only rough population estimates are given. IUCN Red List status in Europe and for the 27 member states of the European Union (EU 27; Croatia excluded) following to BirdLife International (2015): VU = Vulnerable, NT = Near Threatened, blank cells are LC = Least Concern; SPEC (Species of European Conservation Concern) status according to BirdLife International (2017): 1 = European species of global conservation concern, 2 = species of conservation concern on the European level (BirdLife International 2015) and whose global population is concentrated in Europe, 3 = species of conservation concern on the European level (BirdLife International 2015) and whose global population is not concentrated in Europe. EOAC codes cf. Tab. 1; within each of the (non-systematic) groups of "waterbirds", "other non-Passeriformes" and "Passeriformes" species are listed according to the EU Bird List 2016.

English name	Scientific name	Breeding status (EOAC Code)	Breeding pairs			IUCN Red List			SPEC	EU Birds Directive
			2016	2017	2018	Global	Europe	EU 27		Annexes
Waterbirds										
Common Shelduck	***Tadorna tadorna***	FL	4	3	1 - 3					
Ferruginous Duck	***Aythya nyroca***	H	0	0	1	**NT**			1	**I**
Mallard	***Anas platyrhynchos***	FL	9	4	7					**IIA; IIIA**
Little Grebe	***Tachybaptus ruficollis***	ON / FL	17	4	3 - 4					
Greater Flamingo	***Phoenicopterus roseus***	H	1064[1]	149 - 374[1]	581 - 900[1]					
Western Water Rail	***Rallus aquaticus***	T	9	1	8					**IIB**
Common Moorhen	***Gallinula chloropus***	T	15	2	10					**IIB**
Common Coot	***Fulica atra***	FL	30	8	27		**NT**		3	**IIA; IIIB**
Eurasian Bittern	***Botaurus stellaris***	S	1	1	1				3	**I**
Common Little Bittern	***Ixobrychus minutus***	S	1	0	2 - 3				3	**I**
Eurasian Thick-knee	***Burhinus oedicnemus***	ON	13	14	16 - 22				3	**I**
Pied Avocet	***Recurvirostra avosetta***	H	0 - 1	0 - 1	0					**I**
Eurasian Oystercatcher	***Haematopus ostralegus***	P	0	1	0	**NT**	**VU**	**VU**	1	**IIB**
Black-winged Stilt	***Himantopus himantopus***	ON / FL	54	43	80					**I**
Little Ringed Plover	***Charadrius dubius***	ON	5	5	10 - 13					
Kentish Plover	***Charadrius alexandrinus***	ON / FL	84	134	95				3	**I**

English name	Scientific name	Breeding status (EOAC Code)	Breeding pairs			IUCN Red List			SPEC	EU Birds Directive
			2016	2017	2018	Global	Europe	EU 27		Annexes
Northern Lapwing	***Vanellus vanellus***	FL	1 (-2)	1	4 - 6	NT	VU	VU	1	IIB
Common Sandpiper	***Actitis hypoleucos***	P	2	2	2 - 7			NT	3	
Common Redshank	***Tringa totanus***	FL	15	10	8			VU	2	IIB
Collared Pratincole	***Glareola pratincola***	NE / FL	34	176	187				3	I
Yellow-legged Gull	***Larus michahellis***	ON	5	3	2					
Little Tern	***Sternula albifrons***	ON / NE	68	105	89				3	I
Common Gull-billed Tern	***Gelochelidon nilotica***	P	1	1	1				3	I
Common Tern	***Sterna hirundo***	ON	11	5	1 - 8					I
Other non-Passeriformes										
European Turtle-dove	***Streptopelia turtur***	FL	P*	8	10 - 20	VU	VU	NT	1	IIB
Eurasian Collared-dove	*Streptopelia decaocto*	*ON*	*P**	*3*	*2*					IIB
European Nightjar	***Caprimulgus europaeus***	T	3	3	4				3	I
Great Spotted Cuckoo	***Clamator glandarius***	S	0	1	1 - 2					
Common Cuckoo	*Cuculus canorus*	*S*	*P**	*4*	*11*					
Little Owl	***Athene noctua***	N	1	1 - 2	1				3	
Western Marsh-harrier	***Circus aeruginosus***	B	1	1	0 - 1					I
Common Hoopoe	***Upupa epops***	S	0	0	1 - 2					
European Bee-eater	*Merops apiaster*	*UN*	*P**	*19*	*7*					
European Roller	***Coracias garrulus***	NY	9	5	8 - 10[2]				2	I
Common Kingfisher	*Alcedo atthis*	*H*	*1*	*1*	*1*		VU	VU	3	I
Common Kestrel	***Falco tinnunculus***	P	1	1 - 2	0				3	
Passeriformes										
Eurasian Golden Oriole	*Oriolus oriolus*	*P*	*P**	*4*	*1*					
Black-billed Magpie	***Pica pica***	UN	2	2	2 - 4					
Great Tit	*Parus major*	*S*	*0*	*0*	*2*					

Tab. 2 (continued)

English name	Scientific name	Breeding status (EOAC Code)	Breeding pairs			IUCN Red List			SPEC	EU Birds Directive
			2016	2017	2018	Global	Europe	EU 27		Annexes
Eurasian Penduline-tit	*Remiz pendulinus*	*B*	*1*	*1*	*1*					
Barn Swallow	*Hirundo rustica*	*NY / FL*	*P**	*7*	*3*					
Red-rumped Swallow	*Hirundo daurica*	*ON*	*5*	*2*	*3*				3	
Greater Short-toed Lark	***Calandrella brachydactyla***	S	0	0	7				3	I
Crested Lark	***Galerida cristata***	FL	P*	10	40					
Eurasian Skylark	***Alauda arvensis***	S	2	0	0				3	IIB
Zitting Cisticola	***Cisticola juncidis***	P	19	12	1					
Cetti's Warbler	*Cettia cetti*	*S*	*P**	*5*	*38*					
Eurasian Reed-warbler	***Acrocephalus scirpaceus***	S	3	4	0					
Great Reed-warbler	***Acrocephalus arundinaceus***	FY / FL	66	47	52					
Eastern Olivaceous Warbler	*Hippolais pallida*	*S*	*51*	*14*	*2*					
Common Whitethroat	*Sylvia communis*	*S*	*0*	*0*	*2*					
Sardinian Warbler	*Sylvia melanocephala*	*S*	*1*	*1*	*0*					
Subalpine Warbler	*Sylvia cantillans*	*S*	*0*	*1*	*7*					
Common Starling	*Sturnus vulgaris*	*FY*	*0*	*0*	*1*				3	IIB
Common Nightingale	*Luscinia megarhynchos*	*S*	*0*	*1*	*0*					
Black-eared Wheatear	***Oenanthe hispanica***	H	1	0	0					
House Sparrow	*Passer domesticus*	*FL*	*2*	*2*	*7*				3	
Spanish Sparrow	*Passer hispaniolensis*	*FY / FL*	*8*	*28*	*33*					
Yellow Wagtail	***Motacilla flava feldegg***	FL	40	16	24				3	
Corn Bunting	***Miliaria calandra***	NE	61	18	95				2	
Black-headed Bunting	***Emberiza melanocephala***	S	5	5	5 - 8					
Reed Bunting	***Emberiza schoeniclus***	H	1	0	0					

[1] count unit: individuals

[2] To not interfer with an international nest-box program by experts from Austria, Switzerland and Slovenia, nest-boxes are not inspected by our team since 2017. The present breeding numbers are based on observations of feeding adults and begging calls of juvenils. According to the National Parks of Montenegro, international experts counted 13 bp. and a total of 70 juv. in 2018 (www.nparkovi.me).

4. Water levels, 2016 - 2018

In June 2016 almost the whole salina – except the higher dams and some smaller basins of the 2nd evaporation grade (Evaporation II) – was flooded, following to high precipitation in late winter, spring floodings in late April and May, and exceptionally heavy rainfall of 159.4 litters/m^2 on the day before our survey in mid-June, i.e. the three-fold of the long-term monthly mean (Institute of Hydrometeorology and Seismology, Podgorica). In contrast, spring and early summer 2017 were very dry with crystallisation and most evaporation basins dried-out until the second survey in mid-June. After the repair of the Djerane pump (water influx), the salina management was pumping seawater into the salina during our visits in May and June 2018. Hence, following to the influx of seawater and occasional heavy downpours during both surveys, the water level in individual basins was rather high, but by far not as high as in June 2016.

5. Results

5.1 Species richness and breeding status

Since 2016, we found breeding evidence for 62 bird species in Ulcinj Salina, with 24 species of waterbirds, as defined by Wetlands International (cf. http://wpe.wetlands.org/lwhatrwb), constituting 39% of all breeding bird species. According to the EOAC criteria, 19 waterbird species (79%) were confirmed to breed or at least rated as probable breeding (Tab. 2).

Four potentially breeding waterbird species were seen only sporadically, in very low numbers and without further evidence of nesting (cf. Saveljić 2002, Tab. 1 in Stumberger *et al.* 2008). That concerns namely Ferruginous Duck *(Aythya nyroca)* and Pied Avocet *(Recurvirostra avosetta)* of which only individual birds were seen since 2016. In addition, a pair of Eurasian Oystercatcher *(Haematopus ostralegus)* was observed only once in June 2017, while 2 – 3 apparently "paired" Common Gull-billed Terns *(Gelochelidon nilotica)* were annually present in the salina (Tab. 2). The breeding status of these four species remains unclear.

Similarly, up to 14 Common Sandpipers *(Actitis hypoleucos)* regularly spent the summer in the salina. Like the former species, Common Sandpiper is seen mainly in pairs, but up to now we found no direct proof for breeding.

The breeding sites of most of the remaining non-passeriformes (12 species) and of many passerines (26 species) are restricted to the outer embankments, the main dams, the pump houses and the company ground. Besides Crested Lark *(Galerida cristata),* the most abundant passerines for which we have quantitative data, i.e. Great Reed-warbler *(Acrocephalus arundinaceus)*, Yellow Wagtail *(Motacilla flava)* and Corn Bunting *(Miliaria calandra)*, nest mainly in reedbeds, which are restricted to a few basins and to the banks of Porta Milena, in low grasslands, intermixed with scattered *Tamarix*-scrubs, and in halophytic vegetation in wet and dry evaporation basins.

5.2 Breeding populations

In June 2016, a few days after unusually heavy rains, we estimated a total waterbird population of 379 – 381 breeding pairs (bp.). In 2017, with much lower precipitation, the population amounted to an estimated 523 – 524 bp. and reached, with considerably higher spring precipitation, an estimated 555 - 582 bp. in 2018.

Except for the extremely low numbers in 2016, Collared Pratincole *Glareola pratincola* (176 – 187 bp.), Kentish Plover *Charadrius alexandrinus* (95 – 134 bp.), Little Tern *Sternula albifrons* (89 – 105 bp.) and Black-winged Stilt *Himantopus himantopus* (43 – 80 bp.) were the most abundant breeding birds (Tab. 2). Eurasian Thick-knee (*Burhinus oedicnemus*), Common Redshank (*Tringa totanus*) and Common Tern *(Sterna hirundo)* breed regularly but in considerably lower numbers. In contrast

to former surveys (cf. Stumberger *et al.* 2008), we noted comparatively high breeding numbers (Tab. 2) of Mallard *(Anas platyrhynchos)*, Little Grebe *(Tachybaptus ruficollis)*, Common Moorhen *(Gallinula chloropus)* and Common Coot *(Fulica atra)* in the salina.

In 2016 the breeding numbers of 'shore-associated' waders, like Kentish Plover and Collared Pratincole, and of Little Tern were unusually low. In 2016 Collared Pratincole reached less than 20% of its breeding numbers in 2017 and 2018 (Fig. 4). Similarly, the population sizes of Little Tern and Kentish Plover were by 24% - 35% and 12% - 37% smaller after the floods in spring 2016 in comparison to 2017 and 2018 (Fig. 4). At the same time most waders and terns, like Kentish Plover, Collared Pratincole, Black-winged Stilt and Little Tern, were concentrated in dense flocks in shallowly flooded evaporation and crystallisation basins (Fig. 5). In contrast the numbers of most 'freshwater-associated species' like Common Coot and Common Moorhen, as well as Mallard (Tab. 2), were highest in the flooded year 2016, lowest in the dry year 2017 and intermediate in the moderately wet year 2018 (Fig. 4).

Amongst the passerines Corn Bunting, Great Reed-warbler and Yellow Wagtail bred in considerably high numbers in 2016 and 2018 (Tab. 2). Eurasian Skylark *(Alauda arvensis)*, Black-eared Wheatear *(Oenanthe hispanica)* and Reed Bunting *(Emberiza schoeniclus)* were observed only occasionally, while the numbers of Zitting Cisticola *(Cisticola juncidis)* declined continuously over the last years from 19 bp. in 2016, to a single male in May 2018 (cf. Tab. 2).

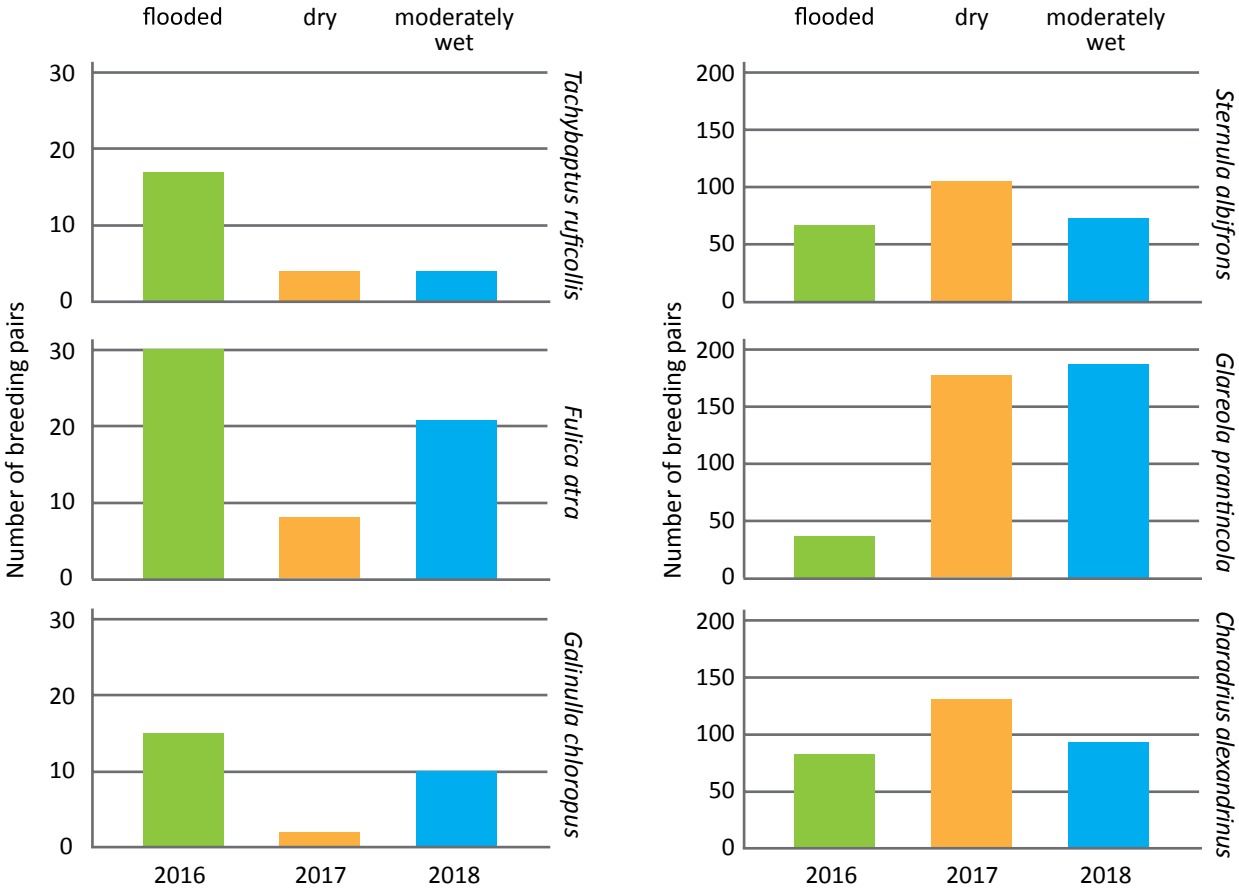

Fig. 4: Breeding populations of main 'shore-associated' (right) and 'freshwater-associated' species (left) and flood conditions in the Ulcinj Salina, Montenegro, in June 2016 – 2018. Note the differing scales on the y-axes.

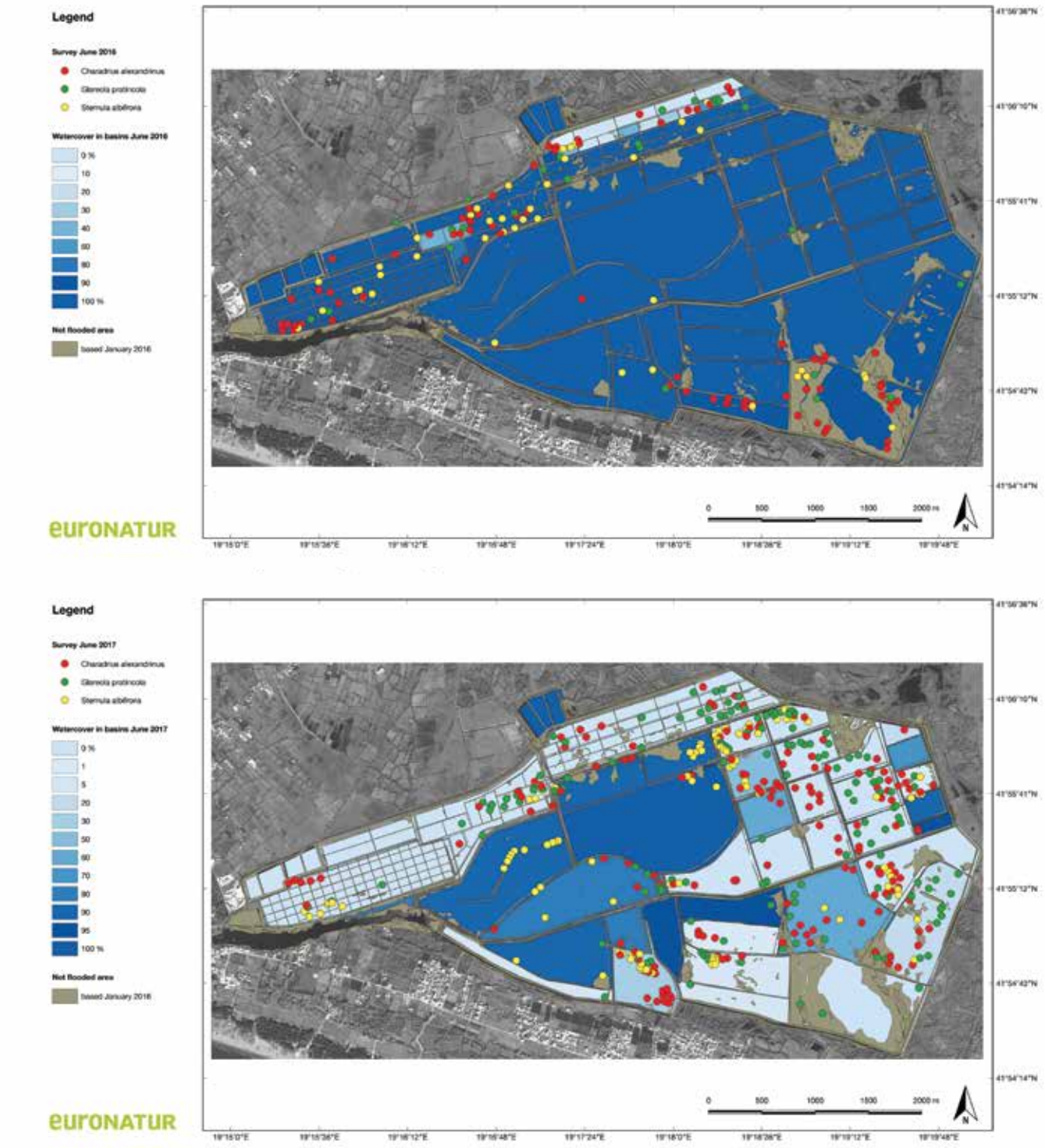

Fig. 5: Water surface and breeding distribution of Kentish Plover (*Charadrius alexandrinus*), Collared Pratincole (*Glareola pratincola*) and Little Tern (*Sternula albifrons*) in the Ulcinj Salina during the flooding in June 2016 and under dry conditions in June 2017. Circles show observation points and not necessarily the location of breeding territories or nesting sites.

5.3 Conservation status

During the surveys we recorded four breeding bird species in Ulcinj Salina that are listed as Near Threatened (3 species) or Vulnerable (1 species) in the IUCN Global Red List (Tab. 2 and 3; BirdLife International 2017). Three of them, together with an additional four species (i.e. seven species in total), are also listed as Near Threatened or Vulnerable in the European Red List of Birds and/or the Red List of the 27 member states of the European Union (BirdLife International 2015). Five of these seven species are listed as Vulnerable in Europe, the EU 27 or both. The other two species, Common Coot and Common Sandpiper, are listed as Near Threatened in Europe and in the EU 27, respectively (Tab. 3).

From the Red-listed species only Common Coot showed medium breeding numbers in the wet years 2016 and 2018. European Turtle-dove *(Streptopelia turtur)*, Common Redshank, Northern Lapwing *(Vanellus vanellus)* and Common Kingfisher *(Alcedo atthis)* all bred in small numbers but annually.

Additionally, four breeding species are listed by BirdLife International (2017) under SPEC 1 (European bird species of global conservation concern) and three further species under SPEC 2 (threatened or rare species whose global population is concentrated in Europe) (Tab. 2 and 3). While the breeding status of Ferruginous Duck and Eurasian Oystercatcher (both SPEC 1) was uncertain, European Turtle-dove (SPEC 1), Common Redshank (SPEC 2), Northern Lapwing (SPEC 1), European Roller *Coracias garrulus* (SPEC 2) and Corn Bunting (SPEC 2) bred in comparatively high numbers in Ulcinj Salina in 2016 - 2018. An additional 19 species, including many of which nest in high or very high numbers in the salina, are listed under SPEC 3, i.e. threatened species but whose global populations are not concentrated in Europe (Tab. 2 and 3).

For evaluating the significance of population numbers on the national and international level we used the latest estimates of population sizes in Europe and calculated, as shown in Tab. 4, the respective overall breeding populations for 10 Balkan countries (BirdLife International 2015, 2017). All numbers in Tab. 4 are given as breeding pairs, with the exception of Greater Flamingo *(Phoenicopterus roseus)*, whose populations were estimated as the number of individuals from conventional waterbird counts (marked ^{w}).

Tab. 3: Overview of the numbers of breeding bird species in the Ulcinj Salina listed in IUCN Red Lists, under SPEC criteria and in different Annexes of the EU Birds Directive.

Species	Red List Global	Red List Europe	Red List EU 27	SPEC	Birds Directive
VU Vulnerable	1	4	4		
NT Near Threatened	3	1	2		
SPEC 1				4	
SPEC 2				3	
SPEC 3				19	
Annex I					16
Annex IIA[1]					2
Annex IIIA[1]					1

[1] To our knowledge no Annex IIB & IIIB species have been declared by the Montenegrin authorities

Tab. 4: Number of pairs of breeding bird species in Ulcinj Salina, 2016 – 2018, and their proportions of the respective Montenegrin, Balkan and European breeding populations. From 62 breeding bird species in Ulcinj Salina, only those 31 that exceed the national 1% threshold are listed here (normal font). Nine species surpass the 1% threshold on the Balkans level (normal font) and one species even on the European level (bold font). Population estimates for the Balkan population are summed over 10 countries: Slovenia, Croatia, Bosnia-Herzegovina, Serbia, Kosovo, Montenegro, Albania, North Macedonia, *Greece and Bulgaria - according to BirdLife International (2017). bp. = breeding pair(s).*

Species	Salina Ulcinj 2016 - 18	Montenegro pop. (bp.)	Salina Ulcinj % Montenegro pop.	Balkan pop. (bp.)	Salina Ulcinj % Balkan pop.	European pop. (bp.)	Salina Ulcinj % Europ. pop.	European pop. trend
Tadorna tadorna	1 - 4	0 - 5	20 - 100%	389 - 685	0.2 - 1.0%	50,800 - 68,900	< 0.1%	Increasing
Anas platyrhynchos	4 - 9	30 - 100	4.0 - 30.0%	73,100 - 114,400	< 0.1%	2,850,000 - 4,610,000	< 0.1%	Stable
Tachybaptus ruficollis	3 - 17	800 - 1,200	0.3 - 2.1%	13,200 - 23,800	≤ 0.1%	129,000 - 208,000	< 0.1%	Uncertain
Phoenicopterus roseus[W]	149 - 1,064	149 - 1,064	100%[1]	5,800 - 11,200	1.3 - 18.4%	172,000 - 264,000	< 0.1 - 0.6%	Increasing
Clamator glandarius	1 - 2	[0]	100%	305 - 425	0.2 - 0.7%	84,100 - 252,000	< 0.1%	Increasing
Rallus aquaticus	1 - 9	500 - 1,500	0.1 - 1.8%	12,100 - 21,700	< 0.1%	157,000 - 346,000	< 0.1%	Uncertain
Botaurus stellaris	1	[50 - 80]	1.3 - 2.0%	459 - 754	0.1 - 0.2%	37,600 - 66,400	< 0.1%	Stable
Ixobrychus minutus	1 - 3	20 - 40	2.5 - 10%	6,600 - 12,200	< 0.1%	63,100 - 111,000	< 0.1%	Stable
Burhinus oedicnemus	13 - 22	30 - 60	21.7 - 73.3%	1,200 - 1,800	0.7 - 1.8%	53,400 - 88,200	< 0.1%	Increasing
Haemantopus ostralegus	0 - 1	2 - 5	20 - 50%	97 - 182	0 - 1.0%	284,000 - 354,000	0 - < 0.1%	Decreasing
Recurvirostra avosetta	0 - 1	1 - 2	100%	764 - 1,910	0 - 0.1%	58,400 - 74,300	0 - < 0.1%	Fluctuating
Himantopus himantopus	43 - 80	80 - 100	43 - 100%	2,200 - 3,800	1.1 - 3.7%	53,900 - 75,700	< 0.1 - 0.2%	Stable
Charadrius dubius	5 - 13	60 - 80	6.3 - 21.7%	6,900 - 11,300	< 0.1 - 0.2%	134,000 - 262,000	< 0.1%	Decreasing
Charadrius alexandrinus	84 - 134	60 - 80	100%	1,400 - 2,700	3.1 - 9.7%	21,500 - 34,800	0.2 - 0.6%	Decreasing
Vanellus vanellus	1 - 6	[0]	100%	5,200 - 11,200	≤ 0.1%	1,590,000 - 2,580,000	< 0.1%	Decreasing
Actitis hypoleucos	2 - 7	20 - 100	2.0 - 35%	1,300 - 2,300	< 0.1 - 0.6%	794,000 - 1,460,000	< 0.1%	Decreasing
Tringa totanus	8 - 15	30 - 80	10 - 50%	653 - 1,300	0.7 - 2.3%	340,000 - 484,000	< 0.1%	Decreasing
Glareola pratincola	34 - 187	100 - 120	28 - 100%	792 - 1,450	2.3 - 12.9%	7,800 - 14,900	0.2 - 2.4%	Decreasing
Larus michahellis	2 - 5	70 - 100	2.0 - 7.1%	155,500 - 209,000	< 0.1%	409,000 - 534,000	< 0.1%	Increasing
Sternula albifrons	68 - 105	90 - 120	57 - 100%	2,200 - 3,500	1.9 - 4.7%	36,000 - 53,000	0.1 - 0.3%	Uncertain
Gelochelidon nilotica	1	[0]	100%	183 - 293	0.3 - 0.6%	16,000 - 21,000	< 0.1%	Increasing
Sterna hirundo	1 - 11	30 - 60	1.7 - 37%	2,700 - 4,300	< 0.1 - 0.4%	316,000 - 605,000	< 0.1%	Increasing
Circus aeruginosus	0 - 1	10 - 20	0 - 10%	736 - 1,100	0 - 0.1%	99,300 - 184,000	0 - < 0.1%	Increasing
Coracias garrulus	5 - 10	15 - 25	20 - 67%	2,600 - 9,100	0.1 - 0.4%	37,700 - 79,200	< 0.1%	Decreasing
Cisticola juncidis	1 -19	[20 - 60]	1.7 - 95%	21,600 - 34,100	≤ 0.1%	922,000 - 2,140,000	< 0.1%	Stable
Acrocephalus scirpaceus	0 - 4	[160 - 800]	0 - 2.5%	54,700 - 93,600	0 - < 0.1%	2,120,000 - 3,880,000	0 - < 0.1%	Stable
Acrocephalus arundinaceus	47 - 66	[1,500 - 2,500]	1.9 - 4.4%	131,800 - 230,900	≤ 0.1%	2,600,000 - 4,680,000	< 0.1%	Unknown
Motacilla flava[2]	16 - 40	1,200 - 1,500	1.1 - 3.3%	259,200 - 685,300	≤ 0.1%	9,630,000 - 16,000,000	< 0.1%	Decreasing
Miliaria calandra	18 - 95	[3,000 - 6,000]	0.3 - 3.2%	898,900 - 2,031,500	≤ 0.1%	18,300,000 - 31,300,000	< 0.1%	Stable
Emberiza melanocephala	5 - 8	[300 - 400]	1.3 - 2.7%	145,100 - 304,800	≤ 0.1%	2,470,000 - 8,160,000	< 0.1%	Decreasing
Emberiza schoeniclus	0 - 1	[10 - 100]	0 - 10%	9,100 - 17,600	0 - < 0.1%	4,060,000 - 7,020,000	0 - < 0.1%	Decreasing

Of 44 bird species, for which total breeding bird counts are available for Ulcinj Salina (see Tab. 2), 31 (71%) surpass the 1% threshold of their respective national population and one third even the 10% threshold. Besides the old Tivat Salina, Ulcinj Salina is for at least 6, including Greater Flamingo, but possibly up to 10 waterbird species the only known breeding site in Montenegro. In addition, according to the current population numbers, the Ulcinj Salina constitutes, by far, the most important breeding site for at least 6 waterbird species in the country: Of Common Shelduck, Black-winged Stilt, Northern Lapwing, Kentish Plover, Collared Pratincole and Little Tern the salina holds ≥ 20% of the national population (Tab. 4).

On the international level the breeding numbers of a minimum of five, but possibly up to 9 species surpass the 1% threshold of their respective Balkan population (cf. Tab. 4). The numbers of Black-winged Stilt (1.1% – 3.7%), Little Tern (1.9% - 4.7%), Kentish Plover (3.1% - 9.7%) and Collared Pratincole (2.3% - 12.9%) constitute particularly high proportions of their overall breeding population for all 10 Balkan countries. In addition, up to 18% of Greater Flamingo that winter on the Balkan Peninsula, are regularly counted in Ulcinj.

Finally, Ulcinj Salina is a particularly important site for Collared Pratincole. Aside of the unusually low breeding numbers during the floods in June 2016, with 170 – 190 bp. the salina currently holds up to 2.4% of the European population (Tab. 4).

6. Discussion

6.1 Breeding status - losses and gains

The initial surface area of the evaporation basins in the Ulcinj Salina of 8.6 km^2 (construction from 1926 – 1934) was enlarged to 9.3 km^2 in 1959 and to 14.5 km^2 in 1980 (Radović 2008). Therefore, older reports on breeding numbers are hardly comparable with recent count data from the time after 1980 (Saveljić 2002, Schneider-Jacoby *et al.* 2006, Stumberger *et al.* 2008). However, since the first breeding surveys in the salina in its present shape in the late 1980s, Eurasian Oystercatcher (1988 1 bp., 1994 4 bp.) and Pied Avocet (1988 7 bp.) vanished as regular breeding species (Puzović *et al.* 1992, Puzović 1994), and, in 2000 and 2001, shortly after the ethnic upheavals in former Yugoslavia, the population size of almost all breeding bird species showed an all-time low (Saveljić 2002).

Furthermore, in retrospect, some former judgements on the breeding status, summarized in Tab. 1 and Annex 2 in Stumberger *et al.* (2008), may have been too optimistic. Caspian Tern *(Hydroprogne caspia)*, e.g., is almost annually present in low numbers in May and June. But, similar to Common Gull-billed Tern or Slender-billed Gull *(Larus genei)*, these birds often concern late migrants or non-breeders who spend the summer months away from the species main breeding areas.

In the same way some waterfowl may over-summer in the area. In particular ducks and waders wounded from gunshot or weakened from diseases sometimes spend months in the salina. These birds were, without further evidence that they at least meet the EOAC criterion for "probable breeding", not listed as breeding species in this paper (cf. Garganey *Spatula querquedula* and Northern Shoveler *Anas clypeata* in Tab. 1, Stumberger *et al.* 2008).

On the other hand, some cryptic and crepuscular species, like Western Water Rail and Common Little Bittern, were possibly overlooked in former surveys. Observations of small chicks in downy plumage of Common Shelduck (Fig. 6) and Northern Lapwing, in June 2018, constitute the first direct proof for breeding. We further documented the breeding of Mallard, Little Grebe and Common Coot who up till now were unknown to nest in the salina (cf. Tab. 1 and Appendix 2 in Stumberger *et al.* 2008).

Additionally, in the first draft of the management plan, prepared by Stumberger *et al.* (2008), the

Photo: Peter Sackl

Fig. 6: Common Shelduck (*Tadorna tadorna*) chick. Salina Ulcinj, Montenegro, 28 June 2018

establishment of a breeding colony of Greater Flamingo was identified as a main goal for the conservation management of the Ulcinj Salina. With maxima of up to 1,400 and 2,100 birds, the numbers of flamingos who use the salina year-round for feeding and roosting, increased dramatically between 2010 and 2014 (CZIP & EuroNatur, *unpubl. data*). In spring 2013, shortly after the formation of a first breeding colony of around 175 bp., almost all eggs disappeared from nests overnight without any trace (M. Jovićević, *pers. comm.*). Later breeding attempts, between 2014 and 2016, were abandoned after spring floods or following to human disturbances (Fig. 7). Since 2016 maxima of up to 1,100 flamingos were counted in the salina. Although we found no further proof for breeding, following to the species high life expectancy, nest-site fidelity and erratic breeding habits, the birds are expected to breed under adequate conditions in the future.

Photo: Peter Sackl

Fig. 7: Over the last years Greater Flamingo (*Phoenicopterus roseus*) initiated nesting colonies on lower dykes and in different evaporation pans. But, so far, all breeding attempts failed. Salina Ulcinj, Montenegro, 11 April 2014

6.2 Habitat conditions and bird populations after salt production

Salinas are artificial habitats in which water levels in evaporation basins change with the annual cycle of salt production. Following to seasonally regular and predictable fluctuations of water levels and salinity, salinas are particularly important feeding and breeding habitats for estuarine waterbirds (Múrias *et al.* 2002, Masero 2003, Fonseca *et al.* 2005). While the reaction of bird communities may vary with local conditions, experts generally agree that the abandonment of salt production and the transformation of industrial salinas to other uses have negative effects on the highly specialized bird fauna of this habitat. For instant, Paracuellos *et al.* (2002) found in Portugal that numeric species diversity increased following abandonment, but that the numbers of Greater Flamingo, Pied Avocet and of some other specialised shorebirds declined after the cessation of salt production (cf. also Fonseca *et al.* 2005, Birtsas *et al.* 2011).

In the Ulcinj Salina, like in other Mediterranean salt-works, industrial salt production usually started in late April by pumping seawater into 1st grade evaporation basins. Afterwards, from June onwards the water surface and salt concentration in basins of different evaporation grades was rather constant until September/October (Radović 2008, Stumberger *et al.* 2008). Recent analyses of land structure and flooding conditions showed that the ineffectiveness and temporary breakdown of the pumping system after the privatisation of the salina company has led to longer and unpredictable flooding periods during winter and spring (Schwarz & Sackl 2017).

The effect of short-term fluctuations of water levels on breeding birds is well illustrated by the repeated floods in spring 2016. In June, shortly after particularly heavy rains, most waders who had, apparently, lost clutches or small chicks during the rains (Fig. 8), were concentrated in dense flocks in lower flooded evaporation and crystallisation basins. In contrast, in 2017 and 2018, ground-nesting shorebirds, in particular Collared Pratincole and Kentish Plover, benefited from much drier conditions and lower water levels by doubling their breeding numbers (Fig. 4 and 5).

Photo: Peter Sackl

Fig. 8: Juvenile Black-winged Stilt (*Himantopus himantopus*) drowned during the floods in 2016. Salina Ulcinj, Montenegro, 15 June 2016 (Photo: Peter Sackl).

The disruption of the water management since the salina's privatisation further favoured the breeding of waterbird species that are normally associated with freshwater habitats. In particular Little Grebe and Common Coot which were formerly unknown to breed in the salina and were present only in small numbers along the main canals and the deeper storage ponds during autumn and winter counts. Simultaneously, the breeding population of Mallard and Common Moorhen has increased considerably since the 2000's (Stumberger *et al.* 2008).

At the same time, in the basins in the south-eastern part of the salina, which are known as the *kneta*, but also in some other parts, the development and extension of reed beds and terrestrial shrub succession has been observed over the last 10 – 15 years (Schwarz & Sackl 2017). A conspicuous extension of reed beds is further evident along the inner main canal and in adjoining basins of the 2nd evaporation grade (Evaporation II). While rails, Great Reed-warbler and possibly ducks will benefit from the invasion of reeds, the shallow flooded basins of the *kneta* currently harbour almost half of the salina's breeding population of Little Tern, Collared Pratincole and Kentish Plover (Fig. 5). Hence, in the long-term an inefficient water management will further increase reed and shrub succession in these areas, which will impair the extent and quality of breeding habitats for key breeding bird species typical for the salina (e.g. Fonseca *et al.* 2005, Birtsas *et al.* 2011).

Photo: Peter Sackl

Fig. 9: Breeding habitat of Collared Pratincole (*Glareola pratincola*) in one of the species' main nesting area in the *kneta*, 28 June 2018.

Photos: Peter Sackl

Fig. 10: On the left, bowing-display, part of the species' courtship behaviour (3 May 2017) and, right, clutch of Collared Pratincole (*Glareola pratincola*) in a dried up cowpat, 28 June 2018, Salina Ulcinj, Montenegro.

6.3 Conservation significance and management implications

The periodically flooded mudflats in the evaporation and crystallisation basins of Ulcinj Salina are covered by loose stands of halophytes. Along the rocky shores of the eastern Adriatic Sea coastal lagoons with marine sand and mudflat habitats are extremely rare and restricted to a few, usually much smaller and largely scattered sites. In the European Union most of the latter, saline and hypersaline habitats are especially protected under the Fauna-Flora-Habitat (FFH) Directive. Due to the shear extent of its open mudflats and saltmarsh habitats the Ulcinj Salina harbours large numbers of estuarine waterbird species, of which several have an unfavourable conservation status and declining population trends in Europe (BirdLife International 2015).

The high concentration of breeding waterbirds in the Ulcinj Salina, in comparison to their numbers in other Balkan countries (BirdLife International 2017), is outstanding along the eastern Adriatic coast where similar breeding habitats are extremely scarce. In Montenegro the respective habitats exist only in Tivat Salina, which has a surface area of about 150 ha, i.e. only 10% of the size of Ulcinj Salina. Subsequently, the salina in Ulcinj is by far the most important or even the only breeding site for at least 6 but, most probably, of up to 10 waterbird species in the country. With a total of 16 breeding bird species that are listed under Annex I of the European Union's Birds Directive, the area harbours one of the highest concentrations of Eurasian Thick-knee, Black-winged Stilt, Kentish Plover, Collared Pratincole and Little Tern on the Balkan Peninsula (Tab. 4). After all, the salina is a particularly important site for Collared Pratincole (Fig. 9 and 10). To our knowledge, with 170 – 190 bp. Ulcinj Salina currently holds one of the highest breeding concentrations of the species within a single site in South-East Europe (Hagemeijer and Blair 1997, BirdLife International 2017).

In the eastern Adriatic region breeding densities of estuarine waterbirds in comparable magnitudes are only known from the Sečovlje Salina in Slovenia. With 750 ha the Nature Park Sečovlje Salina, near Piran, has about half of the size of Ulcinj Salina, but is much better preserved and specifically managed for bird conservation (Škornik 2012).

BirdLife International lists Ulcinj Salina as an Important Bird Area (IBA) in danger. While it is known for years that the salina fulfils six of the nine criteria for a Wetland of International Importance under the Ramsar Convention (Saveljić *et al.* 2007), the Montenegrin Government nominated the area as a Ramsar site only in 2019. On the national level Ulcinj Salina was formally protected as a nature park as late as 2019 and is, unfortunately, not managed in the way that it deserves based on the biodiversity it (still) holds. Nevertheless, the comparison with the breeding numbers in Sečovlje demonstrate the potential, which Ulcinj Salina still has for waterbird conservation.

Despite the ineffective water management, the absolute numbers of breeding waterbirds in Ulcinj Salina have not changed substantially over the last 10 – 15 years. Based on conventional summer counts overall breeding populations of waterbirds for the years 2003 – 2006 were estimated at roughly 329 – 649 bp. by Stumberger *et al.* (2008), while current numbers in 2016 – 2018, for the same species as given in Tab. 1 by Stumberger *et al.* (2008), vary between 319 and 525 bp. While the absolute numbers of the two time periods are not directly comparable due to different methods of the assessments, they nevertheless provide a first indication of a change in species composition of Ulcinj Salina. Partially this can be explained by the compensation of downward trends in some 'shore-associated' species (e.g. Black-winged Stilt, Common Redshank, Common and Little Terns, Yellow-legged Gull) by upward trends in 'freshwater-associated' species (e.g. Mallard, Common Coot, Common Moorhen, Little Grebe) and other 'shore-associated' species (e.g. Kentish Plover, Collared Pratincole, Eurasian Thick-knee).

The temporary breakdown of the pumping system from 2013 – 2017, which is still not fully operational, as well as the successive decay of the main dams and dykes hamper the removal of rainwater from the crystallisation and evaporation basins. In addition, partial damage of the outer embankments favours the incursion of freshwater from the outer canal and adjoining marshlands (Schwarz & Sackl 2017). In contrast to undisturbed coastal saltwater systems, the salina is completely separated from its former inlet, Porta Milena, and from the sea. Subsequently, without adequate management the area will continue to change gradually towards a freshwater ecosystem and loose its function as a main breeding habitat for many estuarine waterbirds.

7. Conclusions

Ulcinj Salina was and still is one of the most important breeding sites for waterbirds (and especially shorebirds) along the Eastern Adriatic Coast. For 11 waterbird species, including Greater Flamingo, Ulcinj Salina is the only or at least the most important breeding site in Montenegro, and with a total of 16 breeding bird species that are listed under Annex I of the European Union's Birds Directive, the area holds one of the highest breeding concentrations of estuarine waterbirds on the Balkan Peninsula.

However, the habitat character of the salina has changed since the salt production was stopped in 2013 due to the lack of active water management, the subsequent incursion of fresh water and the extension of reeds. A comparison with older data indicates a beginning change in the site's species composition from salt- to freshwater-associated species. Urgent and significant management measures are needed if the saline character of Ulcinj Salina with its 'shore-associated' breeding bird fauna should be maintained.

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Photo: Lorand Vigh

Breeding colony of Whiskered Tern (*Chlidonias hybrida*), Jegrička fishpond, Serbia, June 2012

The influence of abiotic factors on the nesting dynamics of Whiskered Tern (*Chlidonias hybrida*) at Jegrička fishpond in the period 2009 - 2013

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Summary

The nesting of Whiskered Tern *(Chlidonias hybrida)* was studied on the Jegrička fishpond near Žabalj (Bačka, UTM DR22) between 2009 and 2013. At two sites a total of 287 nests, i.e. 33 – 93 breeding pairs p.a., were counted over the study period. All nests were located on the leaves of a floating plant community of White Water Lilies *(Nymphea alba)* and primarily built of pondweed. The numbers of breeding pairs showed pronounced annual fluctuations. In order to determine the main drivers of these changes we analysed the correlative relationships between different abiotic factors - air temperature, precipitation and water level - and the annual numbers of breeding pairs. The results are presented in scatter plots and its statistical relevance was tested with Pearson's Correlation Coefficient and the Coefficient of Determination. The strongest correlation was found between breeding numbers and precipitation in which rainfall explained 63% of the annual fluctuation of the number of breeding pairs. Water level and air temperature show a weaker but negative correlation with breeding numbers.

Keywords

breeding biology, Whiskered Tern, Chlidonias hybrida, water level, Serbia

1. Introduction

European populations of Whiskered Tern *(Chlidonias hybrida)* are migratory and winter on the larger lakes of Africa (del Hoyo *et al*. 1996). The nesting period starts from mid-May onwards and lasts until the end of June. The species builds its nest with plant materials which the birds take mainly from the water surface. Nests are normally situated on floating vegetation. Whiskered Tern breeds colonially in monospecific colonies of 10 - 100 breeding pairs (bp.). Within colonies distances between neighbouring nests fluctuate between 1 m and 5 m (del Hoyo *et al*. 1996). In Europe colonies are normally small, rarely over 50 bp. Only along the great rivers and in deltas larger nesting colonies exist (van der Winden 1997). In Serbia the species nests only on eutrophic waters with a well developed and structured aquatic vegetation (Tucakov *et al*. 2009).

In the area of Jegrička Whiskered Tern is known to breed since the second half of the 20th century. The first published data on the nesting of the species in the area dates from 1975 when one clutch was collected (Garovnikov 2006). In 1982, 4 bp. were recorded in a colony in the vicinity of Gospođinci (UTM DR23; 45.24.59 N, 20.00.05 E), while in 1992 a second colony (UTM DR23; 45.24.45 N, 20.01.01 E) held 7 bp. (Balog, *unpubl. data*). Ternovac (1991) recorded 8 nests at two sites in 1989 and according to the same publication 6 - 8 bp. were present in 1990. However, until 2008 further information on the nesting of Whiskered Tern in the area of Jegrička fishpond are lacking. In that year the whole region of Jegrička was surveyed and 5 breeding colonies were found. The largest colony held 85 - 92 bp., i.e. 42.2% of the total breeding population in Jegrička (Tucakov *et al.* 2009).

Numerous studies have shown that the local climatic conditions have an impact on the survival and reproduction of birds (Rodríguez & Bustamante 2003). Like for other birds that nest on the surface of floating vegetation, the destruction and decay of plants, e.g. from improper vegetation management, and bad weather are the main causes for nest loss and poor nesting success in Whiskered

Tern (Tomialojc 1994, van der Winden 1997). Nest building depends on the availability of adequate nesting sites, in particular, carpets of White Water Lily *Nymphaea alba*) and nesting materials (parts of plants) as well on precipitation that can delay nesting (Bakaria *et al.* 2009). Paillisson *et al.* (2006) investigated the impact of the change of the water regime on the development (biomass) of White Water Lily and the numbers of Whiskered Tern in a freshwater lake in western France. The authors determined the appropriate water regime that influences the controlled development of floating vegetation and that, at the same time, corresponds to the breeding requirements of Whiskered Tern. Végváry (2003) explores the habitat conditions for the nesting of certain species of migratory birds, including terns, in the Hortobagy National Park in Hungary. However, in Serbia, there are no published data on the influence of abiotic factors on the nesting of Whiskered Tern.

The aim of this paper is to determine the influence of abiotic factors, i.e. air temperature, precipitation and water regime, on the breeding numbers of Whiskered Tern in the Jegrička fishpond.

2. Study area

Jegrička River, once one of the longest autochthonous rivers in the northwestern part of Vojvodina, has a catchment area of about 144,200 ha. The river crosses the loess terrace between the Mali Bački canal near Despotovo in the west and flows into the Tisa River near Zabalj to the east. With the construction of the Savino Selo-Novi Sad channel in the last century, its main course was cut near Despotovo in the northwest-southeast direction. For a length of 64 km the river became part of the Danube-Tisa-Danube channel network. The most important habitat characteristics as a typical lowland watercourse are determined by the geographical position, the geomorphological and hydrological characteristics of the area. The mosaic of aquatic, marshy, meadow and saline habitats encourages the presence of a large number of rare and endangered species. Following to its importance for bird conservation Jegrička was declared a protected area as a Nature Park in 2005 (Decision on the Protection of Nature Park "Jegrička", Official Gazette of the Municipality of Zabalj, No. 11/05).

Jegrička fishpond is situated in the last 15 km of the Jegrička River, including its outlet into the Tisa River, which covers an area of 325 ha of which the pond covers 319 ha. With the river's usual water level at 75.30 masl the lake has a volume of 4.688.000 m^3. The pond was built in 1954 and is managed by the company "DTD Ribarstvo doo" from Bački Jarak. The existence of a pond within the protected area has multiple consequences, not only for the section in which it is located, but also for the upstream section of the Jegrička River. In the stagnant water economically important species dominate. Fish is harvested each year in autumn by sluicing the pond. Northwest of the pond exist two factories that have a direct impact on the protected area: NIVA and Šajkaška Sugar Plant. Originally after purification wastewater from the production process was released into the river close to Jegrička fishpond. The purifier still exists, but it is not in function. The sugar plant Šajkaška (Fig. 1) is located at the very border of the protected area. Water for washing raw materials is delivered by a pipeline from the Jegrička River, and released as sludge into the sedimentary lagoon near the Jegrička River (Kovačev 2012).

Due to the proximity of the sedimentary lagoon and the slower flow of water, sludge from the factory that contains huge amounts of organic materials, accumulates in this part of the Jegrička River. As a result of the sedimentation process dense reeds have grown in the lagoon that now form a peninsular that constantly expands. From 2007 – 2011 on the southeastern edge of this peninsular, towards the open water, and around smaller reed islands that were later formed, a floating carpet of White Water Lily of the plant community *Nymphaeetum albae* that is surrounded by a belt of

the Yellow Floating Heart *Nymphoidetum peltate* association, has grown. Fig. 2 shows the change of the size and composition of the surface area of floating vegetation (cf. the brighter green area with the darker green area of reeds). The location of the two breeding colonies of Whiskered Tern, K1 and K2, are marked in red.

Based on Fig. 2 and published data for the year 2008 (Tucakov *et al.* 2009) it is assumed that the colony K1 was formed in 2007, parallel to the development of floating vegetation. K2 is situated about 500 m to the northeast of K1. The foundation of this colony can be tied to the period 2007 - 2011.

Photo: Lorand Vigh

Fig. 1: View from Jegrička fishpond to Šajkaška Sugar Plant near Žabalj.

Fig. 2: Satellite imagery of a part of Jegrička fishpond with the two nesting colonies of Whiskered Tern (*Chlidonias hybrida*). The left image was made on 14 March 2007 and the right one on 19 September 2011. The breeding colonies are marked as K1 and K2. Source: GoogleEarth-Historical Imagery.

3. Methods

Breeding surveys of Whiskered Tern on Jegrička fishpond were performed once per year between 2009 and 2013. Over the years surveys were carried out during different phases of the reproductive period. Hence, in some years the number of active nests may not include delayed or abandoned nests as well as second clutches that were laid later during the breeding season. Bearing in mind that the formation of the colony at the start of the breeding period was not determined, deviations from the real numbers of breeding pairs are possible, but the differences are probably minimal.

Colony size was determined by counting nests during incubation, i.e. counting birds sitting on the nest and incubating eggs (Tucakov *et al.* 2009). Birds were counted repeatedly from the boat by observing with and without binoculars and from all sides of the colony. Surveys lasted 20 - 40 minutes per colony. Dates of field surveys are given in Tab. 1.

As abiotic factors average air temperature, precipitation and water level for the May-June period which coincides with the period of colony formation, were taken into account. Data on water level, measured at the pumping station in Žabalj, were obtained from Vode Vojvodine Public Water Management Company, while data on air temperature and precipitation were provided by the Republic Hydrometeorological Institute for the weather station "Rimski Šančevi", Novi Sad (cf. Tab. 2).

The relationship between breeding numbers (bp.) and the respective abiotic factor is shown graphically in a scatter plot. To measure the direction and strength of the relationship the Pearson correlation coefficient r was calculated. The correlation coefficient was determined for all three abiotic factors: r_t - air temperature, r_p - amount of precipitation, and r_v - water level.

The value of r varies from +1 (perfect positive correlation) to -1 (perfect negative correlation). Actual values are interpreted in the following way: r = 0 to ± 0.25 - no connection, r = ± 0.26 to ± 0.50 - poor connection, r = ± 0.51 to ± 0.75 - moderate to good connection, and r = ± 0.76 to ± 1 - very good to excellent connection between the breeding numbers/year and the respective abiotic factor. The sign of the coefficient indicates the direction of the correlation, whether it is positive or negative. In order to determine the percentage of the fluctuation of the dependent variable, i.e. the number of bp., that is explained by the variation of the independent variable, i.e. the respective abiotic factor, the Coefficient of Determination R was calculated: R_t - air temperature, R_p - amount of precipitation, and R_v - water level.

4. Results

4.1 Breeding numbers

During the five-year research period a total of 287 bp. of Whiskered Terns were recorded in two separate locations. With an average number of nests per year of 57.4, total breeding numbers fluctuated between 33 and 93 bp. (Tab. 1). Most nests were registered at the K1 site and all nests were located on the floating leaves of White Water Lily. Nests were mainly built from parts of Eurasian Watermilfoil *Myriophyllum spicatum*.

Tab. 1: Breeding numbers of Whiskered Tern (*Chlidonias hybrida*) on Jegrička fishpond, 2009 – 2013.

Date	*Number of pairs locality K1*	*Number of pairs locality K2*	*Total number of pairs*
04 July 2009	33	0	33
07 August 2010	68	25	93
29 July 2011	37	0	37
03 June 2012	50	0	50
19 July 2013	41	33	74

Photo: Lorand Vigh

Fig. 3: Breeding Whiskered Terns (*Chlidonias hybrida*) in the colony on Jegrička fishpond.

4.2 Influence of abiotic factors on colony size

Tab. 2: Annual mean of air temperature, rainfall and water level in May and June (Information source: Republic Hydrometeorological Service of Serbia - Meteorological yearbooks, PWC "Vode Vojvodine").

Average values for the period May-June			
Year	*Air temperature (°C)*	*Rainfall (mm)*	*Water level (masl)*
2009	19,1	88,8	75,43
2010	18,6	142,75	75,30
2011	18,85	49,95	75,39
2012	20,25	39,85	75,28
2013	18,8	121,9	75,41

Results of the correlation analyses are shown in Tab. 3.

Tab. 3: Results of correlation analyses between abiotic factors and the annual numbers of breeding pairs of Whiskered Tern (Chlidonias hybrida) in Jegrička fishpond, Serbia, 2009 – 2013.

Abiotic factor	*Pearson's Correlation Coefficient (r)*	*Coefficient of Determination (R)*
Air temperature	r_t = - 0,39	R_t = 0,15
Rainfall	r_p = 0,79	R_p = 0,63
Water level	r_v = - 0,44	R_v = 0,19

Air temperature

The descending line of the diagram in Fig. 4 indicates that the air temperature and the numbers of bp. are negatively correlated, i.e. breeding numbers decline with higher temperatures. The value of r_t = - 0.39 indicates that the strength of the relationship is weak. The value obtained for R_t = 0.15 further indicates that only 15% of the variation of breeding numbers are explaind by air temperature.

Precipitation

The amount of precipitation and the breeding numbers of Whiskered Tern are positively correlated (Fig. 5). With r_p = 0.79 the connection is very strong and statistically relevant. The value for R_p = 0.63 indicates that the amount of precipitation explains 63% of the variation of the breeding numbers per year.

Water level

The diagram in Fig. 6 shows a weak negative correlation between breeding numbers and the water level of Jegrička fishpond (r_v = - 0.44). Also the Coefficient of Determination R_v = 0.19 is low.

5. Discussion

The results of the present study show a close relationship between precipitation and the yearly number of nesting Whiskered Tern. On the other hand a negative, but only weak correlation between the breeding numbers and air temperature and the water level were found.

Hence, in the year with the lowest air temperature of 18.6 ^{0}C (two-month average for May – June) the largest number of breeding terns were noted. However, due to the lack of published data on the influence of this factor on the nesting of Whiskered Tern, additional research is needed to determine the existence of this correlation.

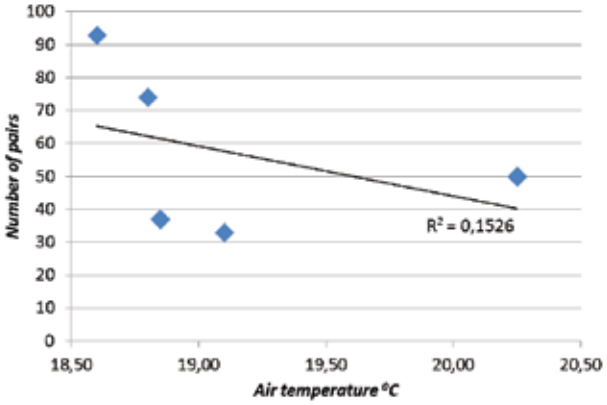

Fig. 4: Relationship between the mean air temperature (May – June) and the annual breeding numbers of Whiskered Tern (*Chlidonias hybrida*) in Jegrička fishpond, Serbia, 2009 – 2013.

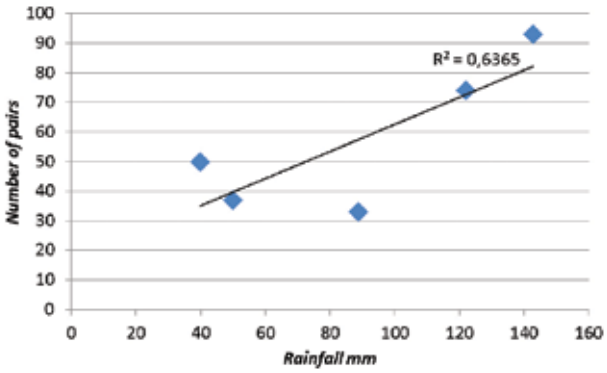

Fig. 5: The relationship between the amount of rainfall in May and June, and the annual breeding numbers of Whiskered Tern (*Chlidonias hybrida*) in Jegrička fishpond, Serbia, 2009 – 2013.

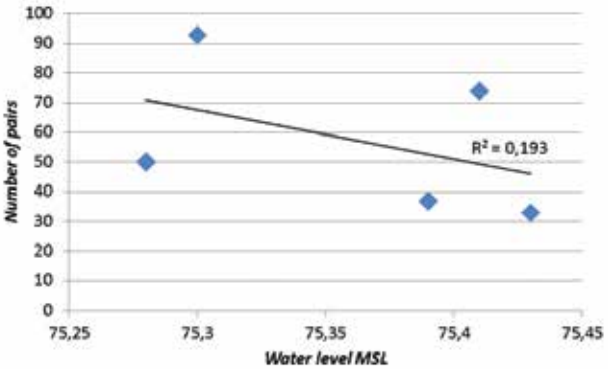

Fig. 6: Correlation between the mean water level (May –June) and the annual breeding numbers of Whiskered Tern (*Chidonias hybrida*) in Jegrička fishpond, Serbia, 2009 – 2013.

The average amount of precipitation in May and June showed the strongest variation over the years of the present study. These could be, at least partly, the reason for the high impact of precipitation on the number of breeding pairs. However, the strong interaction between both variables must be explained from an ecological point of view. In Tab. 1 it can be seen that, over the years, the annual nest survey was carried out during different periods of the year. In particular, in 2010 the breeding survey was conducted very late in early August. Therefore the 2010 numbers may be biased towards replacement clutches and second broods. But, given that in 2010 also the highest amount of precipitation was measured, it is obvious that the breeding season 2010 has been prolonged due to high precipitation in May and June (Bakaria *et al.* 2009) and that, therefore, any deviation from the real values may be less pronounced. It is also interesting to point out that the colony K2 (Fig.2) was active during years with an average precipitation above 100 mm. High precipitation during spring may encourage the formation of small ephemeral ponds through the flooding of natural depressions in meadows and pastures and such provide better feeding conditions which could be one of the key factors for choosing a breeding site. Végvári (2003) explains this phenomenon by the idea that more extensive aquatic habitats provide higher food availability and more potential nesting sites. Presumably, air temperature and precipitation have together a stronger joint effect than each individual parameter. Thus, for example, during the present study the years with the highest breeding numbers coincide with the lowest values of air temperature and the highest amount of precipitation.

A moderate negative correlation between water level and annual breeding numbers can be accounted to high spring water levels and the resulting delayed development of floating vegetation (Paillisson *et al.* 2006). In a large number of bird species, especially in Charadriiformes, it is well known that breeding performance decreases with the advancement of the nesting season (e.g., Parsons 1975, Coulson & Thomas 1985, Sydeman *et al*. 1991, Becker 1995, Arnold *et al*. 2004). Jegrička fishpond is characterized by a relatively low fluctuation of water level. Over the present study the water level in May and June ranged from 5 cm to 15 cm. The most significant and sudden fluctuation was observed in 2009 when water level dropped from 75.50 m masl in May to 75.35 m masl, or for 15 cm, in June. In contrast to 2009, in the remaining years the water level increased from May to June for 5 cm in 2012 and 2013, for 7 cm 2011 and for 10 cm in 2010. Thus, the absolute minimum of 33 bp. coincides with the most significant change of water level in 2009. According to Bakaria (2002) the decline of water level is a significant factor that affects nesting success. In an Iranian wetland Sehatisabet & Nezami (2007) found that the sudden decline of water level directly affected the nesting of Whiskered Tern. In addition, water level affects the development of floating vegetation. Namely, high water levels encourage the rapid growth of coastal vegetation, primarily rushes and reeds, at the expense of floating vegetation. Hence, the intensive growth of coastal vegetation in tern colonies can be of decisive importance (Végvári 2003).

Concerning the possibility to manage water level, Jegrička fishpond is a very important breeding site of Whiskered Tern in Serbia. In 2008 2,231 - 2,483 bp. were counted for the country. Of all 19 breeding colonies, 5 colonies were recorded along the whole watercourse of the Jegrička River. With a total of 211 - 218 bp. this is more than 9% of the national population (Tucakov *et al.* 2009). Throughout the region habitat change, like the decline of groundwater level, drainage, management of water regime that does not correspond to natural processes, mowing or the removal of floating vegetation, eutrophication and overgrowing with reeds, greatly affect the fluctuation of some local populations. However, aside of the relatively large area of floating vegetation and of food availability, the absence of human disturbances in the protection area plays likely an important role for the development of the colony on the fishbond. Therefore,

the protection of the fishpond greatly contributes to the protection of the species on the national and international level. The flooding of adjoining wet meadows and pastures would further increase the attractiveness of the area for Whiskered Tern and other protected species (Paillisson *et al.* 2002). However, Whiskered Tern is a rather erratic species. In some sites nesting can be interrupted and the colony abandoned even though habitat conditions are favourable (e.g., Trotignon *et al.* 1994, Mužinić & Delić 1997).

Paillisson (2006) concludes in his study that there is a close relationship between water management, the development of the biomass of water lilies and the breeding phenology of Whiskered Tern. According to literature, colony size is further correlated with the surface area of wetland habitats (Végvári 2003). Following to the relationship between breeding numbers and habitat conditions, of all five nesting colonies along the Jegrička River the Jegrička fishpond harbours the largest portion of the total breeding population (42.2% of all bp. in 2008). Upstream of the fishpond the river is largely eutrophicated and the surface area of open water is lower.

To ensure the long-term maintenance of adequate nesting habitats activities that will slow down succession are needed. In particular, in the post-fledging period it is recommended to discharge water and allow grazing of the dried-out aquatic vegetation by cattle (Végvári 2003). To maintain and improve the breeding conditions for Whiskered Tern on Jegrička fishpond emerging vegetation should be regularly removed in order to improve the feeding conditions for the species through the expansion of open water surfaces, invasive coastal vegetation (reeds) should be removed from floating carpets of water lilies, particularly, in the immediate surroundings of breeding colonies, and water management should provide optimal conditions for the development of floating vegetation. However, besides a regular monitoring of breeding numbers, further research is needed to understand the relationship between plant cover, food availability as well as the availability and extension of open water surfaces and the breeding performance of Whiskered Tern.

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Photo: Peter Sackl

Sandwich Terns (*Thalasseus sandvicensis*), Mala Bojana, Montenegro, March 2017

Links between Sandwich Terns (*Thalasseus sandvicensis*) from the Black and Adriatic Sea

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Summary

The study presents information on the movements of Sandwich Terns (*Thalasseus sandvicensis*) that were marked with colour rings in the Black Sea region and resighted or recovered along the coast of the Adriatic Sea. The ringed birds originate from the Sandwich Tern colony nesting on artificial islands created by Green Balkans NGO at Pomorie Lake, Bulgaria. This is the first and until now only colour ringing program for the species in Bulgaria. In total 297 Sandwich Terns were marked in the period 2010 – 2013, i.e. 7 adult birds (caught on the nest) and 290 juveniles. Additional data of Sandwich Terns that were marked with colour rings in Italy in the Comacchio saltpans, in the Po Delta and at the Adriatic coast of the Emilia-Romagna region, and that were resighted during the regular monitoring of the birds at Pomorie Lake are also presented. Data on the location and date of marking of foreign individuals are according to the information that has been kindly provided by Italian scientists. The study shows the relation between the Adriatic and Black Sea populations of Sandwich Tern, in particular their migration routes, and their wintering areas and staging sites.

Keywords

Sandwich Tern, Black Sea, Adriatic Sea, migration, colour ringing, ring recovery, wintering areas, staging sites

1. Introduction

Sandwich Tern (*Thalasseus sandvicensis* LATHAM, 1787) is a seabird of the tern family Sternidae with 3 sub-species: *Thalasseus sandvicensis sandvicensis* LATHAM, 1787 found at the coasts of western Europe, in the north-western Mediterranean Sea, the Black and Caspian Sea; *Thalasseus sandvicensis acuflavida* CABOT, 1847 is found along the eastern coast of the USA and on the Caribbean islands, south to the Bahamas, Cuba and Yucatan, and only occasionally in the Western Palearctic; *Thalasseus sandvicensis eurygnatha* SAUNDERS, 1876, inhabits the islands along Venezuela and the coasts of northern and eastern South America, south to Patagonia (Cramp 1983).

The European population is estimated at 79,900 – 148,000 breeding pairs (bp.) with the largest populations in the Ukraine, the United Kingdom and in The Netherlands (BirdLife International 2015). In recent years the highest numbers in the Black Sea region are reported for the Ukraine from the Krivaya Spit at the Sea of Azov with 60,000 bp. in 2010 - 2011 and with 21,000 bp. in 2015 (A. Bronskov, *pers. comm.*) and from the Krasnodar region in Russia with 10,000 bp. in 2004 (M. Dinkevich, *pers. comm.*). In the Adriatic Sea the largest breeding population inhabits the Venice lagoon (Italy) with 1,000 – 1,200 bp. in 2015 (M. Basso, *pers. comm.*). In Bulgaria Sandwich Tern was first recorded as a breeding species at Atanasovsko Lake on 24 May 1981 when 2 nests with one egg each were found in a mixed colony of Gull-billed Terns (*Gelochelidon nilotica*), Common Terns (*Sterna hirundo*) and Av-

ocets (*Recurvirostra avosetta*) nesting on the internal dike of the Salinas (Nankinov, Darakchiev 1984). Next confirmation of breeding was again at Atanasovsko Lake when on 12 June 1984 a mixed colony was found consisting of 12 pairs of Sandwich Tern, 16 pairs of Gull-billed Tern, 2 pairs of Mediterranean Gull (*Larus melanocephalus*) and 7 pairs of Common Tern (Simeonov 1986). The maximum number of breeding pairs for Atanasovsko Lake was 1,269 in 1994 (Dimitrov *et al.* 2005), but in recent years only sporadic breeding of maximal 60 – 80 bp. was recorded in 2006, 2013 and 2016.

The number of breeding pairs at Pomorie Lake started from 5 in 1998 and hereafter gradually increased from 450 bp. in 2001 (Gradev 2003) to 1,500 bp. in 2009 (Green Balkans 2010) and, as a result of the restoration of the nesting habitat by Green Balkans, peaked at 2,400 bp. in 2013 and 2015.

The study of bird migration through different methods of marking individual birds is a widespread technique and bird ringing (banding) is one of the oldest. Bird ringing was introduced in Bulgaria as early as 1928 (Nankinov 1988, 1997). In Bulgaria bird ringing schemes are coordinated by the Bulgarian Ornithological Centre (BOC) which is a separate department of the Institute of Biodiversity and Ecosystem Research of the Bulgarian Academy of Sciences. The inscription on standard metal rings are normally not readable from the distance even with optical equipment. To overcome this restriction colour plastic rings can be used, either as a combination of several colours or with inscribed letters or a numeric code.

A pilot colour ringing scheme for the marking of Sandwich Terns in Bulgaria was started by Green Balkans in 2010. The results of this ringing scheme are presented in the current paper together with the resightings of Sandwich Terns at Pomorie Lake, Bulgaria, which were marked within the Italian colour ringing scheme.

2. Material and methods

Long-distance movements of Sandwich Terns between the Black Sea region and the Adriatic Sea were studied at Pomorie Lake, Bulgaria. The local nesting colony occupies an artificially created islets, 180 m off the southern coast of the lagoon, and a larger islet in the center of Pomorie Lake.

Next to the artificial islets, close to the southern bank of the lagoon rows of wooden sticks remaining from eroded dikes are situated that are used regularly as resting and roosting site by Sandwich Terns as well as cormorants, gulls and other terns, i.e. Common (*Sterna hirundo*) and Little Tern (*Sternula albifrons*). These resting sites provide a good opportunity for monitoring and the reading of rings.

The colour ringing program at the Pomorie Lake colony was implemented in the period 2010 – 2013. Colours and codes used for the birds marked at Pomorie Lake were arranged with the national Bulgarian Ornithological Centre (BOC) and with EURING (European Center for Bird Ringing). Three codes were used: green and blue rings with a code of 3 white letters and orange rings with a code of 3 black letters. All letter codes start with 'C'. Colour rings are principally attached to the left leg and standard metal rings (size 3) to the right leg. The colour rings used within the present study were supplied by the Polish producer INTERREX. They are of the following sizes: inner diameter 5.5 mm, height 12.5 mm.

During the four-year study a total of 290 chicks and 7 adult birds were tagged with colour rings. An overview of colours and letter codes are shown in Table 1.

Tab. 1: Colours and codes of Sandwich Terns (*Talasseus sandvicensis*) ringed at Pomorie Lake, Bulgaria, 2010 – 2013.

Date ringed	Ring code	Age	Number
23.6.2010	CAA-CBZ	Pul.	29
3.6.2011	CAA-CAJ	Ad.	7
6.7.2011	CCA-CPC	Pul.	122
26.6.2012	CAA-CPH	Pul.	80
26.6.2012	CPD-CTH	Pul.	33
5.7.2013	CTJ-CVF	Pul.	14
5.7.2013	CDB-CDZ	Pul.	12
TOTAL			**297**

Green Balkans has implemented a long-term conservation program for the Pomorie Lake wetland in 1996. The program includes the regular monitoring of the avifauna. During these monitoring missions the numbers of waterbirds, including Sandwich Terns, with colour rings are noted. Colours and ring codes were read with the help of a 25x - 75x Nikon Fieldscope ED 82, a 20x - 50x Swarovski HD Spotting scope and a 20x - 50x Hawke Fieldscope. The average distance for reading the codes of colour rings was 150 - 200 m.

Fig. 1: Breeding colony of Sandwich Tern (*Thalasseus sandvicensis*) on an artificial islet created by Green Balkans NGO in Pomorie Lake.

3. Results

3.1 Birds ringed at Pomorie Lake and resighted abroad

Of all 290 Sandwich Terns which were marked with colour rings as chicks, 19 or 6.6% were recovered dead in the proximity of the colony, 88 of the ringed birds were resighted alive, i.e. 30.9% of all birds alive and 29.6 % of all ringed birds.

The highest share of all resighted colour-ringed Sandwich Tern were seen close to the natal colony at Pomorie Lake while resting on the wooden spikes mentioned above. Observations abroad were mostly from the Mediterranean Sea ranging from Israel to Spain, France and Tunisia with the highest share coming from Italy. Two birds were observed in the Atlantic – at Lanzarote on the Canary Islands and in Rota, Cadiz, in Spain. In total, 3 birds, i.e. 1.1% of all birds alive and 3.4% of all recoveries, of the birds ringed at Pomorie Lake were observed in the Adriatic Sea basin. Of these, 2 were marked with green rings and 1 with an orange ring.

The first recovery was for one of the chicks ringed on 23 June 2010 (green ring, white code CBF; ring no. 3-11853). It was observed at the Adriatic coast of Italy in Molfetta, Bari (41°12' N, 6°36' E) by Angelo Nitti on 6 May 2012, 683 days after it has been ringed as a hatchling in the Pomorie colony. The bird was observed in close proximity to the natal colony almost 2 months later on 4 July 2012 and in the following year on 14 May 2013, again on Pomorie Lake. In the winter of 2013/14, on 17 February 2014, the bird was seen again at the Italian coast of the Adriatic Sea further north at Alba Adriatica, Teramo, by Daniele Feriozzi. The last observations of this bird were made in late summer of the same year back at Pomorie Lake on 14 August and 1 September 2014. These observations clearly show that the bird has wintered on the Italian coast in the Adriatic region and has returned to its natal colony at Pomorie Lake (see Fig. 2).

The second Sandwich Tern that hatched at Pomorie Lake and which was observed in the Adriatic Sea was a chick from 2013 that has been ringed on 5 July of the same year (green colour ring, white code CTK; ring no. 3-20235). This bird was observed during the following spring at the Adriatic coast in northern Italy at Foce Logonovo, Comacchio, in Ferrara Province by Silvano Candotto on 1 May 2014 (Fig. 3).

The last observation of a Sandwich Terns from Pomorie Lake concerns a bird which was ringed as a chick on 26 June 2012 with an orange ring with black code CPD, ring no. 3-11866. This bird was observed during the spring of 2013 and 2014 in the Bojana/Buna Delta in Montenegro, in particular on 19 March (Tilen Basle) and 7 April 2013 (Peter Sackl) and on 4 March 2014 (Tilen Basle). Next time it was seen close to the natal colony at Pomorie Lake on 5 September 2014. Further observations in the Adriatic region were made on 16 March 2017, again in the Bojana/Buna Delta in Montenegro (Milan Ruzic) and in exact the same spot like in spring 2013 and 2014, and in the winter of the same year at the Italian coast in Martinsicuro, Teramo (Dimitri Marrone) on 7 December 2017 (Fig. 4).

Fig. 2: Map of the resightings of the Sandwich Tern with white code CBF which hatched at Pomorie Lake, Bulgaria, in 2010

Fig. 3: Map of the resightings of the Sandwich Tern with white code CTK which has hatched at Pomorie Lake, Bulgaria, in 2013.

Fig. 4: Map of the resightings of the Sandwich Tern with black code CPD which has hatched at Pomorie Lake, Bulgaria, in 2012.

3.2 Birds ringed in Italy and resighted at Pomorie Lake

Within the current study 13 Sandwich Terns which have been ringed abroad, were observed at Pomorie Lake, Bulgaria. All these birds were ringed at the western coast of the Adriatic Sea by Adriano Talamelli who is running a colour ringing program in the Salina di Comacchio in the Po river delta in Ferrara Province, Italy. All these birds were trapped in vertical mist nets during autumn and spring migration. These observations, separated by ring colour, are presented below:

Red rings (n = 3)

On 20 April 2007 a Sandwich Tern with red ring and white code FJ was observed at Pomorie Lake. The information kindly provided by BOC revealed that it has been trapped by Adriano Talamelli on 14 September 2004 at Salina di Comacchio (44°39'44.6'' N, 12°11'54.38'' E). The age of the bird at the time of ringing was estimated at > 1st year. The distance between the two sites is 1,262 km and the time that elapsed between trapping and recovery at Pomorie Lake amounts to 947 days. That same bird has been observed twice before it was noted at Pomorie Lake: in Molfetta, Bari, Italy (41°12' N, 16°35' E) on 4 August 2006 and again at the site of ringing in Salina di Comacchio on 27 September 2006. The last information on the movements of this bird shows that it has travelled to the western Atlantic coast of Africa where it was observed on 23 November 2007 at Embouchure Louerr in Morocco (28°10' N, 11°52' E). From all birds of the current study this one is the bird for which the greatest distance was recorded (Fig. 5). Another interesting aspect is that it has been observed in Molfetta, Bari, in Italy, i.e. the same site where another bird originating from Pomorie Lake was observed.

The second Sandwich Tern (Fig 6.) marked with a red ring in Italy and observed at Pomorie Lake was a bird trapped at Salina di Comacchio on 13 April 2011 at an age of two years (A. Talamelli). The tern with the white code IFH was observed at Pomorie Lake 3 years later on 3 May 2014. It is quite interesting that four more recoveries of the same bird were recorded in between and after that date, both in the Black and Adriatic Sea. In late summer and autumn of 2012, on 31 August and 26 September 2012, the tern was seen at Bolshoy Adzhalikskiy Liman in the Odessa region at the Ukrainian coast. Furthermore, about a month before it turned up at Pomorie Lake, it was registered at Cesenatico in Forli Cesena Province on the Adriatic's coast in Italy on 30 March 2014. The distance between the two sites is 1,247 km. On 13 September 2014, 4 months and 10 days after its appearance at Pomorie Lake, the bird was spotted again on the Ukrainian Black Sea coast at Nove Dofinovka, close to its previous record in Ukraine. All these records suggest that the bird is breeding at the Black Sea and is migrating to the Adriatic Sea.

The third and till now the last bird marked with a red ring in Italy and observed at Pomorie Lake is the bird with the code ILV (Fig. 7). It was ringed in its 2nd year on 28 September 2011 (A. Talamelli). This tern was seen 6 times during the summer of 2014 at Pomorie Lake, on 30 June, 3 July, 12, 16, 19 and 21 August 2014. All observations suggest that the bird has bred on Pomorie Lake in this year.

Fig. 5: Map of the resightings of the Sandwich Tern with white code FJ, tagged at Salina di Comacchio, Italy, in 2004.

Fig. 6: Map of the resightings of the Sandwich Tern with the white code IFH tagged at Salina di Comacchio, Italy, in 2011.

Fig. 7: Map of the resightings of the Sandwich Tern with the white code ILV tagged at Salina di Comacchio, Italy, in 2011.

Blue rings (n = 3)

The first observation of the Italian bird with blue ring and the white code PZ (see Fig. 8) on Pomorie Lake was made on 6 April 2011. The bird was later regularly observed at Pomorie Lake on 17 May 2011, 15 June 2011, 7 June 2012, 29 June 2013, 2 July 2013, 20 March 2014, 27 May 2014, 9 June and on 13 July 2014. The bird has been trapped and ringed at Salina di Comacchio on 27 March 2007. At the time of ringing its age was estimated at > 2nd year (A. Talamelli). More observations of the same individual were recorded between ringing and the resightings at Pomorie Lake as well as between the observations in Bulgaria. These were all in the northern Adriatic Sea. The bird was seen twice in the Mirna river mouth (V. Luscovec) in Croatia (45°11' N, 13°33' E) on 19 October 2008 and 28 October 2012 and twice in the Isonzo river mouth (S. Candotto) in Staranzano, Gorizia, in Italy (45°43'55.78'' N, 13°33'47.88' E) on 23 October 2009 and on 28 September 2010. The records during the breeding season and observations in the breeding colony on Pomorie Lake suggests that it has bred there.

The second Sandwich Tern which was tagged with a blue ring and with the white code HN in Italy was a 1st year bird at its ringing in Comacchio on 20 September 2006 (A. Talamelli). It was observed at Pomorie Lake almost 6 years later on 7 June 2012. In the meantime, it has been resighted at the site of ringing 6 days after marking and in Molfetta, Bari, in Italy (Cristiano Liuzzi) on 20 August 2008 (Fig. 9).

The third and last blue-ringed Sandwich Tern from Italy with the white code VP was observed at Pomorie Lake on 16 April 2013, 6 years after ringing in Salina di Comacchio in its 2nd year (A. Talamelli) on 11 April 2007. This bird is the tern with the largest number of recoveries (n = 27), all of it in autumn and winter in two sites in Bari Province at the southern Italian coast (Fig. 10). Almost all resightings were noted in Molfetta between 2007 and 2011 in October and November 2007, January, February and in March 2008, in January 2009, in March and April 2009, in December 2010, in January, February, March and in December 2011. One more sighting was added 2 years later in Bari on 4 January 2013. It should be noted that all these numerous recoveries were possible thanks to the persistence of observer Angelo Nitti who recorded all observations at Molfetta except two which were made by Cristiano Liuzzi (8 March 2008 and 24 December 2011).

Fig. 8: Map of the resightings of the Sandwich Tern with the white code PZ tagged in Salina di Comacchio, Italy, in 2007.

Fig. 9: Map of the resightings of the Sandwich Tern tagged in Salina di Comacchio, Italy, with the white code HN in 2006.

Fig. 10: Map of the resightings of the Sandwich Tern with the white code VP tagged at Salina di Comacchio, Italy, in 2007.

Yellow rings (n = 6)

The highest number of birds with Italian rings observed at Pomorie Lake was that for birds with yellow rings and with a three-letter black code.

The first Sandwich Tern with a ring of this type (code IBD) was observed 4 times at Pomorie Lake including sightings during the breeding season: 16 and 18 April 2011, 14 June 2011 and 6 May 2012. The bird was tagged in the Salina di Comacchio on 11 September 2007 in its 1st calendar year (A. Talamelli). The dates of observations and the time and age of trapping in Italy suggests that the bird may originate from Pomorie Lake and was trapped in the Salina di Comacchio during autumn migration (Fig. 11).

The second Sandwich Tern with a yellow Italian ring and the black code IZP was seen 9 times at Pomorie Lake in the period between July 2011 and March 2013. The bird has been ringed in the Salina di Comacchio on 14 April 2010 in its 2nd calendar year (A. Talamelli). Its first sighting at Pomorie Lake was in summer 2011 on 29 and 30 July with follow-up observations from 1 - 3 August 2011. The next observations were again on the northern Adriatic coast in Italy, during the following autumn, in Malamocco in Venice Province on 24 October and in Pellestrina on 3 November 2011 (Marco Basso). The bird was regularly observed at Pomorie Lake during the following years on 6 June 2012, 26 April, 1 and 4 May 2013. On 23 August 2013 the bird was present again at Port of Malamocco (M. Basso) with a further winter observation at Martinsicuro, Teramo, on 23 February next year before showing up at Pomorie less than a month later on 20 March 2014. On 17 September of the same year it was seen at the Pellestrina Canal in Venice (A. Sartori) before the last observation at Lido Degli Estensi, Comacchio (G. Ferrari) on 15 March 2015 (Fig. 12).

The next yellow-ringed Sandwich Tern from Italy with the individual code ITP (Fig. 13) was ringed in the Salina di Comacchio on 29 April 2009 in its 2nd calendar year (A. Talamelli). The bird was first observed at Pomorie Lake on 7 June 2012 and later during the whole breeding season 2014 (20 March, 5 and 30 June, 25 July and 12 August 2014). Thereafter, the bird was seen at Pomorie Lake 3 years later on 29 March 2017. Before showing up at Pomorie Lake the same bird was observed many times in the mouth of the Isonzo River (S. Candotto) in northern Italy in October 2009, and in September and October 2010.

The next tern with a yellow ring and the code NZ was trapped in the Salina di Comacchio on 29 April 2003 in its 2nd calendar year (A. Talamelli). It was observed almost 10 years later at Pomorie Lake on 17 April 2013 which makes it the oldest bird registered during the present study (Fig. 14).

The bird with the individual code IZJ was ringed in its 3rd calendar year on 13 April 2010 (Fig. 15). This bird was observed at Pomorie Lake 4 years later on 11 April 2014. Only 17 days before it turned up in Bulgaria, the bird has spent at least 17 days in Lido degli Estensi near the Salina di Comacchio. Individual observations in Lido degli Estensi were noted on 8 (Loris Golinelli), 16 (S. Candotto) and 25 March 2014 (Gabriele Ferrari). The bird was further spotted 6 times in the mouth of the Isonzo River in the northern Adriatic region (S. Candotto). Here the bird was seen in August 2011, September 2011, October 2014, September 2016 and in August 2017. It was also recorded in Senigallia, Ancona, further to the south of the Adriatic Sea's coast in Italy on 26 March 2016 (Federico Fanesi).

The last tern with yellow rings with the code IZN was ringed on 13 April 2010 in its second year (A. Talamelli). The bird was observed 1,262 km from the ringing site on Pomorie Lake 3 years later on 17 April 2013. In addition, between 2010 and 2013 the same bird was recorded in Zadina, Cesenatico, in Forli Cesena Province in Italy in March and April, and two days later in Rimini on 11 April 2011 by Adriano Talamelli. After the bird was present at Pomorie Lake on 21 and 23 July 2013 it was seen 2

months later in the Venice Lagoon (M. Basso), and two years later it was noted in the mouth of the Isonzo River in the northern Adriatic on 26 June 2015 (S. Candotto). Following to its presence in the Black Sea area in spring the movements of this bird are quite different from the sightings of the other birds.

Fig. 11: Map of the resightings of the Sandwich Tern with the black code IBD tagged in the Salina di Comacchio, Italy, in 2007.

Fig. 12: Map of the resightings of the Sandwich Tern with the black code IZP tagged in the Salina di Comacchio, Italy, in 2010.

Fig. 13: Map of the resightings of the Sandwich Tern with the black code ITP tagged in the Salina di Comacchio, Italy, in 2009.

Fig. 14: Map of the sightings of the Sandwich Tern with the black code NZ tagged in the Salina di Comacchio, Italy, in 2003.

Fig. 15: Resightings of the Sandwich Tern with the black code IZJ tagged in the Salina di Comacchio, Italy, in 2010.

Fig. 16: Resightings of the Sandwich Tern with the black code IZN tagged in Salina di Comacchio, Italy, in 2010.

Green rings (n = 1)

The tern with green ring and white letters with the code IBT was seen at Pomorie Lake on 9 November 2017. The bird has been trapped and ringed in April 2013 in its 1st calendar year (A. Talamelli) in Salina di Comacchio (Fig. 17). Before the record in Bulgaria it was observed along the Italian coast of the Adriatic in Lido degli Estensi, Comacchio (Loris Golinelli and Gabriele Ferrari) and in Rimini (A. Talamelli) in March 2014. The last observation on the Italian coast was on 15 March 2015 in Lido degli Estensi, Comacchio, by Gabriele Ferrari.

In addition, a Sandwich tern with the metal ring no. U-64902 was found on Pomorie Lake on 29 April 2012. The bird has been ringed in Salina di Comacchio in Italy on 4 April 2006 in its 1st calendar year. The bird was found dead with a cut in the chest but the origin of the cut was not identified. At the time of recovery the bird was approximately 6 years old (A. Talamelli).

Fig. 17: Map of the resightings of the Sandwich Tern with the code IBT tagged at Salina di Comacchio, Italy, in 2013.

4. Discussion

The present data of colour ringed birds reveals a close relation between the Adriatic and Black Sea populations of Sandwich Tern. The importance of saline coastal lagoons for breeding, like on Pomorie Lake, of river mouths and the deltas of the large rivers as staging areas for Sandwich Terns during migration is confirmed by multiple records on Pomorie Lake in Bulgaria and in Adriatic coastal wetlands. Birds originating from Pomorie Lake move to the Adriatic Sea for wintering. Most observations of these birds were made during spring migration. All birds that were marked abroad and observed at Pomorie Lake during the present study have been ringed in the Salina di Comacchio. But none of these birds are of confirmed origin in Italy as all were trapped and ringed in Salina di Comacchio at an age of > 1 year. Only one of the birds ringed in Italy (yellow ring, black code IZN) shows a movement pattern that suggests its breeding on the Adriatic coast. One of the birds trapped and marked in Italy, was observed also in other parts of the Black Sea, i.e. about 500 km north of Pomorie Lake on the Ukrainian coast. As all observations were in late summer, this bird has probably bred in the Black Sea area. None of the colour-ringed Sandwich Terns from Italy which were observed at Pomorie Lake have been ringed as chicks in any of the Italian breeding colonies although a colour-ringing scheme of chicks has been implemented in Venice Lagoon. Sandwich Terns are coastal birds and all observations of marked birds were made on sea shores. River mouths and coastal lakes are important feeding areas especially in winter and during migration. This is confirmed by observations of colour-ringed birds from the river mouths of the Mirna River in Croatia, the mouth of the Bojana/Buna River in Montenegro/Albania, the Isonzo River in Italy, the Bolshoy Adzhalikskiy Liman in the Ukraine and the Lourre River in Morocco.

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Photo: Bruno Dittrich

Eurasian Crane (*Grus grus*), Hornburger See, Sweden, February 2004

Migration of Eurasian Crane (*Grus grus*) in the area of Duvanjsko polje in 2015 - 2017

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Summary

Duvanjsko polje is one of the most important stop-over sites for Eurasian Crane *(Grus grus)* in Bosnia and Herzegovina. According to the data gathered over the past decades, several thousand Eurasian Cranes fly over Duvanjsko polje during the spring migration, and 1,000 - 2,000 individuals regularly rest in the polje. Spring migration generally lasts from mid-February to mid-April and autumn migration takes place in October and November. During autumn migration cranes pass just by flying over the polje without resting. The number of birds that rest in the polje in spring is affected by meteorological conditions and water level. Therefore, in comparison to previous seasons, lesser birds were registered in spring 2017 that was rather warm and dry. In 2016, in Duvanjsko polje first birds were registered on January, 16. It is also interesting that, in 2017, 408 birds stayed in the polje for about 10 days during the autumn migration.

Keywords

Bosnia and Herzegovina, Duvanjsko polje, migration, Eurasian Crane, *Grus grus*

1. Introduction

The Adriatic Flyway is one of three migration routes for different populations of European Crane *(Grus grus)*. Although the migration route across the Balkan Peninsular and the Adriatic Sea is known for a long time from occasional observations (e.g., Makatsch 1970), first systematic data on crane migration in former Yugoslav countries were compiled as late as the last decade during intensive researches of the bird fauna of the region. The first data gathered during the 2007 - 2010 period, indicated the importance of this migratory route (Stumberger & Schneider-Jacoby 2010), while a series of other researches has indicated that the karst poljes of Bosnia and Herzegovina are important stop-over sites for migrating cranes along the Adriatic Flyway (Topić *et al.* 2014, 2017).

Duvanjsko polje is one of the most important stop-over sites for Eurasian Crane in Bosnia and Herzegovina. The field data gathered over several years show that several thousand cranes pass the area during spring migration and, in spring, 1,000 – 2,000 individuals regularly rest in the polje before continuing migration (Topić *et al.* 2014, 2017).

In the present paper the results of a three-year monitoring of Eurasian Crane migration in Duvanjsko polje will be analysed.

2. Study area

Duvanjsko polje is a karst polje located in the south-western part of Bosnia and Herzegovina. It occupies an area of 125.1 km^2. The average altitude of the polje is 865 m a.s.l. The rivers Šujica (from the north) and Drina (Ričina) (from the south) flow through the polje and cause floods in its lowest parts during spring and autumn. The temporarily flooded areas cover approximately 53 km^2.

Duvanjsko polje is surrounded by Vran Mountain in the south-east, Tušnica in the north-west, and Ljubuša Mountain in the north-east, while Midena Mountain is located between Duvanjsko polje and Buško blato. The polje is a part of the spacious Grabovica plateau with a prominent, elongated ridge which extends from the north-west to the south-east towards Mesihovina. The boundary between the polje and the surrounding mountainous areas are not well defined, especially in the hilly part north-west of Tomislavgrad (Radoš *et al.* 2012).

So far, 183 bird species have been recorded in the area of Duvanjsko polje (Šarac *et al.* 2017). Most species were recorded during migration and wintering. The most important breeding species in Duvanjsko polje include Northern Lapwing (*Vanellus vanellus*), Common Quail (*Coturnix coturnix*), Corncrake (*Crex crex*) and Long-legged Buzzard (*Buteo rufinus*), and the most notable species registered during migration and wintering include Eurasian Crane (*Grus grus*), Eurasian Spoonbill (*Platalea leucorodia*), Glossy Ibis (*Plegadis falcinellus*), European Roller (*Coracias garrulus*), Pine Bunting (*Emberiza leucocephalos*) and Horned Lark (*Eremophila alpestris*).

3. Methods

Field data were collected continuously over a period of three years (2015 - 2017) from the moment the first birds were noted in the polje until the last bird has left the polje during a certain migration period. The location, observation time, direction of movement, the numbers of individuals (ind.) and the activitiy of the birds, i.e. resting or flying over, were recorded.

Fig. 1: Map of Duvanjsko polje with main observation sites (map compiled by Denis Radoš)

Photo: Mirko Šarac

Fig. 2: Duvanjsko polje

4. Results and discussion

During the period from 2015 - 2017, the Eurasian Crane was regularly observed during migration in the area of Duvanjsko polje.

4.1 Autumn migration

Autumn migration, generally, takes place during October and November. Most birds observed in Duvanjsko polje pass the area from the north towards the south or south-west.

The first birds arrive in the last days of October and first days of November. One group of cranes migrated from the north along the valley of the Vrbas River, turning towards Šipovo, continuing south through Kupreško polje towards Šuica, and, finally, entered the northern part of Duvanjsko polje. Then they moved along the southwestern side of the polje across Buško blato and flew down the Cetina River towards the Brac channel at the coast of the Adriatic Sea (see Fig. 3). A second group of birds also followed the valley of the Vrbas River, but then moved along the east side of Stožer Mountain and the western side of Raduša Mountain. Then they continued through Vukovsko and Ravanjsko polje across Paklena Mountain, entering the northeastern part of Duvanjsko polje. Then they moved towards the southern part of the polje and continued towards Mostarsko blato and Hutovo blato (Fig. 3).

Probably, because Duvanjsko polje is normally not flooded in autumn and occasional autumn floods concern only a very small part of the polje, the birds do not stop-over in the area or do so only very rarely and briefly. It is, therefore, interesting to note that, even though the polje was not flooded, 408 ind. were observed to rest in Duvanjsko polje for over 10 days in autumn 2017

Fig. 3: Route of two migration flocks of Eurasian Crane *(Grus grus)* that passed Duvanjsko polje during autumn migration (map by Denis Radoš)

Photo: Mirko Šarac

Fig. 4 and 5: Eurasian Cranes *(Grus grus)* flying over Duvanjsko polje

Tab. 1: Overview of the data on autumn migration of Eurasian Crane *(Grus grus)* in Duvanjsko polje for the 2015 - 2017 period.

Date	Locality	Number of individuals	Activity
2015			
30.10.2015	Mrkodol	250	Flying over
2.11.2015	Eko selo Grabovica	800 (4 flocks of 200 ind.)	Flying over
3.11.2015	Srđani	240 (3 flocks of 80 ind.)	Flying over
6.11.2015	Kamensko	ca. 600 (3 flocks of 200 ind.)	Flying over
12.11.2015	Brišnik	80	Flying over
22.11.2015	Brišnik	65	Flying over
2016			
28.10.2016	Ćavarov stan	250	Flying over
29.10.2016	Eko selo Grabovica	150	Flying over
1.11.2016	Ravanjsko polje	800 (4 flocks of ca 200 ind.)	Flying over
2.11.2016	Kamensko	200 (2 flocks of ca 100 ind.)	Flying over
3.11.2016	Brišnik	200	Flying over
4.11.2016	Crvenice	ca 300 (2 flocks of 150 ind.)	Flying over
2017			
29.10.2017	Ravanjsko polje	50	Flying over
30.10.2017	Eko selo Grabovica	150	Flying over
3.11.2017	Ćavarov Stan	22	Resting
6.11.2017	Kovači	130	Resting
8.11.2017	Cebare	100 (2 flocks of 50 ind.)	Resting
11.11.2017	Ćavarov Stan	156	Resting
21.11.2017	Jošanica	200 (2 flocks of ca 100 ind.)	Flying over

4.2 Spring migration

Spring migration takes place from mid-February to mid-April. Normally, the birds enter Duvanjsko polje from the south and continue, after a short rest in the polje, towards the north. The numbers of birds and the duration of stopping-over in the polje depends on weather conditions and water level. In this respect, lesser birds were registered during the spring of 2017, when temperatures were higher than normal and there was no precipitation, so that the polje, in comparison to previous seasons, was not flooded.

Exceptionally, in January 2016 250 birds were registered resting in the polje for 3 days. Winter observations in the karst poljes of Bosnia and Herzegovina are no new phenomenon and, according to Stumberger & Schneider-Jacoby (2010), coincide with particularly harsh winters in the Pannonian Basin. In February 2016 (16 and 17 February) several thousand cranes were observed flying over Duvanjsko polje. At this time, the polje provided no favourable conditions for resting, due to the lack of rainfall and low temperatures. With the beginning of rainfalls a few days later the passengers regularly stopped in the polje. Obviously, water level is an

important factor for stopping-over because temporary lakes may act as barriers against humans and predators, while damp meadows with shallow water provide good feeding conditions. In spring the birds followed the same routes while crossing the area as in autumn, but in the reverse direction.

Tab. 2: Overview of the data on spring migration of Eurasian Crane *(Grus grus)* in Duvanjsko polje for the period 2015 – 2017.

Date	Locality	Number of individuals	Activity
2015			
1.3.2015	Srđani	26	Resting
1.3.2015	Jabuke	1,200	Resting
2.3.2015	Eko selo Grabovica	240 (3 flocks with 80 ind.)	Flying over
3.3.2015	Crvenice	500 (2 flocks with 250 ind.)	Flying over
4.3.2015	Table	150	Resting (until 20.3.)
8.3.2015	Bilila	220	Resting
11.3.2015	Bobara	250	Resting
12.3.2015	Table	230 (1 ind. with ring from Finland)	Resting (until 30.3.)
29.3.2015	Cebara	56	Resting
30.3.2015	Bilila	80	Resting
1.4.2015	Razlivci	150	Resting
4.4.2015	B.Rupa	500	Resting
2016			
16.1.2016	Mandino selo	250	Resting (for 3 days)
15.2.2016	Šuičko polje	1	Resting (for 1 month)
16.2.2016	Vedašić	80	Flying over
18.2.2016	Letka	220	Flying over
20.2.2016	Srđani	15	Resting
25.2.2016	Mandino selo	7	Resting
25.2.2016	Oplećani	55	Resting
26.2.2016	Ćavarov stan	1,052 + 1,000 (4 flocks)	Resting + flying over
27.2.2016	Ćavarov stan	350	Resting
28.2.2016	Ćavarov stan	438	Resting
29.2.2016	Ćavarov stan	228	Resting
1.3.2016	Ćavarov stan	209	Resting
2.3.2016	Ćavarov stan	150	Resting
3.3.2016	Ćavarov stan	180	Resting
4.3.2016	Ćavarov stan	156	Resting

Date	Locality	Number of individuals	Activity
5.3.2016	Ćavarov stan	38	Resting
6.3.2016	Ćavarov stan	38	Resting
7.3.2016	Ćavarov stan	280	Resting
8.3.2016	Ćavarov stan	158	Resting
9.3.2016	Ćavarov stan	132	Resting
10.3.2016	Ćavarov stan	56	Resting
11.3.2016	Ćavarov stan	72	Resting
12.3.2016	Ćavarov stan	38	Resting
13.3.2016	Ćavarov stan	150 (1ind. with ring from Finland)	Resting
14.3.2016	Ćavarov stan	160	Resting
15.3.2016	Ćavarov stan	350	Resting
16.3.2016	Ćavarov stan	350	Resting
17.3.2016	Ćavarov stan	350	Resting
18.3.2016	Ćavarov stan	72 (1 ind. with ring from Finland)	Resting
19.3.2016	Ćavarov stan	15	Resting
19.3.2016	Eko elo Grabovica	200	Flying over
20.3.2016	Tomislavgrad	250	Flying over
20.3.2016	Stipanići	250 (2 flocks)	Flying over
2017			
19.2.2017	Ćavarov stan	6	Resting
19.2.2017	Srđani	10	Resting
22.2.2017	Perići	8	Resting
24.2.2017	Srđani	18	Resting
27.2.2017	Ćavarov stan	8	Resting
28.2.2017	Ćavarov stan	68	Resting
1.3.2017	Vrba	55	Resting
4.3.2017	Ćavarov stan	60	Resting
5.3.2017	Ćavarov stan	48	Resting
6.3.2017	Ćavarov stan	256	Resting
6.3.2017	Mandino selo	36	Resting
11.3.2017	Ćavarov stan	50	Resting
12.3.2017	Ćavarov stan	50	Resting
14.3.2017	Šuica	4	Resting
18.3.2017	Srđani	54	Resting

Tab. 2: continued

Date	Locality	Number of individuals	Activity
19.3.2017	Srđani	54	Resting
20.3.2017	Letka	36	Resting
21.3.2017	Omolje (Blatine)	38	Resting
22.3.2017	Šuica	4	Resting
27.3.2017	Srđani	68	Resting
30.3.2017	Srđani	56	Resting
1.4.2017	Srđani	8	Resting
4.4.2017	Srđani	5	Resting

Photo: Mirko Šarac

Fig. 6 and 7: Eurasian Cranes *(Grus grus)* resting in Duvanjsko polje

According to collected data, shown in Tab. 3, it is evident that spring migration is much more intensive than autumn migration. In spring the birds generally land for resting and feeding, while they mostly pass the polje by simply flying over during the autumn migration.

Crane numbers are considerably lower in autumn. While, depending on weather and habitat conditions, in particular water level, each year up to 2,000 – 8,000 Eurasian Crane stop-over or simply pass over Duvanjsko polje in spring. It can be assumed that these numbers are even larger, since it is known that a significant portion of the birds pass the area during night-time, when it is impossible to determine exact numbers.

Tab. 3: Daily minima and maxima of Eurasian Crane *(Grus grus)* observed during spring and autumn migration in Duvanjsko polje between 2015 and 2017. R = resting, F = flying over.

	2015				2016				2017			
	Spring		Autumn		Spring		Autumn		Spring		Autumn	
	R	F	R	F	R	F	R	F	R	F	R	F
Min	9	240	0	65	1	80	0	150	4	0	22	50
Max	1,200	500	0	800	1,052	1,000	0	800	256	0	156	200
Total	2,871	740	0	2,035	5,350	1,950	0	1,900	1,000	0	408	400

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Photo: Peter Sackl

Western Marsh Harrier (*Circus aeruginosus*), Montenegro, June 2017

Mitigation of bird electrocution in Croatia - A pragmatic approach

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Summary

In Croatia there is an urgent need to reduce the negative effects of critical energy infrastructure, such as medium-voltage power lines, on bird populations. However, even for a relatively small area, comprehensive mitigation projects on large-scale infrastructure can be extremely labour intensive and prohibitively costly. We present our attempt to make the most of limited resources available for the mitigation of bird electrocution on the Croatian electrical power distribution network, by using a simple and objective method to prioritise areas for mitigation. Our approach, based on sensitivity mapping, uses a combination of species distribution modelling and quantitative risk assessment to rank intervention areas by conservation priority and level of risk. Additionally, a field survey of carcasses along power lines was conducted in identified priority areas in order to verify the results of the desktop study and to finalise our recommendations for the implementation of mitigation areas. Based on our results, we believe that the same approach could also be successfully applied to investigate and quantify many other areas of human-wildlife conflict, such as illegal killing or habitat loss.

Keywords

bird protection, electrocution, sensitivity mapping, mitigation, risk assessment

Introduction

The medium-voltage electrical energy distribution network in Croatia is extensive (over 135 000 km) and it is widely recognized that electrocution on medium-voltage infrastructure is a significant risk factor for birds in Croatia. But reports of casualties due to electrocution are circumstantial. Thus, the full extent of this problem is poorly known. This problem is compounded by the fact that electrocution risk for any bird species results from a complex interplay of geographical location, habitat, technical characteristics of individual poles as well as bird anatomy and behaviour (Bevanger 1994, Janss 2000). Therefore, the ideal solution would be to perform a comprehensive national or regional study for the specific species concerned. However, due to the fact that individual electrocution events are comparatively rare and hard to detect because of the removal of carcasses by scavengers, such studies are difficult, time consuming and prohibitively expensive (Ferrer & Janss 1999).

We were hired by the national distribution network operator (HEP ODS Ltd.) to assess which specific micro-locations, i.e. individual medium-voltage network elements (e.g. pylons, transformers) within Natura 2000 sites in coastal Croatia present significant risks for bird electrocution and that are, therefore, the first priority for the application of mitigation measures. Because of financial and time constraints the field visits needed to be limited to 20 man-days. Hence, a compromise had to be reached between feasibility on the one hand and objectiveness on the other. Our approach, presented here as a case study, was to use existing knowledge about bird presence and risks related to medium-voltage infrastructure 1) to identify relatively large (~10 km) potentially dangerous segments of the power grid, 2) to focus field surveys on these areas and, finally, 3) to identify the specific elements that are responsible for bird electrocutions.

Methodology

Our methodology consisted of a computational analysis, followed by carcass searching in the field to verify the findings of the modelling of electrocution risk areas. The exact study area was defined by rasterizing selected Natura 2000 areas in coastal Croatia and the intersection of the grid with a vector layer of the medium-voltage network (Fig. 1).

The species used for computational modelling were large soaring birds listed as conservation targets for the respective Natura 2000 areas. The full list of 'priority species' is given in Tab. 1. The computational analysis consisted of the following steps (summarized in Fig. 2):

1) Create a spatial model of habitat use for each priority species
2) For each species, calculate a relative specific risk index for electrocution
3) Combine (1) and (2), along with the regional IUCN status to produce a risk map for each species
4) Combine individual results from (3) into a general risk map
5) Select the highest-risk map segments to get >10 km network segments

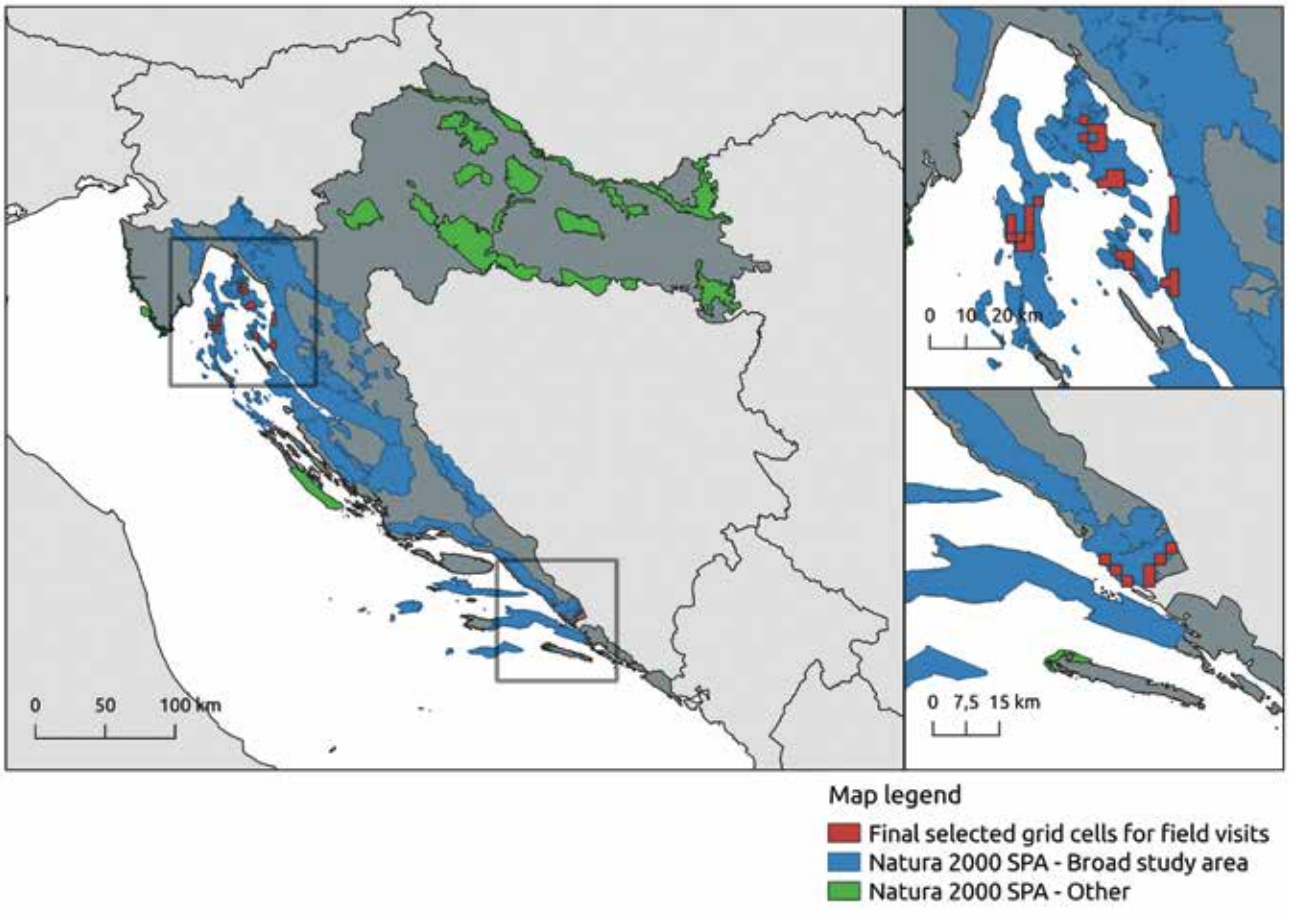

Fig. 1: Map showing the study area (blue) and selected grid cells for field visits (red).

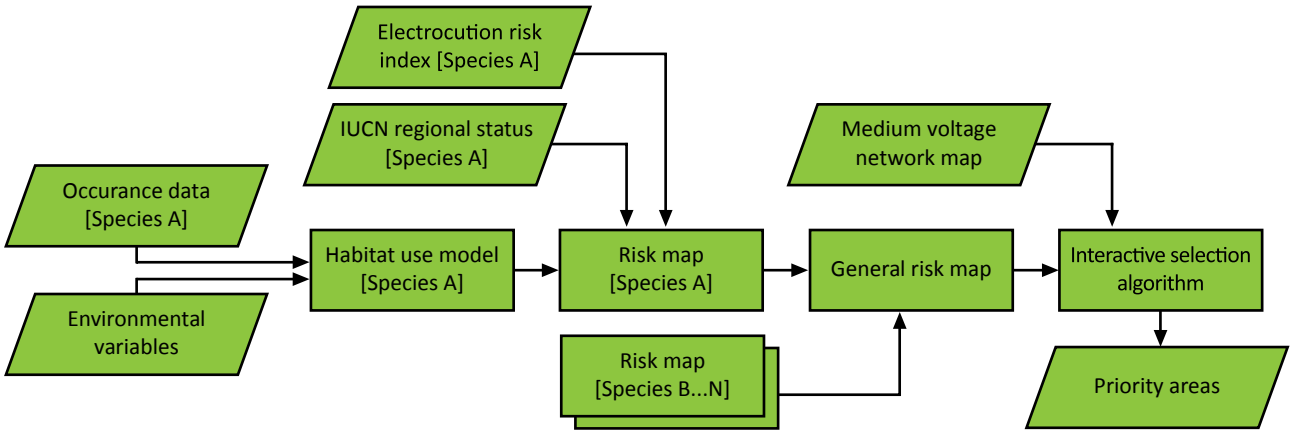

Fig. 2: Flow diagram of the methodology for selecting priority areas for the implementation of electrocution mitigation measures.

Tab. 1: Target species of the Natura 2000 areas (Special Protected Areas SPAs) used for this study (excluding Common Crane (*Grus grus*) due to data deficiency).

Species	Status	Unit	No. of units	Regional IUCN status	Risk index
Aquila chrysaetos	Resident	Pair	26 - 29	CR	0.5908
Bubo bubo	Resident	Pair	337 - 505	LC	0.2417
Circaetus gallicus	Breeding	Pair	73 - 99	EN	0.2355
Circus aeruginosus	Breeding	Pair	10 - 13	EN	0.1022
Circus cyaneus	Wintering	Individual	333 - 1147	LC	0.0147
Circus pygargus	Breeding	Pair	47 - 89	EN	0.0032
Falco columbarius	Wintering	Individual	22 - 38	VU	0.0285
Falco naumanni	Breeding	Pair	30 - 41	CR	0.0032
Falco peregrinus	Resident	Pair	56 - 77	VU	0.1076
Falco vespertinus	Migrant	N/A	N/A	DD	0.0285
Gyps fulvus	Resident	Pair	110 - 131	EN	0.1283
Pernis apivorus	Breeding	Pair	36 - 63	NT	0.1176

Modelling habitat use

Available occurrence data for each species in Tab. 1 were compiled from multiple sources, including the database of the Croatian Agency for the Environment and Nature, Biom's own database, the Natura 2000 Integration Project database as well as reports from the Griffon Vulture Recovery Centre (Sušić 2013). Occurrence data were combined with a number of environmental variables to produce habitat use models for each species (Fig. 3 - 4). The environmental variables used were: BIOCLIM climate variables (Hijmans *et al.* 2004), a detailed digital elevation model, tree cover and wetland areas (European Environment Agency 2016). Pseudoabsences were generated using MaxEnt, in a 1:1 ratio with presence data points (Barbet-Massin *et al.* 2012). The purpose of the habitat use model was not to draw conclusions about the behavior/habitat preferences of each species, but to infer which places in the study area have the greatest chance of conflict. Therefore, the Random Forest algorithm was used, as it has been shown to give good predictions for datasets of this size (Cutler *et al.* 2007). The modelling was performed iteratively, removing autocorrelated covariates until the most parsimonious model remained. With the covariates selected, the modelling step was performed 10 times and the arithmetic mean of all runs was taken as the final habitat use prediction.

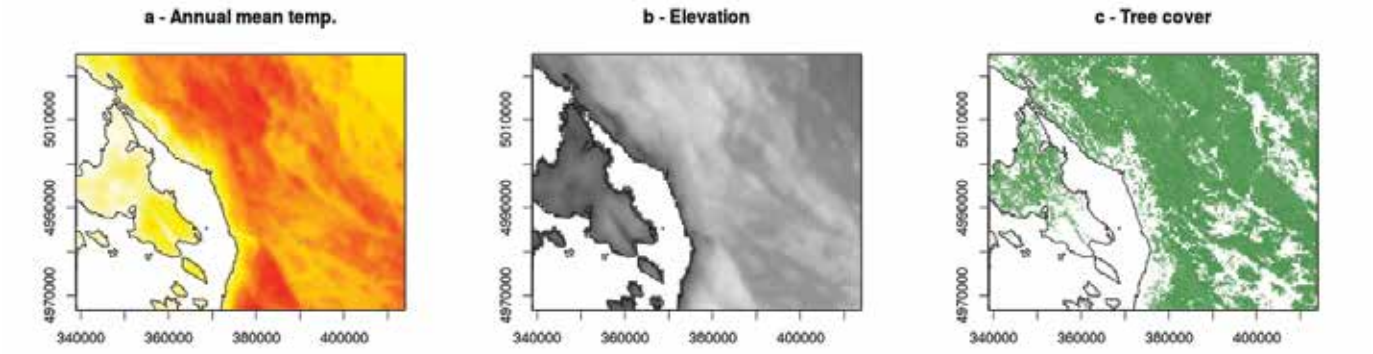

Fig. 3: Examples of different environmental variables used to compile spatial models of electrocution risk. (a) mean annual temperature, (b) elevation, and (c) tree cover.

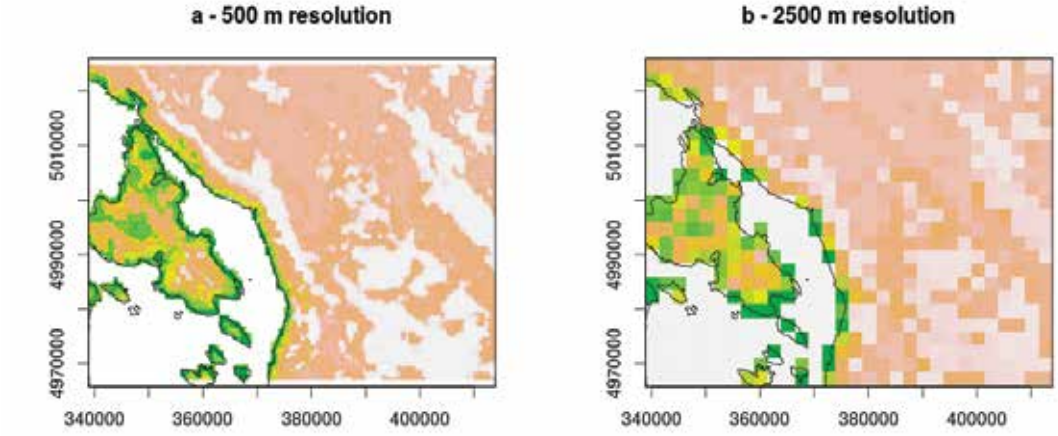

Fig. 4: Habitat use prediction for Griffon Vulture (*Gyps fulvus*). (a) 500 m resolution - original model output; (b) resampled to 2500 m resolution. Dark green colors indicate higher predicted habitat use, i.e. higher expected density of the species for a given grid cell.

Risk mapping

Subsequently, the final cumulative risk map (Fig. 5) was calculated according to the following equation:

$$\sum_{i=1}^{12} (\rho_i \times R_i \times Csi_i)$$

Where ρ_i is the habitat use prediction, R_i is the relative electrocution risk, and Csi_i is the IUCN status score for a given species (Tutiš *et al.* 2013). R_i was calculated for each species according to Guil *et al.* (2015) who use ringing and mortality data, adjusted for bird life expectancy. Essentially, the risk represents the proportion of ringed birds, found electrocuted, divided by the respective species' life expectancy. IUCN status scores (Csi_i) are by definition arbitrary, because there is no objective exchange rate for the relative conservation value of, for example, one Golden Eagle versus one Common Buzzard. Because we wanted the electrocution risk weight by the respective species conservation status, we opted for the simplest solution of assigning scores for the national Red List status from least concern (= 1) to critically endangered (= 5).

Final grid cell selection and field research

Because of the resolution of the covariate, the modelling step was performed at a resolution of 500 m, and the output later resampled bilinearly to 2500 m to provide manageable spatial units for further research and field visits. Therefore, the minimum spatial unit for subsequent field visits constituted 2.5 x 2.5 km grid cells. To select >10 km segments of the medium-voltage network, the following algorithm was used:

1. Find the grid cell with the highest risk rating on the map and select it.
2. Add the length of the medium-voltage power lines within the selected grid cell to the running total and reset the cell's risk score to 0.
3. Find the neighboring cell with the highest risk score and select it.
4. Repeat steps 2 - 3 as long as the running total length of the medium-voltage power lines is <10 km. When the running total exceeds 10 km, stop extending the selection and save all the selected grid cells as one location.

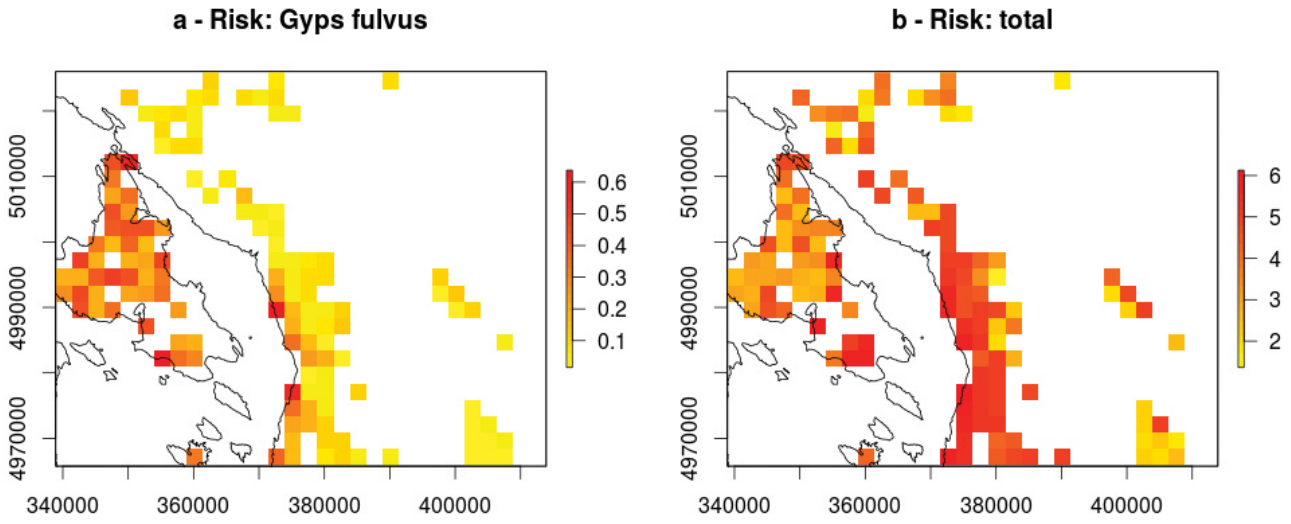

Fig. 5: Risk map for electrocution in 2500 m resolution. (a) Griffon Vulture, (b) all species (cumulative). Dark red = high risk, light yellow = low risk.

Finally, for each of the 30 selected locations, the number of high-risk medium-voltage network elements (Manosa 2001, Tinto *et al.* 2010) was estimated by experts from HEP-ODS, and the 10 locations with the greatest number of high-risk elements were chosen for field visits.

In this way, a 2.5 km resolution raster was turned into compact spatial units with 10 - 13 km of medium-voltage power lines that correspond roughly to a single day of carcass searching by two teams of two persons. Fieldwork was performed during May, June and August 2017. Carcass searching was performed around all medium-voltage poles with grounded consoles as well as pole-mounted transformers by two researchers in a 5 m radius during 5 min. (Bevanger & Janss 1999).

Results

A total of 509 poles were searched for carcasses, and a total of 84 dead birds were found in their vicinity. All remains were identified to the most precise taxonomic category possible. An overview is given in Tab. 2. The average number of bird carcasses per pole was 0.165, but this number was as high as 0.23 on the island of Cres and 0.32 on the island of Rab.

(a)

(b)

(c)

(d)

Fig. 6: Photos of dead birds found with their corresponding poles: (a) Griffon Vulture (*Gyps fulvus*) found next to (b) a steel lattice load-bearing pole with ineffective diverters installed; (c) Tawny Owl (*Strix aluco*) found next to (d) a pole-mounted transformer.

Tab. 2: Total numbers of bird carcasses found under 509 sampled poles in selected SPAs in coastal Croatia.

Species	Family	No. of carcasses	Average per searched MV pole
Aves sp.	N/A	20	0.0393
Corvus cornix	Corvidae	18	0.0354
Gyps fulvus	Accipitridae	10	0.0196
Bubo bubo	Strigidae	9	0.0177
Buteo buteo	Accipitridae	5	0.0098
Strix aluco	Strigidae	5	0.0098
Larus sp.	Laridae	4	0.0079
Corvus corax	Corvidae	3	0.0059
Larus michahellis	Corvidae	3	0.0059
Turdus merula	Turdidae	2	0.0039
Corvus sp.	Corvidae	1	0.0020
Garrulus glandarius	Corvidae	1	0.0020
Passer domesticus	Passeridae	1	0.0020
Pernis / Buteo sp.	Accipitridae	1	0.0020
Phasianus colchicus	Phasianidae	1	0.0020
Total		84	0.1650

Discussion

The results of this study suggest that risk mapping based on species distribution modelling can be a valuable method to objectively prioritise field research when a full-scale mortality study is not possible due to financial or time constraints. However, several important limitations need to be kept in mind when considering the application of this method.

First, birds can have very different habitat requirements depending on the season. Because the ecological requirements of many birds are most specific regarding their nesting habitats, whenever possible, nesting data have been used in the present study. For species which do not nest in the study area, the input for the respective modelling step were roosting and feeding locations used by the birds during stop-over or wintering.

Second, because the mapping resolution is 2.5 km, small-scale variations of electrocution risk and mortality that arise as a consequence of local landscape features or habitat specificities, such as forest clearings, ponds or small hills, are not reflected in risk maps.

Finally, the assumptions of this methodology are:

1. The probability density of encountering an individual bird is inversely proportional to the distance from its nest, i.e. a bird spends more time near its nest than away from it.
2. The level of risk for any given species in a certain area is proportional to the relative density of birds present in the area.
3. The level of risk is equal for all individuals of a certain species, regardless of their age, sex or activity.

In certain cases, depending on species, construction of network elements, landscape features or habitat distribution, any of these assumptions can be violated. When considering to use this method, the researcher should consider carefully whether these simplifications are acceptable for their particular study or research question.

As our study was designed for guiding carcass searches in order to find blackspots of bird electrocution in general (and due to its methodological assumptions and simplifications), we refrain from interpreting the biological impact of our results on a population or species level for the studied species - with one exception: Notably, the number of discovered Griffon Vulture carcasses (10) corresponds to around 5% of the estimated Croatian breeding population (100 - 110 pairs), which suggests that there might be a significant negative effect of medium-voltage power lines on the local population of that species. Other studies, which have been explicitly designed for finding such population level effects, have shown that electrocution can indeed have a significant biological impact on bird populations (e.g. Hernández-Matías *et al.* 2015). Whether this is actually also the case for the Croatian Griffon Vulture population, remains to be studied with an adequate study design.

Our results show that our methodological approach can (despite its intrinsic limitations) particularly benefit environmental impact or risk assessment studies that (a) are spatially extensive, (b) include multiple species, (c) deal with rare or semi-rare occurrences and (d) are severely constrained with regard to time or budget. Because the final result will only be as good as the basic model's prediction, a moderate amount of good data is still necessary. Following to the present study, given the large number of carcasses found, the implementation of mitigation measures will be necessary for the discovered high-risk elements. Therefore, our conclusion is that given an appropriate research question and sufficient input data, this methodology can be useful for prioritising conservation efforts.

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Photo: Goran Topić

European Bee-eater (*Merops apiaster*), Livanjsko Polje, May 2020

Analysis of known poaching cases in Bosnia and Herzegovina (2003 – 2018)

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Summary

This paper presents the so far most comprehensiv and most detailed analysis of information on poaching in Bosnia and Herzegovina. It includes information collected in the field by members of the Ornithological Society “Naše ptice”, by associates of the Birdwatchers’ Network of Bosnia and Herzegovina as well as information derived from different media and social networks between 2003 and March 2018. The study shows that at least 11,383 individual birds of 103 species were killed or taken within 532 individual cases. Out of the total number of killed, wounded and taken birds at least 6,621 ind. of 61 species are victims of bird crime. Out of the total number of 103 querry species, at least 55 are permanently protected in the Federation of Bosnia and Herzegovina and at least 56 species are permanently protected in the Republic of Srpska. Common Quail (*Coturnix coturnix*) and Tree Pipit *(Anthus trivialis)* are the species with the highest number of illegally killed specimens. While the Common Quail is huntable in both entities of Bosnia and Herzegovina, the large number of killed specimens in individual cases clearly indicates the use of banned electronic calling devices. Seven out of the 16 species with the largest numbers of killed individuals are permanently protected in both entities of Bosnia and Herzegovina, i.e. Common Buzard *(Buteo buteo)*, Eagle Owl *(Bubo bubo)*, Tree Pipit *(Anthus trivialis)*, Goldfinch *(Carduelis carduelis)*, Bullfinch *(Pyrrhula pyrrhula)*, Siskin *(Carduelis spinus)* and Common Linnet *(Carduelis cannabina*). Three other species are permanently protected only in the Federation of Bosnia and Herzegovina: Great Cormorant *(Phalacrocorax carbo)*, Northern Goshawk *(Accipiter gentilis)* and Common Skylark *(Alauda arvensis*). Aside of Common Quail and Tree Pipit, the species which are most affected by poaching activities include the Eagle Owl, Golden Eagle (*Aquila chrysaetos*), Peregrine Falcon (*Falco peregrinus*) and Capercaillie (*Tetrao urogallus*). From the present findings it is clear that the control of poaching and illegal bird shooting will be a great challenge for many years to come. On the other side the implementation as well as the improvement of existing laws will be a key factor for the conservation and survival of viable populations of many bird species in Bosnia and Herzegovina.

Keywords

poaching, Bosnia and Herzegovina, protected species, legislation, illegal hunting, wildlife crime, bird conservation

1. Introduction

Most countries that harbour a rich and diverse bird fauna have a long tradition in bird hunting. Bosnia and Herzegovina, located on the Adriatic Flyway, is characterized by a wide variety of different bird habitats including wintering areas for large numbers of passerines, raptors and waterbirds. The first data on hunting in Bosnia and Herzegovina date back to the period before the Ottoman Empire. During the Ottoman rule bird hunting was almost non-existent, but was later intensified during the Austro-Hungarian period. The first hunting law was adopted in 1893 (Laska 1905) and the first hunting association was founded in 1925 (Ilić 2010). Today in Bosnia and Herzegovina hunting is organized in four hunting associations with 202 local hunting societies including a total of 40,000 - 50,000 hunters (Kotrošan & Sarajlić 2014).

In Bosnia and Herzegovina the protection of birds and their habitats is presently regulated through the Animal Protection and Welfare Law of Bosnia and Herzegovina (Official Gazzete of the Bosnia and Herzegovina, No. 25/2009 and No. 9/2018), laws on nature protection by the Law on Nature Protection of Federation of Bosnia and Herzegovina and the Law on Nature Protection of Republic of Srpska, and through the hunting laws of both entities (Law on Hunting of Federation of Bosnia and Herzegovina and Law on Hunting of Republic of Srpska). In addition, the „Ordinance on the hunting season of seasonally protected game and list of birds and mammals considered beneficial for agriculture and forestry in Federation of Bosnia and Herzegovina", the „Order on determination of birds and mammals beneficial for agriculture and forestry in Republic of Srpska" and the Red Lists define permanently protected species, regulate the hunting and hunting seasons of protected and 'beneficial' birds and mammals

The Laws on Nature Protection (Official Gazette of Republic of Srpska, No. 20/14, Official Gazette of the Federation of Bosnia and Herzegovina, No. 66/13 / 28.08.2013) refer to the Red Lists and the Red Books. In the Republic of Srpska, the "Red List" contains 304 species, but the conservation status and the vulnerability according to red list criteria are not given[1]. The „Red List" of the Federation of Bosnia and Herzegovina[2] contains 198 breeding bird species and 62 species of migrating, wintering and non-breeding bird species (cf. Tab. 1).

The Law on Hunting of the Federation of Bosnia and Herzegovina (Official Gazette of the Federation of Bosnia and Herzegovina, No. 4, 2006) and the Law on Hunting of Republic of Srpska (Official Gazette of Republic of Srpska, No 60, 2009) are to a large extent incompatible with the conservation needs of many bird species. Both laws as well as the Ordinance and Order, mentioned above, are not in line with each other neither within the same entity nor between both entities. In the same way they are not aligned with the Bern Convention, nor with the European Union's Birds Directive.

The „Order on determination of birds and mammals beneficial for agriculture and forestry in Republic of Srpska" (hereafter referred to as „The Order") includes 143 bird species (Official Gazette of Republic of Srpska 3, 2010), while the "Ordinance on the hunting season of seasonally protected game and list of birds and mammals considered beneficial for agriculture and forestry"(hereafter „The Ordinance") (Official Gazette of the Federation of Bosnia and Herzegovina, No. 4/06, 2008) includes 142 bird species. The Ordinance consists of two parts. One considers the hunting season for game birds and the other part is a list of "beneficial birds and mammals". The Order of the Republic of Srpska is just a list of "beneficial" bird and mammal species. The Hunting Law of the Federation of Bosnia and Herzegovina prohibits the hunting of species listed in the Ordinance as beneficial for forestry and agriculture and the Hunting Law of the Republic of Srpska prohibits the hunting of species listed in the Order.

Because of the contradicting legal regulations, mentioned above, as well as due to poor implementation of existing laws there are numerous reports on poaching and the devastating impact of uncontrolled hunting on birds in Bosnia and Herzegovina (Laska 1905, Rucner 1993, Stumberger, 2001). One hundred years ago hunting in the Neretva Delta devastated the populations of Dalmatian Pelican (*Pelecanus crispus*), White-headed Duck (*Oxyura leucocephala*) and Marbled Duck (*Marmaronetta angustirostris*) (Reiser 1939). Fifty years later, they became totally extinct in the area (Rucner 1993). Furthermore, Black Grouse (*Tetrao tetrix*), Bearded (*Gypaetus barbatus*), Griffon (*Gyps fulvus*), Cinereous (*Aegypius monachus*), and Egyptian Vulture (*Nephron percnopterus*) as well as Great Bustard (*Otis tarda*) became extinct in the entire area of Bosnia and Herzegovina due to excessive hunting and poisoning (Kotrošan 2008/2009), while a number of some other bird species were brought to the brink of extinction (Kotrošan *et al.* 2012, Kotrošan & Hatibović, 2012).

Since the day of its foundation, in 2003, the Ornithological Society "Naše ptice" has gathered data on bird hunting and poaching in the area of Bosnia and Herzegovina in cooperation with numerous associates from the country and from abroad (Schneider-Jacoby 2008/2009, Stumberger *et al.* 2008/2009, Schneider-Jacoby & Spangenberg 2010, Kotrošan & Sarajlić 2014, Durst & Mikuška 2016) and only recently we started to derive information from internet media, like social networks, internet portals and commercials.

Based on the analysis of these data and on field observations the present paper summarizies our current knowledge on the killing of protected and endangered bird species, the use of illegal hunting techniques, the presence and frequency of illegal bird shooting, bird-catching and trafficking with wild birds in various parts of Bosnia and Herzegovina. The aim of the paper is to draw public attention to the negative impact of hunting and poaching on wild bird populations, to prevent illegal activities and to ensure sustainable hunting in accordance with the legislation of the country but also to show what type and quantity of data can be collected through desk research. The paper further points to legislative deficiencies, the lack of compliance between the hunting laws of the two political entities and with international regulations and conventions.

Although this paper deals with poaching in Bosnia and Herzegovina, data on the killing of game species are also included. Since social networks and the media were used as the main source of information on the killing and capture of birds, with the same probability of obtaining information on legal as well as on illegal activities (with a probable bias against illegal shooting), our goal was to assess the proportional ratio of legally and illegally killed wild birds.

2. Materials and methods

Most data on poaching in Bosnia and Herzegovina concerns the years between 2012 and 2018, while a smaller fraction concerns the period from 2003 - 2012. Around 95% of all information from social networks were derived from the internet during February 2018.

For the current analyses poaching is defined as any capturing, wounding, poisoning and killing of wild animals in contradiction with the existing hunting and conservation laws of the two political entites of Bosnia and Herzegovina. Examples of illegal killing include the hunting of 'game' species during the closed season, the use of prohibited methods (e.g. mist-nets, lime-sticks, electronic calling devices, hunting from moving motorboats, use of rifles with more than two bullets, traps, poisons etc.) or other illegal activities (e.g. egg-collecting) for capturing, holding and trading with wild species, the killing, wounding and trapping of protected species as well as the killing, wounding and trapping of game species inside protected areas in which such activities are forbidden. Because in many cases essential data were missing, we each time considered an individual bird as a victim of bird crime when the dead, wounded, trapped or traded specimen concerns a species that is permanently protected in both entities or when the ind. of a wild species was poisoned or smuggled across the border (cf. chapter 3.3). Common Quail *(Coturnix coturnix)* was considered as the victim of bird crime whenever the number of shot birds amounted to ≥ 10 individuals (cf. chapter 3.2).

Besides information derived from the internet, information on poaching and hunting were collected by members of the Ornithological Society „Naše ptice" (a) during regular monitoring of bird habitats for illegal activities and (b) through occasional observations by numerous associates of the society. All information were stored in a shared database. Both, data that clearly indicated the violation of

the law (e.g. by hunting permanently protected species) as well as information on potentially illegal hunting activities were stored in the database, with the aim to gain insight into the hunting pressure on certain bird species. Whenever possible, all available information on individual cases of hunting or poaching were stored as an Excel-file, including species, the number of birds killed, date and description of the offense, location, name of the perpetrator, its address and telephone number, source of information, the internet-link etc. In addition, any photographs, video clips, screenshots of Facebook pages, advertisements and all other materials concerning individual cases were collected.

For analysis all cases were classified according to the following categories:

1. Killing and wounding of wild birds with fire or cold weapons includes the killing and wounding of permanently protected species and cases of gamebird poaching. Poaching includes cases of hunting with illegal methods and means, like the use of decoys, electronic calling devices and semiautomatic shotguns.
2. *Poisoning* involves the deliberate introduction of poison for the purpose of killing certain birds, as well as the unintentional poisoning by consuming the poisoned prey, seed or baits intended for other animals.
3. *Illegal capture, keeping, trading and smuggling of wild birds* involves various activities leading to the illegal taking of wild species for captivity, their illegal selling or killing.
4. *Skins, mounted specimens or any other trophies* of protected species include taxidermies of permanently protected species that are further connected with other types of crime (poaching, trade with protected species etc.).

It is important to highlight that in many cases it was not possible to distinguish poaching from legal activities following to inconsistencies and many ambiguities of the exsisting laws, but also following to research methodology that was largely based on desk work.

3. Results and discussion

Between 2003 and March 2018 a database including 532 individual cases of legal and illegal bird killing that concern 11,383 individual birds of 103 species (Tab. 1) were compiled. Out of the total of 103 bird species, five exotic species do not belong to the autochthonous bird fauna of Bosnia and Herzegovina, i. e. White-cheeked Pintail *(Anas bahamensis)*, Northern Bobwhite *(Colinus virginianus)*, Indian Peafowl (*Pavo cristatus)*, Willow Grouse *(Lagopus lagopus)* and Reeves's Pheasant *(Syrmaticus reevesii).* All latter species are represented in the database only by a single individual (ind.). They are, therefore, not listed in Tab. 1. The total of 11,383 birds include 1,027 unidentified ind. of small passerines that were confiscated by the police at the national border[3,4].

The authors personally recorded 78 cases of killing, capture or the possession of wild birds during field work (14.7 % of the total number of cases), 248 cases (46.6 %) were extracted from social networks (33 Facebook profiles and 3 YouTube channels), 152 (28.6 %) were found on commercial websites and 43 in printed and electronic media (8.1%). Finally, 11 cases (2.1 %) were obtained from occasional observations of associates.

3.1 Analysis of individual cases in the scope of EU and local legislation

Since Bosnia and Herzegovina is not a member of the European Union, the EU Birds Directive (EU Directive 2009/147/EC) does not directly apply, but can be used to compare the impact of hunting and poaching in Bosnia and Herzegovina in relation to European standards. Accordingly, 37 species which were reported for the present study are protected in the European Union, and 27 more are listed in Annex I of the European Union's Birds Directive (Tab. 1).

In 2008, Bosnia and Herzegovina has signed the Bern Convention which is an obligatory interna-

tional legal act. In Annex II of the Bern Convention 50 species are listed that we registered as victims of hunting and/or poaching in Bosnia and Herzegovina, and 44 species are listed in Annex III of the same convention (Tab. 1).

Of all 103 bird species 98 belong to the autochthonous bird fauna of Bosnia and Herzegovina. Of these at least 30 species are permanently protected by the Law on Hunting of the Federation of Bosnia and Herzegovina (marked 3 under Order in Tab. 1). In contrast to males, female Capercaillie (*Tetrao urogallus*) and Hazel Grouse (*Bonasa bonasia*) are also protected by the same law, while another 26 bird species are protected under the Ordinance (marked with Z in Tab. 1).

In the Law on Hunting of the Republic of Srpska at least 33 species are listed as permanently protected (marked 3 under Ordinance in Tab. 1). And an additional 24 bird species are protected under the Order (marked with Z in Tab. 1). Like the Order of the Federation of Bosnia and Herzegovina the same law protects the hens of Capercaillie and Hazel Grouse.

We recorded one species that is listed as „protected" in the Law on Hunting of the Federation of Bosnia and Herzegovina and 9 species listed as „protected" in the Law on Hunting of the Republic of Srpska but it is not specified if they are protected permanently or through the closed season, only.

The hunting status of all species that are not explicitly listed as game in the hunting laws of the entities, i.e. as species marked 1, 2 or 3 in Tab. 1 and which at the same time are not listed as species beneficial for agriculture and forestry , i.e. species marked Z in Tab. 1, remains unclear but could also be considered as permanently protected since they are not listed as game in the hunting laws. This is the case for 7 species in the legislative of the Republic of Srpska and for 15 species in the legislative of the Federation of Bosnia and Herzegovina. In the same way, due to imprecise definition, the status of Common Shelduck (*Tadorna tadorna*), Eurasian Spoonbill *(Platalea leucorodia),* Eurasian Sparrowhawk (*Accipiter nisus),* Common Kestrel *(Falco tinnunculus)* and Eurasian Collared Dove (*Streptopelia decaocto*) remains unclear. While Spotted Nutcracker (*Nucifraga caryocatactes*) is protected under the Ordinance and Order, the species is open for hunting under the Federal Law on Hunting and the Law on Hunting of the Republic of Srpska.

In total, 50 species or 51% of all 98 bird species (i.e. 2,540 ind. or 22.3%) which were recorded as poaching victims are considered as non-huntable according to the hunting laws and the Ordinance or Order in both entities and 15 more species (i.e. 1,028 ind. or 9%) are considered as non-huntable in just one of the political entities without taking in account the species whose status is unclear. If we add to this number 1,027 unidentified ind. (or 9%) of small passerines which are also protected by the Ordinance/Order more than 31.3% of all recorded ind. concern permanently protected species and are therefore poaching victims. The other 68.7% of all recorded ind. represent species that are permanently protected in only one of the entities, species that are protected by a closed season, unprotected species and species whose protection status is unclear.

Tab. 1: Bird species recorded as quarry of legal and illegal hunting activities and wildlife crime in Bosnia and Herzegovina between 2003 and March 2018.
Besides the numbers per species killed or caught alive, the conservation status in Europe, the Republic of Srpska and in the Federation of Bosnia and Herzegovina are given. **EU conservation status** refers to the EU Birds Directive (2009): I - species listed in Annex I, P - species not allowed to be hunted within the entire EU, IIB - species allowed to be hunted in certain EU countries, IIA- species allowed to be hunted in all EU countries, IIIA - the sale, transport for sale, keeping for sale and the offering for sale of live or dead birds and of any readily recognisable parts or derivatives of such birds is allowed in all EU countries, IIIB - the sale, transport for sale, keeping for sale and the offering for sale of live or dead birds and of any readily recognisable parts or derivatives of such birds is allowed in certain EU countries; **BC status** refers to the Bern Convention: II - species under strict protection under Annex II, III - species under protection according to Annex III; Republic of Srpska **RS Red List:** X = species listed but conservation status not defined, see 1. Introduction, p. 160; Federation of Bosnia and Herzegovina **FBiH Red List**: Critically endangered (CR) – in a particularly and extremely critical state, Endangered (EN) – very high risk of extinction in the wild, Vulnerable (VU) – considered to be at high risk of unnatural (human-caused) extinction without further human intervention, Near threatened (NT) – close to being at high risk of extinction in the near future, Least concern (LC) – unlikely to become extinct in the near future, Data deficient (DD). Categories outside brackets refer to the breeding period, within brackets to the non-breeding period, migrants and wintering birds; RS Hunting Law/Ordinance and FBiH Hunting Law/Order: H - species considered as huntable, 1 – species listed as protected but not specified if it is permanently or protected by a closed season, 2 - species protected during the closed season; 3 - species permanently protected by the entity's hunting law; Z – species protected under special regulations, i.e. the Ordinance and the Order, as beneficial for agriculture and forestry (cf. Introduction).

Species	Number of individuals	EU status	BC status	RS Red List	FBiH Red List	RS Hunting Law/ Ordinance	FBiH Hunting Law/ Order
Anser albifrons	3	IIB, IIIB	III	X		1	2
Anser anser	6	IIA, IIIB	III	X		2	2
Tadorna tadorna	2	P	II	X		1	2? or H?
Aix galericulata	1	P	III	X			
Anas strepera	1	IIA	III	X	(DD)	1	2
Anas penelope	3	IIA, IIIB	III	X	(DD)	1	
Anas platyrhynchos	553	IIA, IIIA	III	X	LC	2	2
Anas clypeata	2	IIA, IIIB	III	X	(DD)	1	2
Anas acuta	1	IIA, IIIB	III	X	(DD)	1	2
Anas crecca	17	IIA, IIIB	III	X	DD (LC)	2	
Aythya ferina	4	IIA, IIIB	III	X	DD (LC)	1	2
Aythya nyroca	3	I	III	X	EN (DD)	1	
Melanitta fusca	1	IIB	III	X			
Bucephala clangula	1	IIB	III	X	(DD)	1	
Mergus merganser	2	IIB	III	X	(DD)	3	3

Species	Number of individuals	EU status	BC status	RS Red List	FBiH Red List	RS Hunting Law/ Ordinance	FBiH Hunting Law/ Order
Coturnix coturnix	4,572	IIB	III	X	NT	2	2
Phasianus colchicus	1,198	IIA, IIIA	III	X	LC	2	2
Tetrao urogallus ♂	20	I, IIB, IIIB	III	X	VU	2	2
Tetrao urogallus ♀	2	I,IIB, IIIB	III	X	VU	3	3
Tetrao tetrix	1	I, IIB	III	X	RE	3	3
Bonasa bonasia	1	I, IIB	III	X	LC	3♀,2♂	3♀, 2♂
Alectoris graeca	13	I, IIA	III	X	DD	2	2
Gavia stellata	2	I	II	X	(DD)	3	3
Gavia arctica	1	I	II	X	(DD)	3	3
Tachybaptus ruficollis	3	P	II	X	NT	3	3
Podiceps cristatus	2	P	III	X	NT	3	3
Ciconia ciconia	1	I	II	X	EN	3	3
Phalacrocorax carbo	121	P	III	X	VU (LC)	H	3
Microcarbo pygmaeus	2	I	II	X	CR	H	3
Botaurus stellaris	4	I	II	X	EN	3	3
Ardea cinerea	3	P	III	X	VU	H	H
Ardea alba	2	I	II	X	(VU)	3	
Egretta garzetta	1	I	II	X	VU		3
Platalea leucorodia	1	I	II	X	RE (EN)	3? or H?	H
Pernis apivorus	1	I	II	X	NT	3	
Circaetus gallicus	3	I	II	X	VU	3	
Aquila chrysaetos	4	I	II	X	EN	3	3
Circus cyaneus	1	I	II	X	(DD)	3	
Accipiter nisus	12	P	II	X	LC	H	3? or H
Accipiter gentilis	20	P	II	X	LC	H	3
Buteo buteo	52	P	II	X	LC	3	3
Crex crex	3	I	II	X	VU	3	3
Rallus aquaticus	2	IIB	III	X	LC	3	3
Gallinula chloropus	2	IIB	III	X	LC	3	3
Fulica atra	91	IIA, IIIB	III	X	LC	2	2
Grus grus	7	I	II	X	RE (NT)	3	3
Vanellus vanellus	1	IIB	III	X	VU	3	3

Tab. 1 (continued)

Species	Number of individuals	EU status	BC status	RS Red List	FBiH Red List	RS Hunting Law/ Ordinance	FBiH Hunting Law/ Order
Numenius arquata	1	IIB	III	X	(EN)		
Numenius phaeopus	1	IIB	III	X			
Gallinago gallinago	3	IIA, IIIB	III	X	EN	2	2
Scolopax rusticola	18	IIA, IIIB	III	X	(DD)	2	2
Chroicocephalus ridibundus	1	IIB	III	X	LC	3	3
Larus canus	1	IIB	III	X		3	3
Columba livia	60	IIA	III	X	LC	2	2
Columba palumbus	10	IIA, IIIA		X	LC	2	2
Streptopelia turtur	6	IIB	III	X	LC	2	2
Streptopelia decaocto	2	IIB	III	X	LC	2	H? or 2?
Tyto alba	5	P	II	X	VU	3	3
Otus scops	2	P	II	X	NT	3	
Bubo bubo	20	I	II	X	VU	3	3
Athene noctua	2	P	II	X	NT	3	3
Strix aluco	12	P	II	X	LC	3	3
Strix uralensis	10	I	II	X	VU	3	
Asio otus	12	P	II	X	LC (NT)	3	3
Asio flammeus	2	I	II	X	CR	3	
Alcedo atthis	1	I	II	X	NT	Z	Z
Upupa epops	1	P	II	X	NT	Z	Z
Dendrocopos major	1	P	II	X	LC	Z	Z
Dryocopus martius	4	I	II	X	NT		Z
Picus canus	1	I	II	X	LC	Z	Z
Falco tinnunculus	5	P	II	X	LC	3?	3
Falco subbuteo	1	P	II	X	(VU)	3	3
Falco cherrug	1	I	II	X	(DD)	3	3
Falco peregrinus	7	I	II	X	DD	3	3
Garrulus glandarius	7	IIB		X	LC	H	H
Pica pica	80	IIB		X	LC	H	H
Nucifraga caryocatactes	1	P	II	X	LC	H and Z	H and Z
Corvus cornix	86	IIB		X	LC	H	H
Corvus corax	7	P	III	X	LC	3	1

Species	Number of individuals	EU status	BC status	RS Red List	FBiH Red List	RS Hunting Law/ Ordinance	FBiH Hunting Law/ Order
Alauda arvensis	847	IIB	III	X	LC		Z
Cyanistes caeruleus	2	P	II	X	LC	Z	Z
Turdus merula	1	IIB	III	X	LC	Z	Z
Sturnus vulgaris	1	IIB		X	LC	Z	Z
Motacilla flava	2	P	II	X	LC	Z	Z
Motacilla alba	6	P	II	X	LC	Z	Z
Anthus trivialis	1,949	P	II	X	LC	Z	Z
Luscinia megarhynchos	1	P	II	X	NT	Z	Z
Sitta europaea	1	P	II	X	LC	Z	Z
Emberiza citrinella	1	P	II	X	LC	Z	Z
Emberiza calandra	3	P	III	X	LC	Z	Z
Fringilla montifringilla	1	P	III	X	(LC)	Z	Z
Pyrrhula pyrrhula	59	P	III	X	LC	Z	Z
Chloris chloris	14	P	II	X	LC	Z	Z
Spinus spinus	39	P	II	X	LC	Z	Z
Carduelis carduelis	266	P	II	X	LC	Z	Z
Carduelis cannabina	23	P	II	X	LC	Z	Z
Serinus serinus	1	P	II	X	LC	Z	Z
C. coccothraustes	9	P	II	X	LC	Z	Z
Passer montanus	5	P	III	X	LC	Z	Z
Unid. passerine species	1,027						
Exotic species	5						
Total	**11,383**						

3.2 Hunting pressure

Seven of the 16 most numerous quarry species (Fig. 1) are permanently protected in both entitites of Bosnia and Herzegovina either under the hunting law (2 species: Common Buzzard *Buteo buteo* 52 ind., Eagle Owl *Bubo bubo* 20 ind.) or under the Ordinance and Order, respectively, as species beneficial for agriculture and forestry (5 species: Tree Pipit *Anthus trivialis* 1949 ind., European Goldfinch *Carduelis carduelis* 266 ind., Eurasian Bullfinch *Pyrrhula pyrrhula* 59 ind., Eurasian Siskin *Carduelis spinus* 39 ind. and Eurasian Linnet *Carduelis cannabina* 23 ind.), while an additional 3 species, i. e. Eurasian Skylark *Alauda arvensis* (847 ind.), Great Cormorant *Phalacrocorax carbo* (121 ind.) and Northern Goshawk *Accipiter gentilis* (20 ind.), are permanently protected only in the Federation of Bosnia and Herzegovina. The status of Eurasian Skylark in the Republic of Srpska is unclear because it is not listed neither in the Law on Hunting nor in the Order. According to the hunting laws of both entities, female Capercaillie (2 ind.) is permanently protected whereas male Capercaillie (20 ind.) is protected through a closed season. And both sexes of the remaining 5 species are protected through a closed season in the entire country, but are open for hunting during a certain period of the year.

An analysis of the numbers of birds per species shows that Common Quail is subjected to the largest hunting pressure. For the species is partly protected through a closed season in both poltical entities, quail numbers may contain an unknown portion of legally killed birds (cf. 2. Materials and methods).

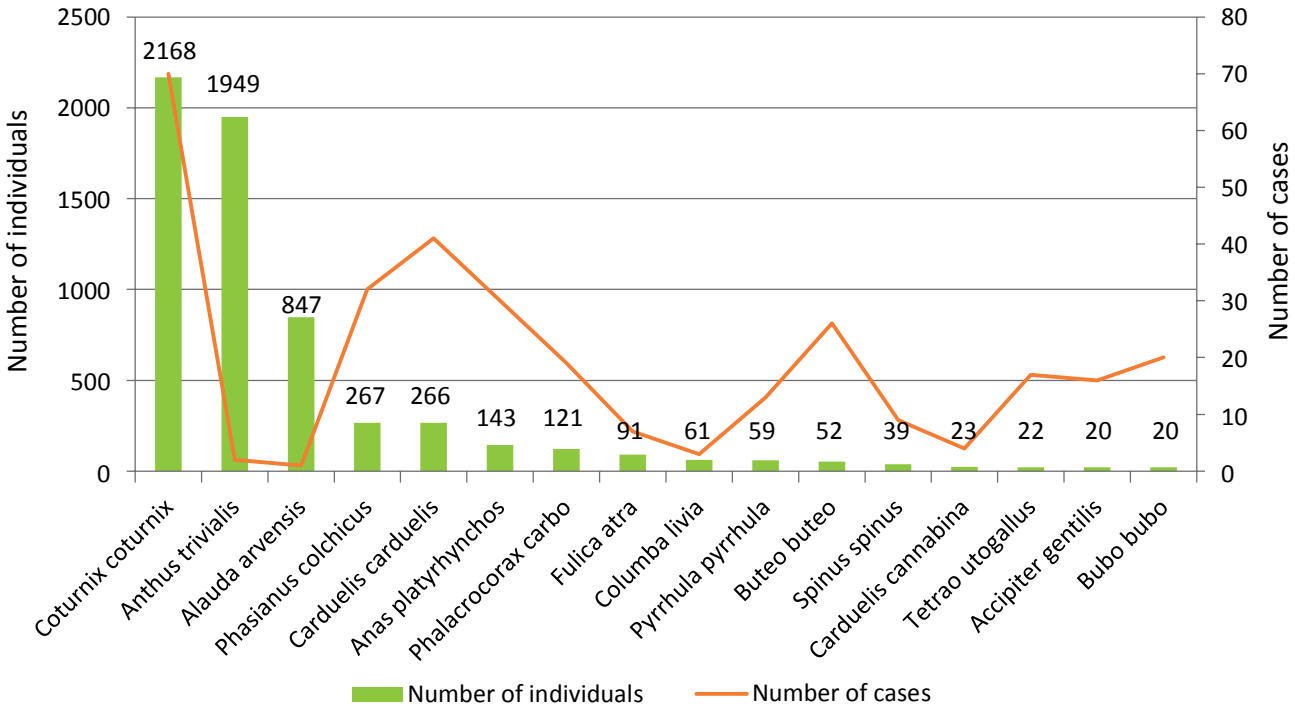

Fig. 1: Number of individuals of the most common species (blue bars) and the number of captured, traded, hunted or poisoned birds per species (orange line) in Bosnia and Herzegovina, 2003 – 2018.

Of the total number of Common Quails, 2,414 ind. were reported as legally killed quarry in the annual report of the Hunting Society "Sava", Orašje (Dabić 2009; Fig. 4) and 863 ind. were confiscated at the border[5,6,7]. The remaining 1,295 ind. were killed during 69 individual hunting trips and extracted from 14 Facebook profiles, 3 YouTube channels, one case was personally recorded and 5 cases were found in the media. In 21 of these cases (hunting trips) < 10 ind. were killed, in 26 cases 10 - 19 ind. were killed (i.e. 356 ind.), and in 22 of 69 reported cases ≥ 20 quails were killed (i.e. 864 ind.). According to hunters which we have interviewed, it is very difficult to kill 10 or more Common Quails by legal hunting methods. Therefore, we suppose that in the cases in which at least 10 quails were killed per hunting trip in Fig. 2 and Fig. 3 illegal devices, like playbacks, were used. Due to this, the total number of illegaly killed and/or illegaly traded quails recorded in our research amounted to at least 2,083 ind., i.e. 45.6% of the total number of reported quails. Only on one out of 14 Facebook profiles we found no case of ten or more killed quails during a single hunting trip. In two YouTube videos playbacks and illegal hunting weapons could be heard. Concerning the number of killed specimens per hunting trip, two cases from Doboj with 144 and 85 killed quails, respectively, stand out (both of them recorded at the same Facebook profile). In neighbouring countries with better law enforcement, estimates of illegaly killed quails per year amount to 50,000 - 60,000 in Serbia, 10,000 - 100,000 in Croatia and 30,000 - 100,000 birds in Montenegro (BirdLife International 2015). We suppose that the situation in Bosnia and Herzegovina is the same, if not even worse.

Fig. 2: A single hunting bag of Common Quail (*Coturnix coturnix*); case extracted from a Facebook profile.

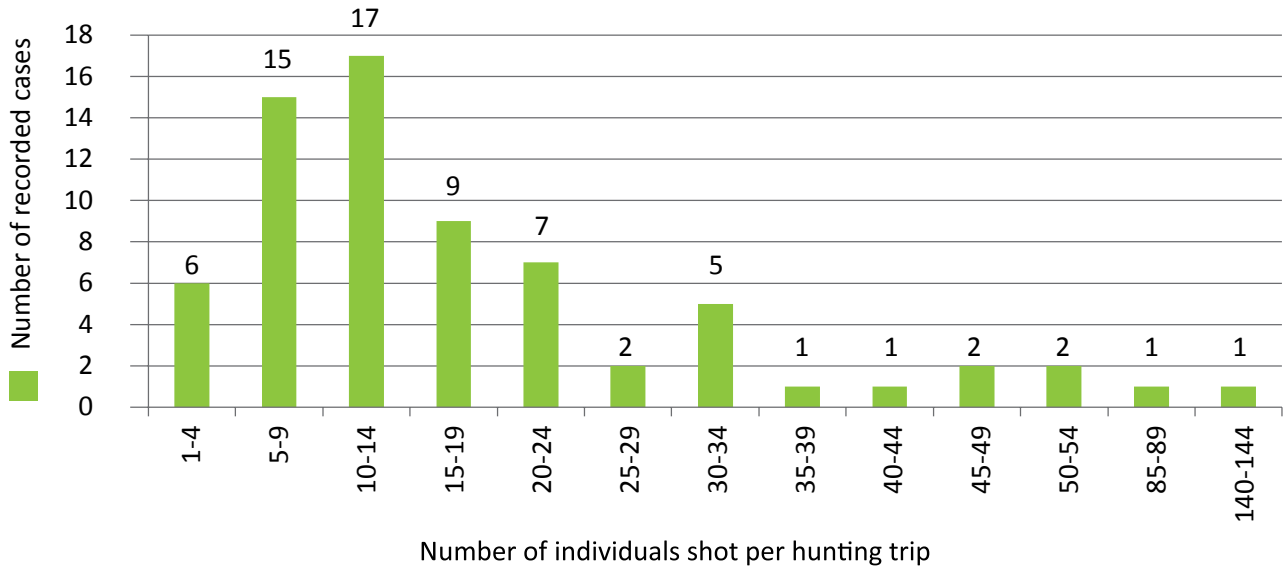

Fig. 3: Numbers of individual Common Quail (*Coturnix coturnix*) shot per hunting trip.

The only estimate of the total numbers of Common Quail legally shot in Bosnia and Herzegovina has been published in the official newsletter of the Hunting Federation of Herceg-Bosna and the Kinological Association of Herceg-Bosna. According to Bošnjak (2008) at least 15,000 – 20,000 ind. are annually shot during "organized huntings". In 2009 the Hunting Society "Sava" from Orašje reported that alone in the hunting season 2008/2009 2,414 quails were shot. Bearing in mind that there are 202 active hunting societies in Bosnia and Herzegovina with more than the half of them engaged in quail hunting and that not all hunting trips are legal, it is estimated that the number of annually shot birds is several times larger than it is suggested by Vlado Bošnjak.

Since the breeding population of Common Quail in Bosnia and Herzegovina is currently estimated at 20,000 - 30,000 breeding pairs (Kotrošan *et al.* 2012) the present pressure on the quail population from hunting is unsustainable and the control of legal and illegal shooting will be a key factor for the survival of the species in the region.

Another interesting point is the proportion of shot pheasants and quails, both species protected by a closed season. Members of the Hunting Society "Sava" from Orašje shot 931 pheasants and 2,414 quails in the same year and released 3,767 pheasants, but no quails.

A closer look on the report of HS Sava (Fig. 4) shows a further problem - the way of annual reporting, i.e. the listing of hunted species that is provided to the public. According to the report of HS Sava members of the society shot 410 "divlje patke/wild ducks" which, according to the Federal Hunting Law, is the general name for all duck species except domesticated ducks, but at the same time is also the local name for the Mallard *(Anas platyrhynchos)*. The same applies to 20 ind. of "šljuka" which is the general name for Woodcock *(Scolopax rusticola)*, Great Snipe *(Gallinago media)*, Common Snipe *(Gallinago gallinago)*, Curlew *(Numenius arquata)*, Whimbrel *(N. phaeopus)* and Slender-billed Curlew *(N. tenuirostris)*. Hence, the numbers reported may include some proportion of endangered and permanently protected species.

IZ LOVAČKIH DRUŠTAVA

LU „Sava", Orašje: PREDSJEDNIK U OBILASKU SEKCIJA

Popravlja se stanje divljači u lovištu

Adam Dabić

Tijekom lovne sezone 2008./09, predsjednik LU „Sava" Pavo Kosić povremeno je obilazio lovačke sekcije ove udruge, s ciljem da sasluša probleme lovaca i da, na određeni način, olakša rad predsjednicima sekcija, lovnicima i lovočuvarima, koji nose najveći teret u svakoj lovačkoj udruzi. Tijekom tih razgovora analizirala se, između ostaloga, situacija u lovištu glede stanja divljači, te se zaključilo kako je veliki problem praksa puštanja divljači u dijelove lovišta koji nisu dovoljno očišćeni od predatora.

Sa zadovoljstvom se može istaknuti da je tijekom sezone 2008./09. u ovdašnje lovište uneseno različite divljači u vrijednosti od oko 50.000 KM. U proljeće 2008. pušteno je u lovište matično jato fazanske divljači, 397 komada, te još 2.860 fazana starosne dobi 12 tjedana. Na skupštini Društva, održanoj 31. kolovoza 2008., odlučeno je da se kupi terensko vozilo (plaćeno je 6.000 KM) i da se kupi 450 fazana starih 5 mjeseci i šezdesetak koka, koje su puštene u lovište 18. listopada 2008., u vrijeme lova fazana. Kad se sve zbroji, u 2008. godini pušteno je u lovište 3.767 komada fazanske divljači, te 20 zečeva, koje su samoinicijativno u lovište puštale sekcije. Stanjem srneće divljači također možemo biti zadovoljni, što znači da se ukupno brojno stanje divljači unazad dvije-tri godine značajno popravilo.

Kroz cijelu lovnu sezonu, u 10 sekcija, odstrijeljen je 931 fazan mužjak, 111 zečeva, 410 divljih pataka, 20 šljuka, 2.414 prepelica, jedna divlja svinja, te 4 srnjaka, s tim da ima naznaka da je broj srnjaka veći jer se zbog miniranog područja svi srnjaci nisu mogli pokupiti i prijaviti. Tijekom sezone pregaženo je jedno lane, a jedno je uginulo prilikom hvatanja u zamku. Pregažena su 2 srnjaka i jedna srna, ali su iskorišteni za potrebe Društva.

U lovištu je još uvijek previše predatora, premda ovdašnji lovci poduzimaju različite akcije protiv njih i rezultata ima. Odstrijeljene su, primjerice, 132 lisice, 5 divljih mačaka, 22 kune, 121 pas lutalica, 29 običnih mačaka, 75 svraka, 82 vrane, 6 jazavaca i 2 čaglja. Ove brojke nisu loše, ali je jasno da se na svođenju predatora na podnošljivu mjeru još mora raditi, kako bi divljač bila što sigurnija i kako bi se mogla razmnožavati u miru.

Lovci sekcije Vidovice, s predsjednikom Pavom Kosićem u obilasku lovišta

Fig. 4: Unofficial annual report of the HS „Sava" from Orašje published in the HOOP periodical.

According to our database a minimum of 7 Peregrine Falcon *(Falco peregrinus)* were killed in Bosnia and Herzegovina illegally since 2003. We estimate that this number represents about 6% of the species's current breeding population in the country. At the same time the database includes information on the shooting of 2 Short-eared Owl *(Asio flammeus),* i.e. > 10% of the countrie's breeding population (Kotrošan *et al.* 2012), of 20 Eagle Owl (about 2%), of 4 Golden Eagle *Aquila chrysaetos* (> 4%), 4 Eurasian Bittern *Botaurus stellaris* (> 4% of the national population) and the possible killing of a Black Grouse *(Tetrao tetrix).* The later species is considered as an extinct breeder in Bosnia and Herzegovina.

3.3 Classification of bird crime

Of all 11,383 birds, 10,913 were reported as dead, 3 as wounded and 467 as alive. Dead ind. were killed by fire or cold weapons, poisoned or they were reported as mounted specimens. Live individuals were captured or kept for trading. Of all birds reported at least 6,621 ind. belong to a species which is permanently protected in both entities and at least 60 more ind. to a species that is permanently protected in one entity.

3.3.1 Killing and wounding of wild birds with fire or cold weapons

The primary motive for illegal bird killing is the acquisition of material profits. The resale of poached birds in foreign markets is a lucrative source of income. Hence it is not suprising that the majority of small passerines will be smuggled to foreign countries, first of all to Italy. Cormorants, Common Buzzard, Sparrowhawk, Golden Eagle and Peregrine Falcon are considered as predators of fish, poultry and high flying pigeons and are usually killed as pests. Owls are killed for various reasons such as superstition or for feathers that are used for fish baits. Common Coot *(Fulica atra)* are killed for food. In Bosnia and Herzegovina the most common means for poaching are semiautomatic shotguns with more than 2 bullets, the hunting with dogs, usage of electronic calling devices, usually used for quail, ducks and Hazel Grouse, and plastic decoys used for duck hunting. Where possible ducks and coots are hunted from motorboats.

Only 3 birds were found as wounded; 2 of it, Common Crane *(Grus grus)* and Eagle Owl, are permanently protected in both entities and Great Cormorant *(Phalacrocorax carbo)* is permanently protected in the Federation of Bosnia and Herzegovina.

Most birds, i.e. 5,929 ind., out of at least 46 species were killed by firearms. Usually the only reliable criterion for us for determining if an individual was the victim of bird crime is the local hunting and protection status of the species. Common Coot that is a game species and protected during the closed season is also hunted in protected areas where hunting is illegal (i.e. Nature Park and Ornithological Reserve Hutovo Blato). Three species, i.e. 8 ind., are permanently protected in just one entity. At least 13 more species, i.e. 71 illegaly killed birds, are permanently protected in both entities and another 71 poached ind. were shot in Nature Park Hutovo blato (out of the later 69 ind. were coots). Twelve other ind. were illegaly killed by using decoys, calling devices etc. mainly at Šipovo and Mostarsko blato. By adding 1,220 ind. of poached quails, of a species protected through the closed season (cf. chapter 3.2) we get at least 1,376 ind. as victims of bird crime.

Photo: Biljana Topić

Fig. 5: Illegaly shot Long-eared Owl (*Asio otus*). This case was personally recorded at one of the largest roosting sites of the species (180 – 250 ind.) in Bosnia and Herzegovina in Domaljevac, Federation of Bosnia and Herzegovina

3.3.2 Poisoning

We found information for only two cases of the poisoning of 41 Domestic Pigeons *(Columba livia* f. *domestica)* and of one Common Buzzard. The reason for poisoning as well as the type of poison are unknown. According to the biocide laws of both entities, the Law on Hunting of both entities as well as the Law on Nature Protection of Federation of Bosnia and Herzegovina the poisoning of wild birds is strictly forbidden.

3.3.3 Illegal capture, keeping, trading and smuggling of wild birds

4,703 ind., recorded during our research, were smuggled at the boarder. The most numerous species are Tree Pipit *Anthus trivialis* (1,949 ind.), Common Quail (863 ind.), Eurasian Skylark *Alauda arvensis* (847 ind.) and other unidentified passerines (1,028 ind.).

The capture, husbandry and trafficking of wild birds is also very common in Bosnia and Herzegovina, treated by the Animal Protection and Welfare Law of Bosnia and Herzegovina, the laws on nature protection and the hunting laws of both entities. The regulations are not always concise enough. So it is usually not possible to distinguish if the ban applies on all wild birds or just on strictly protected species (the other problem is that there is no law in which „strictly" protected bird species are listed). So, we will consider all birds of the permanently protected species as victims of bird crime. At least 433 ind. (15 species) out of 468 ind. (25 species) belong to a species that is permanently protected in both entities and at least 17 ind. (3 species) belong to a species which is permanently protected in just one entity.

The majority of indivuduals, recorded under this category (428 ind.), were reported as cage birds. The selling price for live birds ranged from 5 to 150 BAM depending on the species (see Tab 3.)

Species mostly affected by this sort of crime are songbirds such as finches (Fringilidae) and birds of prey (falcons, hawks and owls) (Tab. 2). Songbirds are caught with the use of nets, glue, traps with mounted speciments (Fig. 6), live decoys and so on, generally for caging and illegal trade. Raptors are usually caught by accident, in chicken coops, or deliberately as chicks in nests and later kept in cages as touristic attractions, for falconry or trading. Quails are kept for the purpose of being used as live decoys or given to the hunting dogs to „play" with, the later also applies to coots.

Tab. 2: Number of birds illegaly captured, traded or kept as cage birds. Number of entities where the species is permanently protected under the law on hunting.

Species	Number of individuals	Number of entities
Aquila chrysaetos	1	2
Emberiza citrinella	1	2
Falco cherrug	1	2
Falco peregrinus	1	2
Falco subbuteo	1	2
Fringilla montifringilla	1	2
Asio otus	2	2
Bubo bubo	2	2
Corvus corax	2	1
Falco tinnunculus	3	1
Buteo buteo	6	2
C. coccothraustes	9	2
Accipiter gentilis	12	1
Carduelis chloris	13	2
Carduelis cannabina	23	2
Carduelis spinus	39	2
Pyrrhula pyrrhula	59	2
Carduelis carduelis	274	2
Sum.	**450**	**33**

Fig. 6: Decoys of Europaen Goldfinch (*Carduelis carduelis*), made out of stuffed specimens and used for illegal bird trapping. This case was reported by members of HS Orlov Kuk from Tomislavgrad. Along with the decoys mist-nets, cages and live specimens used as lures were recorded (extracted from Facebook).

Tab. 3: Prices for live birds on the black market in Bosnia and Herzegovina (most of it found in the internet).

Species	*Accipiter gentilis*	*Accipiter nisus*	*Buteo buteo*	*Carduelis cannabina*	*Carduelis carduelis*	*Carduelis spinus*	*Coccothraustes coccothraustes*	*Corvus corax*	*Fringilla montifringilla*	*Pyrrhula pyrrhula*
Price/ ind. (BAM)	50-150	50	50	10-30	5-100	20-40	15-50	45	30	50-100

3.3.4 Skins, mounted specimens or any other trophies of protected species

Mounted specimens of 69 protected and game species (239 ind. or 2.1% of the total) were registred, mostly displayed in hunting lodges (Fig. 7), catering facilities, cafés and restaurants, but also in numerous private collections and some displayed for sale. Out of these 68 ind. which belong to 24 species are permanently protected in both entities with illegal possession represented by at least 44 cases (48 ind.) and illegal trade by at least 19 cases (20 ind.). 33 other birds belong to 12 species that are permanently protected in only one entity.

This type of bird crime mainly concerns larger species, like Capercaillie, raptors, owls, waterfowl, etc. The selling price for mounted specimens varies from 20 BAM to 1,250 BAM depending on species and the quality of taxidermy (Tab. 4).

Fig. 7: Part of a private collection of mounted specimens. Among game species there are many specimens of species that are strictly protected in both entities (case extracted from Facebook).

Tab. 4: Prices of mounted specimens of birds on the black market in Bosnia and Herzegovina (most of it found on internet).

Species	*Anas platyrhynchos*	*Botaurus stellaris*	*Buteo buteo*	*Casmerodius albus*	*Corvus corax*	*Falco peregrinus*	*Strix uralensis*	*Tetrao urogallus*
Price/ ind. (BAM	20	100	50-100	50	200	600	100	1000-1250

3.4 Protected areas and regional destribution of bird crimes

Of the total area of Bosnia and Herzegovina (51,129 km^2) only about 1,049 km^2 or about 2% of its territory are protected by law. In the European Union this percentage amounts to 15.3% and to 25% by including Natura 2000 areas (Romao *et al.* 2012). On the other hand, hunting grounds occupy 32,421 km^2 or 63.4% of the country. Consequently, there are practically no safe places for birds in Bosnia and Herzegovina.

Yet, the present data allow to distinguish four areas with particularly many poaching activities. With 27.1 % of all cases the north-wester part of the Republic of Srpska is the most prominent area where most illegal activities including illegal quail shooting, killing of birds of prey, and the capture and trading with songbirds is taking place. Experiences over many years in this area show the large-scale use of electronic calling devices and that a large-scale hunting tourism for foreign hunters, mainly from Italy, has been developed in the area. The north-western parts of the Republic of Srpska are followed by the Sarajevo Canton (15.5% of all reported cases) with information on the killing of birds of prey, numerous reports on the existence of trophies of protected species, and several cases of wild bird trade. In Herzegovina-Neretva Canton (12.6 % of all cases) hunting by presumably using illegal sound devices and wild bird trade was reported, while in Posavina Canton (12.2%) the most frequently reported poaching activities concern shooting of Common Quail with the help of sound devices and reportings on many trophies and stuffed specimens of protected species.

4. Conclusions

After the last war in former Yugoslavia during the 1990s Bosnia and Herzegovina faced many economic and social challenges. Economic breakdown, low ecological awareness of the general public, the lack of strictly protected areas, the lack of expert institutions, insufficient standards and statutory regulations as well as the corrupted state system took a hard toll on the country's biodiversity.

Bosnia and Herzegovina is located on the Adriatic Flyway. Along this migratory corridor each year hundreds of thousands of birds migrate towards the Mediterranean and Africa. Therefore, to protect the populations of Eurasian migratory birds the country is obliged to provide safe feeding and resting areas for migrating birds during their long and exhausting migrations free from poaching and bird shooting (Schneider-Jacoby 2001). The most important stop-over and feeding sites for migrato-

ry birds in Bosnia and Herzegovina include Hutovo blato, Livanjsko polje with Buško Lake, Mostarsko blato, Dabarsko polje, Modrac Lake, Bardača and Saničani fishponds.

After habitat destruction which has accelerated over the last years since the end of the war in Bosnia and Herzegovina, unsustainable hunting and poaching has emerged as one of the most important threats to bird populations in the Balkans and in the Mediterranean region. During the 20th century 15 bird species went extinct in Bosnia and Herzegovina (Kotrošan 2008/2009). With the only exception of European Roller *(Coracias garrulus),* poaching was the main reason. And yet, so far the authorities have taken no substantial measures to prevent the extinction of further species by unsustainable hunting, poaching, poisoning or the wild bird trade. In Bosnia and Herzegovina shooting is present even in protected areas, there is no adequate monitoring of the populations of endangered species, the national legislation is not aligned with international standards and regulations, the percentage of protected areas is among the lowest in Europe and, finally, there is high hunting pressure on game as well as non-game species. Hence, unproportionally great efforts will be needed to protect important bird habitats and the country's bird fauna.

While under the influence of the powerful hunting lobby politicians and the public authorities are largely passive, in recent years there are some changes following to the great efforts of members of the Ornithological Society "Naše ptice" and its numerous associates. The increase of waterbird populations in Hutovo blato is a good example. While the numbers of wintering waterbirds dropped to about 3,500 ind. in 2013, the lowest number ever recorded in the area since the beginning of the International Waterbird Census in Bosnia and Herzegovina (Topić 2013), after controlling of poaching since 2014, numbers increased to more than 20,000 – 35,000 waterbirds till 2017 (Topić 2014/2016, 2017). The example of Hutovo blato illustrates what would be possible to accomplish with similar projects and larger legally protected hunting free areas.

In addition, in 2015 Naše ptice compiled a study on „Birds and Hunting in Bosnia and Herzegovina" and presented it to all competent institutions. Since in the Federation of Bosnia and Hercegovina a new hunting law is under preparation, we expect the legislator to take into account the results of the study. However, following to the extremely high hunting pressure on birds, it will be, like in Albania, necessary to suspend all bird hunting until adequate regulations have been adopted and the implemention and control of the new regulations through the public authorities is guaranteed.

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Photo: Marin Mamuza

Hunting hide, Livanjsko Polje, Bosnia and Herzegovina, August 2020

Results of monitoring of birds and poaching in Hutovo blato and Mostarsko blato in 2016 and 2017

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Summary

Hutovo blato and Mostarsko blato are sub-Mediterranean wetlands located in the southeastern and western part of Herzegovina. Sofar, according to current censuses, a total of 259 bird species were recorded in Hutovo blato and its immediate surroundings, and a total of 222 species in the area of Mostarsko blato. In 1995, Hutovo blato was declared a nature park, in 1998 as an Important Bird Area (IBA), and in 2001 designated as a wetland of international importance within the Ramsar Convention. Mostarsko blato is currently listed as a potential IBA, and during the recent project “NATURA 2000 in Bosnia and Herzegovina” it was included into the list of potential NATURA 2000 sites, but is not yet protected under national legislation. Although in Hutovo blato hunting is forbidden since 1995, due to the lack of financing for the ranger service between 2008 and 2013, adequate control was missing. Consequently, illegal hunting and poaching is still rather common in the area. Although hunting is also prohibited in the greater part of Mostarsko blato, and the hunters’ awareness for the importance of birds is high, poaching is still one of the major disturbances for protected waterbirds in the area. Both, Hutovo blato and Mostarsko blato, are important stop-over and wintering sits on the Adriatic Flyway. This paper presents the results of waterbird counts and records of illegal hunting activities that were registered in both sites in 2016 and 2017. The analyses of the data showed a declining trend of illegal hunting, while, on the other hand, bird numbers increased.

Keywords

Hutovo blato, Mostarsko blato, bird monitoring, poaching, hunting

1. Introduction

Hutovo and Mostarsko blato are sub-Mediterranean wetlands, located in the southeastern and western part of Herzegovina. Hutovo blato is situated on the left side of the Neretva River near the border between Croatia and Bosnia and Herzegovina. It occupies an area of 7,411 ha of swamps, plains and mountains, ranging from 1 - 432 m a.s.l. It is an important stop-over and wintering site for waterbirds from Central and North Europe. According to data published between 1888 and 2000, and to research performed by members of the Ornithological Society „Naše ptice“, since 2000, so far a total of 259 bird species has been recorded in the area of Hutovo blato and its surroundings (Kotrošan & Sarajlić 2014). In 1995, Hutovo blato was declared a nature park, in 1998 as an Important Bird Area, and in 2001 it was designated as a wetland of international importance within the Ramsar Convention.

Mostarsko blato is a typical karst polje, located in western Herzegovina, at an altitude of 220 - 245 m a.s.l. It extends in a northwest-southeast direction, occupying an area of 4,256 ha with a length of 12 km and an average width of 3 km. The banks of the Lištica River, which flows through Mostarsko blato, are overgrown by wetland vegetation and riverine forests, surrounded by wet meadows and dry pastures, much of it has been converted into agricultural land. So far, 222 bird species have been recorded in the area of Mostarsko blato which represent about 50% of the total bird fauna of Bosnia and Herzegovina. Mostarsko blato was recently listed as a potential International Bird Area (IBA), and was included in the list of potential NATURA 2000 sites, but is still not protected under national legislation.

Although in Hutovo blato hunting has been forbidden since 1995, due to the lack of financing for the ranger service between 2008 and 2013, adequate control of illegal activities was missing. Consequently, till today illegal hunting and poaching is rather common in the area (Stumberger *et al.* 2008/09). A part of Mostarsko blato is managed as a hunting ground by the hunting societies "Mosor" from Široki Brijeg and "Jarebica" from Mostar. Hunting is prohibited in the greater part of Mostarsko blato. Nevertheless, the hunters' awareness of the importance of birds and bird conservation is high, but poaching is still one of the major disturbances for protected waterbirds in the area.

This paper presents the numbers of waterbirds and the records of illegal hunting activities in Hutovo and Mostarsko blato which were registered between April 2016 and August 2017.

2. Methods

The monitoring of illegal hunting activities and waterbird counts were conducted once a month from April 2016 to December 2017. All waterbird counts were conducted during a single day. Simultaneously, the occurrence and intensity of illegal hunting activities were noted during bird counts and hunting pressure was estimated by the occurrence and numbers of shots heard, the numbers of cartridges found, and the presence of hunters and motorboats. We further used data from local authorities on the numbers of reported and arrested poachers, and confiscated hunting weapons.

3. Results

3.1 Hutovo blato

During the study period the intensity of illegal hunting activities in Hutovo blato was most prominent between October and December 2016 (Fig. 1). Most shots (300) were registered in December 2016, followed by November (256) and October (220 shots). Shooting was also registered during other autumn and winter months, but on a smaller scale. Except in August 2017, no shots were registered during the spring and summer months.

Photo: Goran Topić

Fig. 1: Poacher in Mostarsko blato shooting at Common Cranes (*Grus grus*).

Similarly, most cartridges (75) were found in December 2016, followed by November 2016 (55) and in February 2017 (21 cartridges). Cartridges were found almost exclusively in months when also shots were heard. Most boats were registered in December 2016 (34), in April 2017 (28) and February 2017 (25 boats). Boats were seen in every month until June 2017, but were not registered afterwards. In most cases it was not possible to determine the poachers' identity. In October 2016 seven poachers were reported to the police by the observation team of Naše ptice, but none of them were arrested. In December 2016 three poachers were reported but, again, there were no arrests. The cooperation with the local police improved considerably after a series of workshops and meetings in late 2016. Thereafter, in 2017, every reported poacher was arrested and their weapons confiscated.

The main reason for the occurrence of illegal activities in Hutovo blato was the reduction of the financing of the public institution „Hutovo blato" Nature Park which led to the disbandment of the ranger service. The current decline of the numbers of illegal activities which we have recorded in the area, probably derives from the presence of joint observation teams consisting of members of the Ornithological Society "Naše ptice", Hutovo blato Nature Park, Hunting Association Galeb and the NGO Lijepa Naša as well as the presence of hunting inspectors and of the local police which discourage poaching.

Hutovo blato is an important stop-over and wintering site for migratory waterbirds. This is illustrated by the total numbers of birds which we counted during autumn migration (27,115 individuals in October 2016) and in winter 2016/17 (25,170 individuals in January 2017). In November and December, when illegal activities were most common, bird numbers decreased, but increased again after illegal activities decreased considerably in January and February 2017 (Fig. 2).

In the years between 2008 and 2010 when illegal hunting was common, total numbers of waterbirds in Hutovo blato didn't exceed 5,000 individuals, but after illegal hunting activities declined, numbers raised up to more than 24,500 birds in 2014 (Kotrošan *et al*. 2017). A similar effect was registered after a complete hunting ban at Lake Constance in Switzerland and Germany (Schneider-Jacoby 2009).

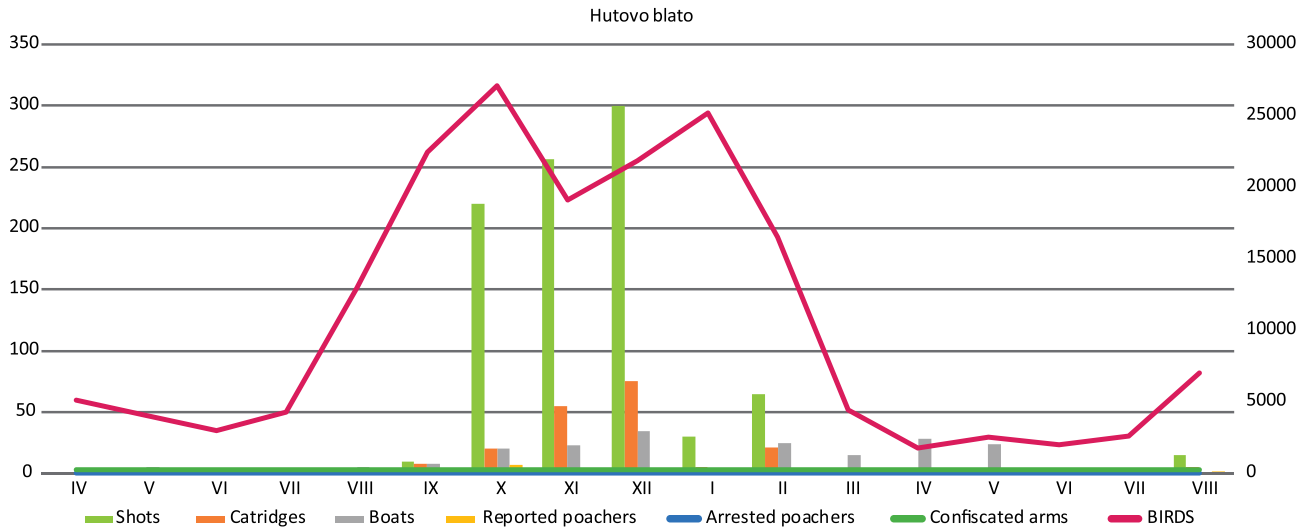

Fig. 2: Total numbers of waterbirds and poaching in Hutovo blato, 2016 and 2017.

3.2 Mostarsko blato

In Mostarsko blato illegal activities were most common from August to December 2016. In contrast, birds were most numerous during spring migration, with a maximum of > 3,000 individuals in March 2017. Unlike Hutovo blato, the numbers of birds were obviously heavily impaired by illegal hunting (Fig. 3). Most shots were registered in August (100) and September 2016 (150 shots), and on a smaller scale, but regularly, until April 2017. Like in Hutovo blato, no shots were heard during counts during the spring and summer months, except for August 2016 and 2017.

Most cartridges (12) were found in December 2016, followed by September 2016 (10) and February 2017 (6 cartridges). In August 2017, three poachers were reported to the police, but none of them were arrested.

4. Discussion

Despite heavy hunting in autumn and winter, during spring migration Mostarsko blato is one of the most important stop-over sites for cranes, waders and other waterbirds in Bosnia and Herzegovina. During migration thousands of birds - sandpipers, spoonbills, herons, Ruffs *(Calidris pugnax)*, Little Stints *(C. minuta)* and other species - can be seen in Mostarsko blato in a single day. Mostarsko blato is especially important for Common Crane (*Grus grus*), for which the area is one of the most important stop-over sites along the Adriatic Flyway, as well as Red-footed Falcon (*Falco vespertinus*) which can be seen in large flocks of often more than a hundred birds during spring migration. The later species may even occasionally breed in the area.

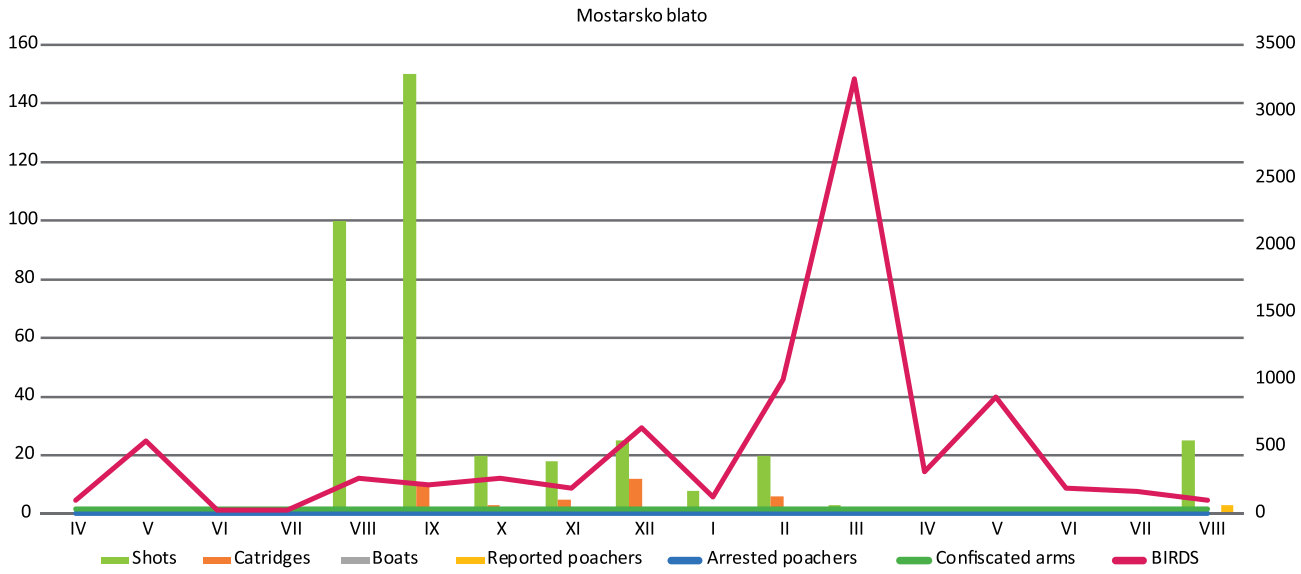

Fig. 3: Total numbers of waterbirds and illegal hunting activities in Mostarsko blato, 2016 – 2017.

While illegal hunting activity is comparably low in Mostarsko blato, controlling of illegal hunting in Hutovo blato has probably encouraged the first nesting of Glossy Ibis (*Plegadis falcinellus*) in the area in 2013 (Dalmatin *et al*. 2013) as well as, probably, the first record of Cattle Egret (*Bubulcus ibis*) in 2014. It will be necessary to ensure the continuity of bird counts and the monitoring of illegal activities in Hutovo blato to further reduce poaching and other disturbances. At the same time, it will be necessary to provide adequate funding for the ranger service, to strengthen the capacities of the rangers, and to improve cooperation with the police, the local community and hunting associations.

5. Conclusions

The presented data show that the reduction of illegal hunting activities had a positive and immediate effect on waterbird populations in Hutovo as well as in Mostarsko blato. The analyses of waterbird counts and information on illegal hunting activities showed that the decline of poaching coincided with an increase of bird numbers. We estimate that the number of wintering waterbirds may in both sites reach up to 50,000 birds if it is possible to reduce illegal hunting to a minimum. This could be achieved by providing funding for rangers for strengthening their capacities and by improving the cooperation between NGOs, local communities and hunting associations. In addition, the development of a sustainable birdwatching tourism may contribute to prevent poaching and other bird crimes.

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Photo: Andrea Rutigliano/CABS

Illegale hunting hide, Prud Ornithological Reserve, Croatia, December 2017

Neretva Delta - How to tackle poaching in a maze of reedbeds?

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Summary

The Neretva Delta is one of the most valuable wetlands on the eastern Adriatic coast and the largest reedbed complex in Croatia. The area serves as an important stop-over, breeding and wintering site in the Adriatic Flyway for 200 bird species. However migratory birds are threatened by illegal hunting activities, even in the ornithological reserves. It is estimated that at least 37.000 and up to 50.000 birds are illegally killed in the Neretva Delta each year, making the area the worst blackspot in Croatia. Poachers kill birds during night, while using motor vehicles, electronic lures, plastic decoys and automatic weapons. Furthermore, reedbeds in the Neretva Delta are destroyed to create poaching ponds called "*plana*". This is a unique type of platform for illegal killing of birds, specific to the Neretva Delta area. Poaching in a maze of reedbeds is very hard to control and offenders are rarely caught. In 2017, in scope of the Adriatic Flyway 3 project, Biom organized two anti-poaching camps in the Neretva Delta. The camps were organized with the help of Committee Against Bird Slaughter (CABS), Public institution Dubrovnik-Neretva county, the nature protection inspection, local police and fire departments. The results include 9 dismantled illegal hunting hides and 3 arrested and criminally charged poachers. These are the first anti-poaching camps organized in Croatia and Biom plans to continue with such actions in the future. This case study demonstrates methods used by Biom employees to tackle Illegal Killing of Birds (IKB) in one of the most important bird areas in Croatia, which is at the same time a killing trap for birds migrating along the Adriatic Flyway. Additionally, recommendations are given on how to organize anti-poaching actions in wetland areas.

Keywords

wetland, poaching pond, illegal hunting hide, Coots, reedbed, Neretva

Introduction

The Neretva Delta is one of the most biologically valuable wetlands on the eastern Adriatic coast. The delta, which represents the largest reedbed complex in Croatia (Tutis *et al.* 2013) is situated in Dubrovnik-Neretva County. The area is also part of a wider transboundary wetland with Hutovo Blato Nature Park in Bosnia and Herzegovina.

The delta is characterized by wide lagoons, sandflats and saltmarshes, lakes and tributaries of the Neretva River. The main visual identity is a reclaimed agricultural landscape with many irrigation channels. The delta is surrounded by karst hills, rich with underground water that supplies many springs, streams and lakes.

The area serves as an important stop-over, breeding and wintering site in the Adriatic Flyway for almost 200 regularly occurring bird species. More than 10.000 waterbirds regularly winter in the Neretva Delta (European Commission 2020) including thousands of ducks and Common Coots (*Fulica atra*), hundreds of Pygmy cormorants (*Phalacrocorax pygmaeus*) and many others.

The area is a Natura 2000 site, designated both as a Special Protection Area and Site of Community Importance. Since 1993 the area is also designated as a Ramsar site, i.e. as a wetland of international importance. Additionally, there are six protected areas covering a total of 1,724 ha, with four ornithological reserves. The management authority of the protected areas in the Neretva Delta is the Public Institution for Management of Protected Areas of Dubrovnik-Neretva County (PI Dubrovnik-Neretva).

The area is highly populated with around 35,600 inhabitants (2011 census). There are various threats and activities that have negative impacts on the wildlife of the delta, such as poaching, habitat degradation and agricultural intensification. The Neretva Delta is the worst blackspot in Croatia for illegal killing of birds (IKB). It is estimated that at least 37,000 and up to 50,000 birds are illegally killed in the Neretva Delta each year (Brochet *et al*. 2016).

Resolving poaching in a maze of poaching ponds and channels in reeds, whilst including the hunting community and other local stakeholders is challenging, not only for an NGO like Biom, but also for the management authority, inspectors and police.

"Tradition" as a mask for poaching

There are a total of 576 registered hunters in the Neretva Delta, who are active in 5 hunting societies and on 10 hunting grounds. More than half of all game species in the delta are birds, such as Common Coot, Mallard (*Anas platyrhynchos*), the Common Snipe (*Gallinago gallinago*), Eurasian Woodcook (*Scolopax rusticola*) and many others (Hunting Association of Dubrovnik-Neretva County, *pers. comm*). The main hunting season is from late summer until the first half of winter, while the closed season for most bird species is from February until September. Hunting waterfowl is a tradition in the area and as such should be respected, when performed according to Croatian hunting legislation.

However, when a wooden mouthpiece for coot and duck luring is replaced by an electronic tape lure, traditional paddling boats with engine ones and diurnal hunting with hunting at night using strong torches – this cannot be called tradition any longer, it can only be characterized as poaching. Apart from using illegal hunting methods, poaching also includes killing game species in excessive numbers, outside the hunting grounds (on sea) and outside of the hunting season.

All four ornithological reserves are part of hunting grounds, yet bird hunting has been illegal in these areas since the 1960s. However, it is evident that these invaluable wetland areas are massively used for poaching. To become aware of the extent of poaching, a visit to the Neretva Delta is not even necessary. It is enough to open any web mapping service and take a look at the man-made poaching ponds, called *plana*, created in the heart of Prud and Pod gredom ornithological reserves.

These are unique death traps for birds, specific to the reedbed area of the Neretva Delta. Each *plana* consists of an open water pond in the reedbeds, which is used by ducks and coots for resting and foraging. Hence, hunters often argue that *plana* are positive and that such open water bodies are essential for bird protection (PI Dubrovnik-Neretva 2018). However, all *plana* often have multiple channels leading to them, as well as a wooden hide and coot and duck decoys placed in front of the hides (Fig. 1). Thus, this cannot be called anything other than a poaching pond, which are all created illegally and on state owned land without relevant permission from the PI Dubrovnik-Neretva.

Photo: Biom

Fig. 1: A typical man-made poaching pond in the Neretva Delta, called plana. It consists of an open water body with a channel leading to it.

Apart from illegal activities in the reedbed areas, poaching also takes place on the river mouth of the Neretva Delta. The coastal lagoons and sandflats of the river mouth provide one of the most important wintering grounds for many protected bird species, such as different wader, egret and duck species. Poaching at the river mouth occurs on the sea during night. Poachers kill birds from motor boats, using very strong torch lights and electronic lures.

IKB that takes place during night, on the sea or in a maze of reedbed channels is very difficult to control and even harder to prosecute. Hunting controls are usually carried out on road intersections or mountain and field exits. Such easily accessible check points do not exist in the Neretva Delta. This case study demonstrates methods used by Biom employees to tackle IKB in one of the most important bird areas in Croatia, which is at the same time a killing trap for birds migrating along the Adriatic Flyway.

Workshops with stakeholders

During the AF3 project, Biom organized several workshops and focus groups with relevant stakeholders directly connected to tackling IKB: PI Dubrovnik-Neretva, hunters, police, the nature protection and hunting inspections, local NGOs and many others.

During these workshops, the responsibilities and jurisdiction of certain authorities involving poaching have become more evident. For example, police officers maintain a crucial role in tackling IKB. However, the lack of their capacity for regular and constant prosecution of poaching is indisputable. Furthermore, the police in the Neretva Delta does not own a boat for fast anti-poaching actions in the reedbeds or on the sea.

All members of hunting societies that attended the workshops denied having jurisdiction to tackle IKB in the ornithological reserves, although the reserves are parts of hunting grounds. After the workshops it was evident that Biom and the PI Dubrovnik-Neretva, needed to take matters into their own hands. On the ground actions, which included the organization of two anti-poaching camps, were planned in detail to ensure a success story in the years to come.

Know your area well

Biom has been working in the Neretva Delta from 2013, i.e. 5 consecutive years in scope of the Adriatic Flyway projects. During our field work and while examining aerial footage, we have recorded 27 poaching ponds in the Pod Gredom and Prud ornithological reserves (Fig. 2) (Budinski & Šarić 2015; Šarić & Budinski 2018). In the Prud ornithological reserve we assumed that at least 4 poaching ponds were active, while 5 were considered active in Pod Gredom. The other 18 poaching ponds visible on aerial footage were characterized as poaching ponds of uncertain activity.

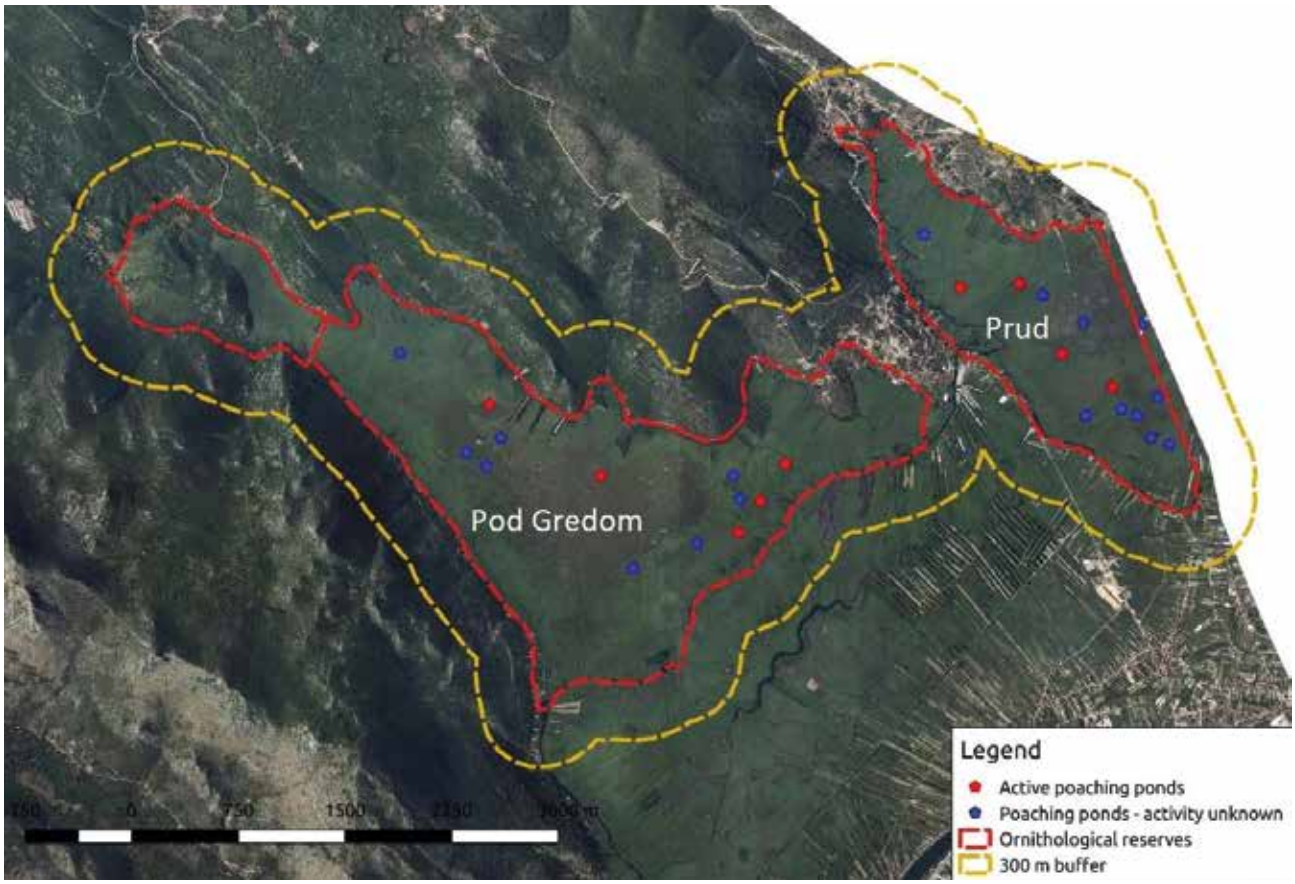

Fig. 2: Detected poaching ponds in the ornithological reserves Prud and Pod Gredom in the Neretva Delta (Photo: Biom).

A poaching pond is characterized as definitely active if gunshots or tape lures are heard. If a hunting hide is visible on the outskirts of the pond, this does not imply that it is certainly active, because the hide could be deserted, as was the case in one poaching pond in the Pod Gredom reserve. Thus, field checks are necessary to determine whether poaching ponds are indeed active or not.

1st anti-poaching camp in the Neretva Delta

From 1st to 10th September 2017 Biom held the 1st anti-poaching camp in the Neretva Delta area. A part from Biom employees and a local volunteer, CABS members and the employees of PI Dubrovnik-Neretva also participated in the camp.

The camp was marked as a preliminary one, as this was the first time that Biom carried out such a long field research with the aim to monitor and sanction poaching activities. In fact this was the first such action organized in Croatia.

During the camp we implemented several activities and the results are the following:

Monitoring of IKB during the night in three areas: the Prud and Pod Gredom ornithological reserves and the area east of Opuzen. During the camp we also explored adequate vantage points for IKB monitoring. Unfortunately, due to heavy rain and wind, it was not possible to monitor IKB every night during the camp. In our experience the rate of poaching decreases in such unfavourable weather conditions. Poaching was observed during two nights in Prud and Pod gredom, while east of Opuzen no poaching activities were detected. The goal of this preliminary camp was to gather as much information as possible on the pattern of poaching in the reedbeds.

Dismantling of illegal hunting hides. This was a coordinated action with employees of the PI Dubrovnik Neretva, the nature protection inspection, local fire departments and police. We started our two-day action in the Prud reserve, where the goal was to dismantle at least 5 illegal hunting hides. A dozen of us began our journey to the first poaching pond, which was in the heart of the ornithological reserve, where none of us have ever been before. Equipped with a boat, kayak and a chainsaw, we assumed that one hide was awaiting for us on the poaching pond. Very soon we realized that one chainsaw was not enough. Once inside the poaching pond, we could see a "weekend resort" of 5 illegal hunting hides. One hide was extremely large and the demolition of it lasted all day. The illegal "hunting house" also had a small agricultural plot next to it. Inside we found mattresses, sleeping bags and, to our biggest surprise, paintings and a kitchenette (Fig. 3). A total of five plastic duck decoys were found and confiscated on the poaching pond, as well as numerous cartridges. The next day, we removed the remaining four hunting hides on that poaching pond and the one adjacent to it.

Photo: Biom

Fig. 3: Poaching hide in the ornithological reserve Prud, dismantled during the anti-poaching camp in September 2017.

2nd anti-poaching camp in Neretva Delta

The 2nd anti-poaching camp was organized from 4th to 11th December 2017. The camp was attended by 7 Biom employees and two CABS members, which were split into three teams. After the knowledge gained during the preliminary camp in September 2017, we had several coordinated actions with the inspection and the police:

Tackling IKB in the reserves. This activity was conducted in three areas: Prud, Pod Gredom and the Neretva river mouth. During the first two nights we monitored illegal hunting activities to figure out the pattern of poaching.

This was extremely important for the Prud and Pod Gredom ornithological reserves because we were not certain how the poachers use reedbed channels to travel between the poaching ponds and the main land. During the first few nights, shots and coot tape lures were heard from two poaching ponds in Prud. We usually went to the vantage points at 8 PM when poachers were already active, with shooting lasting usually till midnight. When leaving the poaching pond, they did not use flashlights in the strong moonlight, which made it impossible to see how they navigate through reedbed channels.

On the 3rd night of the camp, the nature inspector for Dubrovnik-Neretva County joined us in the field. This was a crucial point because if an inspector calls the police, they need to respond almost immediately. A swift police action undeniably increases the chance of catching the poachers. On that day we decided to go to the vantage at dusk, with an assumption that the poachers start paddling to the poaching pond while there is still daylight. Our assumption was correct and when around 4 PM we saw two man paddling to the poaching pond - we knew this was our night. We heard 11 shots and an electronic tape lure. Three hours later, at 8 PM we saw the poachers leaving the poaching pond and heading back down the channel. The police caught one poacher with 9 dead coots. This person was criminally processed for poaching during night, inside an ornithological reserve and for not having a firearms permit. The police officers were aware that poaching is a criminal offence and they were quite acquainted with the criminal law.

Meanwhile, one team was situated on the Neretva river mouth and was keeping an eye on several poachers that were hunting on the sea. During the camp we found two trustworthy police officers with jurisdiction in that area and were keeping them informed about poaching activities. The police had two actions during which two men were caught, with one of them leaving the river mouth with 32 dead coots. The caught poachers were criminally charged for poaching during night and outside hunting grounds.

Dismantling of illegal hunting hides. Again we had a coordinated activity of dismantling illegal hunting hides in Prud and Pod gredom with employees of the PI Dubrovnik Neretva, the nature protection inspection and police (Fig. 4).

Photo: Biom

Fig. 4: Dismantling of illegal poaching hide in the ornithological reserve Prud.

The action lasted for two days and a total of four hides were destroyed - two in Pod gredom and two in Prud and many duck and coot decoys were confiscated from the poaching ponds. Unlike the action in September, all of the hunting hides were relatively small and made out of wood and reeds, making them easier to dismantle than the hides in September. With this action, all of the known illegal hunting hides in the ornithological reserves were destroyed.

Educational workshop. At the end of the camp we organized a workshop with local children, during which we built bird feeders out of wooden material from the hunting hides dismantled in September 2017.

Future planned activities

Although our anti-poaching activities in the Neretva Delta were a great success, there is still a lot of work to be done. Within the Adriatic Flyway 4 project Biom will continue to organize such anti-poaching camps and smaller actions in the years to come, in order to make the Neretva Delta a safe haven for birds.

Recommendations for organizing anti-poaching activities in wetland areas

Here are some lessons learned from our work in the Neretva Delta, which could be useful if you are organizing an anti-poaching camp in a wetland area (or anywhere else):

1. **Know your area well.** Find the place where poaching occurs, study the maps and have them with you while in the area. This is especially important for wetlands, which can often have a complex network of passages. Find some potential vantage points where you are safe, but can still see the poachers clearly. If poachers kill birds from poaching ponds, prepare a map with coded poaching ponds before the camp and mark possible exits from the ponds to the mainland.

2. **Examine when poaching occurs.** If poaching takes place mostly during night, it is almost impossible to take quality footage of poachers. It is also very hard to keep track how the poachers enter or leave the wetland area during night. Thus, get to your vantage point during dusk because there is a good possibility that poachers go to their hides while there is still daylight. Also, poaching often occurs during full moon so make sure to check the lunar calendar before setting the dates of the camp.

3. **Organize a preliminary camp.** If you decide to organize multi-day or multi-week actions in an area in the years to come, organize a preliminary camp. This will help you to gather relevant information on poaching, before contacting police or the competent inspection. A preliminary camp will also help you to organize teams better on future camps. And be patient, not every action can lead to a police arrest – just collecting information will eventually lead to a successful catch.

4. **Poachers are faster while paddling downstream than upstream.** Quite a logical fact, until you are calling the police in panic when the poachers are leaving the poaching pond extremely fast. Thus, keep in mind that they can be very fast if they are going back to the mainland in a downstream direction. For example in Neretva Delta paddling the same distance upstream takes 30 minutes, while downstream less than 7 minutes.

5. **Prepare informational material for volunteers.** Prepare a fact sheet for volunteers so they know the legal basis of poaching, how to report poaching to the police and what their rights as eye witnesses are.

6. **Dismantling illegal hunting hides.** As hunting is a social activity, poaching ponds can contain more than one hunting hide, which are not always visible from a vantage point due to seclusion in the reeds. Hence, dismantling "one" hide may take much longer than planned, if more hides are present than you anticipated.

If you are in a river delta area, bear in mind that water levels in the beginning of autumn are probably still too low to use any kind of motor on a boat while navigating through the reedbeds. This substantially slows down the time needed to get from the mainland to the poaching pond and you may need to walk in deep mud. Thus, plan your activities after the autumn rains. Also when planning your activities, it is important to bear in mind the time needed to transport non degradable material from the poaching pond to the mainland so you don't leave rubbish behind you.

At least one person should be on the mainland during the whole action in order to facilitate conflict situations with unpleased locals and to keep an eye on the vehicles and equipment.

7. **Cooperate with government officials.** Inform the public institution in charge of managing the area before you start planning any anti-poaching activities. They are probably also keen to tackle this issue and will most likely help you. Try to get the competent inspector on the field with you because the police needs to respond to their call almost immediately. Keep in mind that the inspectors will most likely need to work overtime, so inform them of your actions at least two or three weeks in advance. Also, find the few police officers that are keen to tackle poaching and never let them go.

8. **Educational aspects.** During the camp, try to organize an educational workshop for local children. If you have torn down a hunting hide or reported poaching, most likely some of the locals don't like you right now. Adding an educational aspect to your camp increases the approval of locals and maybe you are one step closer to a future generation with less poachers.

If you have any wooden left-over material from the hides that you tore down, it is a good idea to recycle it for the construction of bird houses or bird feeders.

9. **Media work.** Never forget about media work. Make a communication plan before your camp and designate a person in the office responsible for this. You will most likely not have time during the camp to send out press releases and social media posts. Try to prepare some press releases in advance and have an office person with whom you will be in touch and who will follow activities as they happen.

10. **Have fun.** When witnessing IKB every night for several days, the atmosphere tends to get depressing whether you perform successful actions or not. Accommodate your team outside the area you are working in, not only for your own (and vehicle) safety, but to get your mind out of the horrific poaching activities. Also, have a rest day after a successful action and take your team to wine & dine so laughter can replace the sound of gunshots at least for one night!

Acknowledgements

All employees of Biom and PI Dubrovnik-Neretva would like to thank Katia, Andrea and Boštjan from CABS for their enthusiasm and time taken to come to Neretva Delta. Lessons learned from them will help us organize camps in the future. Also, successful actions would not be possible without keen local police officers and Vesna Daničić, the nature protection inspector for the Dubrovnik - Neretva County. We would also like to thank BirdLife Malta and the Bird Protection and Study Society of Serbia for sharing experience. And, finally, a big thank to EuroNatur and MAVA foundation for financing our activities in the Neretva Delta.

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Photo: T. & A. Mikuska

Waterbird concentration in the Neretva river mouth, Croatia, August 2016

Rapid assessment of the impact of tourism on waterbirds at the Neretva river mouth

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Summary

We made a rapid assessment of the impact of disturbances from tourism and kite-surfing on the resting and feeding of waterbirds at the Neretva river mouth, Croatia. The numbers of waterbird species were highest during early morning hours when no humans were present. With increasing numbers of people along the beaches and sandbars during the day, the birds were disturbed and forced to change foraging and resting sites. Disturbance was at its peak when kite-surfers were present and occupied most of the available area. We propose proper zoning and further protection of the most important areas in order to secure safe resting and feeding sites for migrating waterbirds.

Keywords

tourism, disturbance, waterbirds, Neretva Delta, kite-surfing

1. Introduction

Coastal wetlands are well known for their importance for waterbirds, particularly, as feeding and resting areas as well as stop-over sites during migration. At the same time, the increase of tourism and leisure activities, including extreme sports such as kite-surfing, led to the occupation of such habitats by humans and increased the disturbances to waterbirds (Navedo & Herrera 2012, Davenport & Davenport 2006, Smit & Visser 1993).

The mouth of the Neretva River, as a part of the Neretva Delta wetland, is one of the most important stop-over sites for migratory waterbirds along the Dalmatian coast in Croatia (Šarić & Budinski 2018). The river mouth along the left bank of the Neretva River is characterised by a 1 km long beach, a shallow bay with inner and outer sandbars, and an inner lagoon (Fig. 1). Adjoining the public beach an official camping site and an official kite-surfing area is present. Over the summer months an illegal camping site develops at the tip of the river mouth and another kite-surfing area with beach bar has been developed during the last decade. Limited fishing and shell collection by locals are present throughout the year. Tourists use the area from April until October, with peak numbers during the summer months (July - August). At times of favourable winds kite-surfers use the whole bay for surfing.

The purpose of the present study was to assess the impact of tourism and kite-surfing on waterbirds and to suggest measures for reducing the pressure from disturbances for the birds in the area.

Fig. 1: The river mouth along the left bank of the Neretva River

2. Methods

During three years (2015 - 2017) we have made brief 2-day visits to the Neretva river mouth and counted all waterbirds that were present between the mouth of Mala Neretva and the Neretva River. Counts were conducted during early morning (usually from 6:00-7:30 h) when no people were present on the beach and sandbars. Counts were repeated during late afternoon (usually from 17:00-19:00 h) when the area was crowded by tourists like kite-surfers, swimmers and sunbathers. We recorded the exact number of kite-surfers and estimated the number of other people that were present on the beaches and sandbars. The presence of birds and their numbers were recorded separately for the beach, the inner lagoon as well as the inner and outer sandbars.

3. Results and discussion

Not surprisingly, the highest numbers of waterbird species (up to 30) with the highest numbers of individuals (186,12 ± 54,26 on average) were recorded during early morning hours when tourists were not present (Tab. 1). At that time the birds used the inner and outer sandbars for resting (Fig. 2), while they foraged mainly in the inner lagoon and along the beach. Later during the day, the beaches and sandbars are occupied by swimmers and sunbathers (Fig. 3), while during late afternoon, with the presence of westerly winds, called *maestral*, the number of kite-surfers quickly increased. With the increase of disturbance pressure from tourists over the day the numbers of waterbirds decreased, particularly on sandbars and along the beach. The lowest numbers of waterbirds (up to 8 species with 71,0 ± 73,53 individuals on average) were recorded during the presence of kite-surfers who occupied most of the bay area before the coast (Fig. 4 and 5).

Tab. 1: The impact of disturbances from tourists and kite-surfing on waterbird numbers at the Neretva river mouth, Croatia.

	Without tourists and kiters	With tourists without kiters	With tourists and kiters
Time of day	early morning n = 5	mid-day n = 4	late afternoon n = 2
Average number of bird species	15,60 ± 3,36	11,33 ± 3,51	5,0 ± 4,24
Average number of waterbirds (ind.)	186,12 ± 54,26	167,33 ± 38,66	71,0 ± 73,53
Estimated number of tourists on the beach	2	50+	200+
Number of kite-surfers	0	0	40

Photo: T. & A. Mikuska

Fig. 2: Birds resting at the inner and outer sandbars.

Photo: T. & A. Mikuska

Fig. 4: Area occupied by kite-surfers.

Photo: T. & A. Mikuska

Fig. 3: Beaches and sandbars occupied by tourists.

Photo: T. & A. Mikuska

Fig. 5: The shore occupied by kite-surfers.

Not all bird species responded equally to disturbances. With increasing numbers of tourists on the beach and on sandbars, most ducks (Anatidae) and terns (Sternidae) completely left the area (Tab. 2). Others, like herons (Ardeidae), Pygmy Cormorant (*Microcarbo pygmaeus*) or some waders, like Whimbrel (*Numenius phaeopus*) or Common Redshank (*Tringa totanus*), moved into the inner lagoon and continued foraging and resting. Kite-surfing caused the heaviest disturbance with only a few species that tolerated their presence. The most tolerant species were Little Egret (*Egretta garzetta*), Black-winged Stilt (*Himantopus himantopus*), Whimbrel and Black-headed Gull (*Chroicocephalus ridibundus*) that rested or foraged in the inner lagoon even when kite-surfers were present.

Tab. 2: Minimum and maximum numbers of different waterbird species present at the Neretva river mouth, Croatia, without and during the presence of tourists and kite-surfers. Mean ± SD are given in brackets where feasible.

		Number of birds		
	Species	Without tourists and kiters (n = 5)	With tourists without kiters (n = 4)	With tourists and kiters (n = 1)
1	Tadorna tadorna	1-1	0	0
2	Spatula querquedula	4-56 (21,33 ± 30,02)	1-1	0
3	Anas platyrhynchos	3-6 (4,50 ± 2,12)	1-1	0
4	Anas crecca	0	3-3	0
5	Podiceps cristatus	2-2	0	0
6	Gallinula chloropus	1-1	0	0
7	Platalea leucorodia	0	2-2	0
8	Ardeola ralloides	6-6	0	0
9	Ardea cinerea	3-32 (20,80 ± 13,70)	16-16	0
10	Egretta garzetta	10-67 (27,60 ± 23,09)	14-50 (26,67 ± 20,23)	14
11	Microcarbo pygmaeus	3-8 (5,40 ± 2,07)	4-22 (13,0 ± 12,73)	0
12	Recurvirostra avosetta	3-3	0	0
13	Himantopus himantopus	1-5 (3,25 ± 1,71)	1-8 (4,0 ± 3,61)	8
14	Pluvialis apricaria	1-1	1-1	0
15	Charadrius dubius	1-1	0	0
16	Numenius phaeopus	3-12 (7,20 ± 4,02)	2-20 (12,0 ± 9,17)	20
17	Numenius arquata	1-2	1-4 (2,50 ± 2,12)	4
18	Arenaria interpres	1-1	0	0
19	Calidris alba	1-1	1-1	0
20	Calidris alpina	2-2	1-4 (2,50 ± 2,12)	0
21	Calidris minuta	2-3	0	0
22	Gallinago gallinago	1-1	0	0

		Number of birds		
	Species	Without tourists and kiters (n = 5)	With tourists without kiters (n = 4)	With tourists and kiters (n = 1)
23	Actitis hypoleucos	3-11 (6,0 ± 3,56)	1-1	0
24	Tringa erythropus	1-2	0	0
25	Tringa nebularia	1-10 (5,50 ± 6,36)	1-1	0
26	Tringa totanus	1-34 (15,0 ± 17,05)	6-30 (20,0 ± 12,49)	6
27	Tringa glareola	1-1	2-2	2
28	Chroicocephalus ridibundus	27-83 (52,60 ± 24,06)	35-64 (52,67 ± 15,50)	64
29	Larus michahellis	17-62 (29,80 ± 18,98)	5-53 (30,0 ± 24,06)	5
30	Sterna caspia	0	1-1	0
31	Sterna hirundo	1-1	0	0
32	Sterna sandvicensis	1-1	0	0
33	Alcedo atthis	1-3	0	0
	AVERAGE	**186,120 ± 54,26**	**167,33 ± 38,66**	**123**

In order to reduce the disturbances to waterbirds by tourists and kite-surfers at the Neretva river mouth we propose two easy-to-achieve measures. Firstly, a proper zoning of the area should be established in the already existing Natura 2000 site. The western part of the bay, including the inner and outer sandbars, shallows and inner lagoon, should serve as the core area for waterbird protection where human activities should be restricted to walking paths along the existing road on the left bank of the Neretva River. The eastern part of the bay can be used by all visitors. We propose that all parking, camping and launching of kite-surfers should be placed in a single place (instead of two) in front of the already existing camping site "Rio" and the second launching site for kite-surfers at the river mouth should be abandoned. Kite-surfing should be further strictly restricted to the eastern part of the bay and a "no-go" distance of 500 m from all existing sandbars has to be respected by surfers and all other activities. Other tourists, like swimmers and sunbathers, should be kept to the existing public beach, while the illegal camping site should be deconstructed. Secondly, the western part of the bay should be officially declared as a protection area in the form of a special zoological reserve. This protection status of the area was already proclaimed in the past, but never legally adopted and officially enforced by the local government. With the proposed measures we can achieve a win-win situation for both, the birds and humans.

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Photo: Peter Sackl

Eurasian Thick-knee (*Burhinus oedicnemus*), Salina Ulcinj, Montenegro, April 2014

Seaside recreation and the breeding numbers of shorebirds along Velika Plaža and on Ada Island, Bojana-Buna Delta

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Summary

In the former Republic of Yugoslavia the sandy shores of Velika Plaža and Ada Island on the Montenegrin side of the Bojana-Buna Delta constituted the most important breeding site for various waders and terns. Since the 1970s the area is also a major tourist destination and after the end of the last Yugoslav Wars, in 2001, numerous new restaurants and other tourist infrastructure were - often illegally - erected along the beach. To assess the pressures from seaside recreation on shorebird populations, results of current breeding surveys, in May 2018 and June 2019, along the 14 km long shoreline between Ulcinj and the Albanian border are compared with data from former surveys. Since the end of the war, in particular, Collared Pratincole *(Glareola pratincola)* has vacated the coast and nests currently almost exclusively in the nearby Ulcinj Salina which has, during the 1970s and 1980s, grown into the main shorebird breeding site in the delta. Similarly, Eurasian Oystercatcher *(Haematopus ostralegus)* and Little Tern *(Sternula albifrons)* currently nest only irregularly or in very small numbers along the coast, while the breeding numbers of Kentish Plover *(Charadrius alexandrinus)* and Eurasian Thick-knee *(Burhinus oedicnemus)* declined, since 2003, for up to 29% and 63%, respectively. On the other hand, Little Ringed Plover *(Charadrius dubius)* whose numbers increased from 5 – 10 pairs, in 1988 and 2003, to currently 14 – 17 breeding pairs, has obviously benefited from new artificial habitats, like unpaved access roads and extensive parking grounds. During the last survey, after the start of the main tourist season in June 2019, neither Eurasian Thick-knee nor Kentish Plover were present on Velika Plaža. At the same time, aside of new infrastructure, the numbers of tourists and night-time noise from discos and beach parties have increased considerably over the last 10 – 15 years. The loss of undisturbed nesting habitats and the decline of shorebird breeding numbers, in particular of Eurasian Thick-knee, along Velika Plaža results from the lack of development planning and weak, if any, enforcement of existing law. To improve breeding conditions for shorebirds, besides the formal protection of the remaining breeding sites inside the core area of the proposed Bojana-Buna Marine Park, the cleaning-up of potential breeding habitats from plastic waste, adequate visitor management, and the provision of undisturbed artificial nest-sites are recommended.

Keywords

tourism, bird conservation, shorebirds, Montenegro, Eurasian Thick-knee, Kentish Plover, Little Ringed Plover

1. Introduction

The approximately 14 km long shoreline of Velika Plaža and Ada Island at the delta front of the Bojana-Buna River in Montenegro is the longest uninterrupted sandy beach in former Yugoslavia. Consequently, with the development of the Dalmatian coast for seaside holidays during the 1960s and 1970s, the area became soon known as a major tourist destination.

On the other hand, the Bojana-Buna Delta is of high ecological importance. In particular, the coastal areas on the Albanian and Montenegrin side of the delta harbour a number of fresh- and saltwater habitats that are rare along the mainly rocky Dalmatian coast (Schneider-Jacoby *et al.* 2006). In addition to many thousands of birds that pass during migration or visit the delta in winter (Stumberger & Schneider-Jacoby 2010, Sackl *et al.* 2014), the sandy shores and coastal sand dunes are long known as a significant breeding site of different shorebirds (e.g., Reiser & Führer 1896, Vasić 1977, 1979a).

Between 2003 and 2004 Schneider-Jacoby *et al.* (2006) conducted a rapid assessment of the natural values and conservation status of the Bojana-Buna river delta and set a first step for the protection of core wetland habitats. Whereas in the nearby Ulcinj Salina further assessments of bird populations were achieved in the following years, at Velika Plaža and on Ada Island no systematic breeding surveys were conducted since 2003. At the same time, although no official statistics exist (Z. Lika *pers. comm.*), the numbers of tourists have increased considerably since the end of the recent Yugoslav Wars, in 2001, and numerous new seaside restaurants, cafés, access roads, parking lots and other tourist infrastructure were developed along the coast over the last 10 – 15 years.

Seaside recreation has the potential to negatively affect habitat availability, survival and the breeding success of shorebirds (cf. review in Colwell 2010). In the Bojana-Buna Delta, in addition to the construction of new infrastructure, the unrestricted access to the shore for tourists and vehicles of all kinds, camping, new aggressive sports, like kite surfing and water scooting, and the cleansing and preparation of the beach for the main tourist season during the early breeding season, in April and May, maybe detrimental for the reproduction of shorebirds (Fig. 1). Therefore, to document the current status and the impact of seaside recreation on shorebird populations, we repeated the breeding bird surveys that were conducted along Velika Plaža and on Ada Island during the rapid assessment (Schneider-Jacoby *et al.* 2006).

Photo: Peter Sackl

Fig. 1: The formerly almost pristine shore of Velika Plaža, Montenegro, in May 2003 (left) and 14 years later in November 2017.

2. Materials and methods

2.1 Study area

The report of Schneider-Jacoby *et al.* (2006) contains a detailed description of the Bojana-Buna Delta, including Velika Plaža and Ada Island. The survey area for the present study of 1,470 ha on the Montenegrin side of the delta encompasses, as described by Vasić (1979b), the following habitat types: the beach and the adjoining sand dunes along shoreline (habitat zones 2 – 5), and the inland Mediterranean steppes and dry pasturelands (habitat zone 8), whereas the belt of flooded tamarix, brackish marshlands and coastal woodlands that run parallel to the coast and contain no adequate nesting habitats for shorebirds (habitat zones 6, 7 & 9 according to Vasić 1979b), were not surveyed.

Information on main transformations of land-cover between 2007 and 2019 were available from visual analyses of high-resolution satellite imagines during a present study on land use and habitat changes in core Adriatic Flyway sites (cf. article by U. Schwarz, p. 12 - 33, in the present publication). Over the last 10 – 15 years, the beach from the outlet of Porta Milena in Ulcinj to the nudist camp on Ada Island was, as already mentioned, further developed for seaside amenities and is, during the summer months, frequented by thousands of tourists. Preparations for the tourist season, like the restoration of cafés, restaurants and other buildings that are unused during winter, bulldozing and the cleaning of the beach start in late March. Inshore waters are further year-round used by locals for stationary gill-netting. Additionally, parts of the formerly extensively managed dry steppes and pasturelands in the hinterlands of the coast were cultivated for fruit plantations and arable fields (cf. 3.3).

2.2 Bird surveys

Field methods of bird surveys were, as far as possible, identical with the methods applied during the rapid assessment by Schneider-Jacoby *et al.* (2006) when the beach and adjoining habitats along the shoreline of Velika Plaža and Ada Island were surveyed between 27 - 29 April and 17 – 19 June 2003. To get reliable breeding numbers of waders and terns inside the present study area in 2003, we recalculated the data of the rapid assessment that were originally published as population estimates for the whole delta area (cf. Schneider-Jacoby *et al.* l.c.). Current field surveys were conducted from 8 - 10 May 2018 and 25 – 26 June 2019. On each occasion five experienced observers spend a total of 27 – 28 hours in the field. Like in 2003, fieldwork was conducted during the early and late hours of the day by walking along the beach, through sand dunes, and along transects through open pasturelands. Additionally, in 2018 as in 2019, 1 – 2 days after the day-time surveys the presence of Eurasian Thick-knee *(Burhinus oedicnemus)* was again verified with the help of tapes during dusk and night-time excursions.

3. Results

3.1 Breeding numbers

In 2003 three species of waders, i.e. Eurasian Thick-knee, Kentish *(Charadrius alexandrinus)* and Little Ringed Plover *(Ch. dubius),* bred in substantial numbers along Velika Plaža and on Ada Island. All three were still present during the current surveys (Tab. 1).

In contrast to the former, Eurasian Oystercatcher *(Haematopus ostralegus)*, Collared Pratincole *(Glareola pratincola)* and Little Tern *(Sternula albifrons)* were seen only occasional during the surveys since 2003 (Tab. 1): In 2003 and June 2019 breeding attempts of Little Tern were noted in the mouth of both river arms of the Bojana-Buna, i.e. the Mala and Velika Bojana. Territorial behaviour of oystercatchers was observed in the Spatula area of Velika Plaža in April 2003 (J. Smole, B. Stumberger) and in June 2019 paired birds were present on Ada Island. In addition, the foundation of a small nesting colony of Collared Pratincole was observed on Velika

Plaža during the survey in late April 2003 (J. Smole, B. Stumberger). But no evidence for the presence of the species was found either in 2018 or 2019 (cf. 4. Discussion).

While the breeding numbers of Little Ringed Plover, in 2018 and 2019, were almost the double of its numbers in 2003, the small population of Kentish Plover was halved from 6 – 8 bp., in 2003, to 3 – 4 bp. (Tab. 1). Similarly, in comparison to an estimated 14 – 19 bp. in 2003, with 7 – 10 bp. the breeding numbers of Eurasian Thick-knee are currently considerably lower (Tab. 1).

Tab. 1: Breeding numbers of shorebirds along Velika Plaža and on Ada Island, Ulcinj municipality, in spring 1988 according to Puzović (2002) and during recent surveys in April and June 2003, in May 2018 and in June 2019. Obs./Ind. = number of observations/individuals, bp. = breeding pair(s). Roman numerals indicate decades/month (May I = 1.5. - 10.5. etc.).

Date	Obs.	Ind.	Pop. min. - max.
Eurasian Thick-knee *Burhinus oedicnemus*			
April - June 1988			13 - 15 bp
April III 2003	27	44	14 - 19 bp
May I 2018	10	13	7 - 10 bp
June II 2003	16	28	9 - 16 bp
June III 2019	8	10	6 - 7 bp
Eurasian Oystercatcher *Haematopus ostralegus*			
April - June 1988			1 - 2 bp
April III 2003	5	5	1 - 2 bp
May I 2018	0	0	0
June II 2003	0	0	0
June III 2019	1	2	0 - 1 bp
Little Ringed Plover *Charadrius dubius*			
April - June 1988			5 bp
April III 2003	12	17	6 - 10 bp
May I 2018	19	26[1]	14 - 17 bp
June II 2003	4	9	3 bp
June III 2019	13	22[2]	7 - 9 bp
Kentish Plover *Charadrius alexandrinus*			
April - June 1988			11 - 12 bp
April III 2003	10	18	6 - 8 bp
May I 2018	5	5	3 - 4 bp
June II 2003	0	0	0
June III 2019	0	0	0
Northern Lapwing *Vanellus vanellus*			
April - June 1988			2 bp
April III 2003	0	0	0
May I 2018	0	0	0
June II 2003	0	0	0
June III 2019	0	0	0

Date	Obs.	Ind.	Pop. min. - max.
Collared Pratincole *Glareola pratincola*			
April - June 1988			10 bp
April III 2003	4	14	4 - 7 bp
May I 2018	0	0	0
June II 2003	0	0	0
June III 2019	0	0	0
Little Tern *Sternula albifrons*			
April - June 1988			0
April III 2003	2	32	≥ 2 bp
May I 2018	0	0	0
June II 2003	1	1	0 - 1 bp
June III 2019	1	5	2 - 3 bp

[1] 4 pulli excluded
[2] including min. 2 in juvenile plumage

3.2 Distribution and seasonal movements

In contrast to both plovers (Fig. 3 - 4), thick-knees breed also in cultural lands further inland (Fig. 2). The small breeding numbers in the pasturelands between Stoj and Sv. Nikolai, and on Ada Island appear to be stable, while in May 2018 very few thick-knees were noted on Velika Plaža. Particularly, in June 2019 the beach along Velika Plaža was absolutely free of thick-knees (Fig. 2).

Kentish Plover was mainly found in the mouth of the Mala Bojana and close to the north-western end of Velika Plaža in Ulcinj (Fig. 3). Seasonally, *Ch. dubius* was, as shown in Fig. 4, present in good numbers in spring as well as during June surveys, while no Kentish Plover was seen along the beach either in June 2003 or in June 2019 (Tab. 1, Fig. 2).

Fig. 2: Distribution of Eurasian Thick-knee (*Burhinus oedicnemus*) and areas of main land-use changes (yellow polygons) along Velika Plaža and on Ada Island, Montenegro, in 2003, and (right) in spring 2018 and in June 2019. Green dots spring (April/May), red dots June surveys. Dots show observations and not necessarily indicate breeding pairs or the location of nesting territories.

Fig. 3: Distribution of Kentish Plover (*Charadrius alexandrinus*) and areas of main land-use changes (yellow polygons) along Velika Plaža and on Ada Island, Montenegro, in spring 2003 (red dots) and in spring 2018 (green dots). For further details cf. Fig. 2.

Fig. 4: Distribution of Little Ringed Plover (*Charadrius dubius*) and areas of main land-use changes (yellow polygons) along Velika Plaža and on Ada Island, Montenegro, in 2003, spring 2018 and in June 2019. Green dots spring (April/May), red dots June surveys. For further details cf. Fig. 2.

3.3 Habitat loss

According to the visual analysis of satellite images, main changes of coastal wetland habitats and landscape structure of 37.9 ha or 4% of the whole study area, as shown in Fig. 2 – 4, are largely restricted to Velika Plaža and adjacent areas, while, aside of two beach kiosks, no substantial changes were found on Ada Island. By considering a 100 m buffer around polygons of land-use transformations the potentially impacted area increases to 242 ha or 23% of the overall study area. Land-cover change mainly concerns infrastructure like the construction of new buildings (residential, beach restaurants, smaller touristic developments) and traffic infrastructure such as additional access roads to the beach and parking areas. The conversion of wet meadows and former pasturelands for agricultural plantations, as mentioned in 2.1 Study area, concern only 4.5 ha.

4. Discussion

The beach and coastal sand dunes with their characteristic zonation of different habitat types on Velika Plaža and Ada Island constituted the most important breeding sites for various shorebirds in the former Republic of Yugoslavia (Vasić 1977, 1979a). During early visits of the Bojana-Buna Delta, in March and June 1895, Reiser & Führer (1896) encountered on the shores of Ada Island a '*large colony*' of different waders, gulls and terns that included many Collared Pratincole, Yellow-legged Gull *(Larus michahellis)* and a few Eurasian Oystercatcher. In addition to Little and Common Tern *(Sterna hirundo)* whose numbers Reiser & Führer (l.c.) estimated at 80 – 100 bp. and 8 – 10 bp., they reported '*numerous*' Gull-billed Tern *(Gelochelidon nilotica)* and suspected a viable nesting colony of the species in the immediate vicinity. Gull-billed Tern was also later noted as a possible breeding bird by Vasić *et al.* (1977) and Vasić (1979a).

After the construction of the Ulcinj Salina in the inland lagoon and marshlands of the former Zoganjsko Jezero in the 1920s and subsequent enlargements during the 1950s and 1980s, the salina grew into the main shorebird breeding site in the delta (Vasić *et al.* 1977, Puzović *et al.* 1992). At present, Little, Common and 1 – 2 bp. of Gull-billed Tern as well as Collared Pratincole and Northern Lapwing *(Vanellus vanellus)* nest only or almost exclusively in the salina (cf. Sackl *et al,* present publication). Nevertheless, despite the development of seaside tourism and the ongoing construction of additional tourist infrastructure along the coast, the former breeding grounds on Velika Plaža and Ada Island were never completely abandoned.

Based on thorough surveys, between April and June 1988, Puzović (2002) reported six waders breeding along Velika Plaža and on Ada Island (cf. also Vasić *et al.* 1977). Of these, except of Northern Lapwing, all are still present in the area (Tab. 1). Besides three more abundant breeders, i.e. Eurasian Thick-knee, Little Ringed and Kentish Plover, a very small transboundary population of Eurasian Oystercatcher has survived on the Albanian and Montenegrin side of the delta and, almost annually, Little Tern try to nest on sandbars in the mouth of both river arms of the Bojana-Buna. Additionally, over the last years, but outside of the current surveys, occasional breeding attempts of Collared Pratincole were observed on Velika Plaža (P. Sackl, *unpubl. obs.*). But, following to the high frequency of disturbances from bathers, campers and beachgoers, and the presence of predators, like feral dogs, Red Fox *(Vulpes vulpes)* and Golden Jackal *(Canis aureus)*, presumably all attempts remained unsuccessful.

However, aside of the former, the numbers of all regularly breeding waders, as shown in Tab. 1, can be hardly explained as stochastic fluctuations of population numbers. Thus, the breeding numbers of Eurasian Thick-knee and Kentish Plover have declined for at least 29% and 63%. Whereas the formerly small population of Little Ringed Plover increased for up to 71% of its numbers in spring 1988 and 2003 (Tab. 1).

Following to Puzović (2002), until 1988, shorebirds have vacated about a quarter of their former breeding area in the north-western part of Velika Plaža, due to the building of hotels and the daily presence of bathers. While we have no information on tourist numbers, the present data indicate a relationship between breeding numbers and the construction of new buildings and access roads, particularly, in Eurasian Thick-knee and Little Ringed Plover. Thus, thick-knees have deserted almost all of their former nesting sites along Velika Plaža, the area that, over the last years, has been most heavily impacted by new tourist developments (Fig. 5). The species' breeding area contracted considerably and is now restricted to the pasturelands between Stoj and Sveti Nikola, and along the unobstructed coastline of Ada Island (Fig. 2). On Velika Plaža Eurasian Thick-knee is currently present mainly in the vicinity of a small, fenced-off nature reserve. According to large home ranges of up to 2 km^2 and high flight distances of > 200 m (cf. Flade 1994, Brichetti & Fracasso 2018), thick-knees appear to be particularly susceptible to habitat loss and human disturbances.

Photo: Peter Sackl

Fig. 5: Construction of a new seaside restaurant in the sand dunes of Velika Plaža, Montenegro, amidst prime nesting habitat of Eurasian Thick-knee and Collared Pratincole, 16 November 2006.

Furthermore, thick-knees retreat from the coast during the main tourist season between June and August. In particular, in June 2019 Velika Plaža was absolutely devoid of thick-knees, while on Ada Island the species was, during the most recent surveys, 2018 - 2019, present only in the least disturbed area close to the mouth of Velika Bojana (Fig. 2). The vacation of the coast during summer obviously reflects pressures from the sheer number of tourists, from traffic and the noise produced by beach parties, bars and discos. The noise of loudspeakers currently continues well into the night, thus, coinciding with the crepuscular and night-time activity of thick-knees. According to own observations during regular visits of the area, night-time noise has increased considerably since the 2003 survey (cf. Schneider-Jacoby *et al.* 2006, Rubinić *et al.* 2019).

Besides thick-knee, Kentish Plover deserts the beach totally till mid-June (Fig. 3), although their breeding territories are, as in Little Ringed Plover, smaller (0.5 – 1 ha) and flight distances from people may fall < 10 m during the breeding season (Flade 1994). The species's prime nesting habitats are situated along drift line and in the sandflats of the supralittoral zone, immediately above the mean high-water mark (Glutz von Blotzheim *et al.* 1975). Hence, in contrast to thick-knees that inhabit more inland mudflats and sand dunes, the nesting habitat of Kentish Plover coincides with the area that is most heavily frequented by beachgoers and swimmers.

Little Ringed Plover is the only wader whose breeding numbers have increased since the end of the war. The species prefers freshwater, is more tolerant against human disturbances and often colonizes man-made habitats, like gravel-pits or industrial wastelands (Glutz von Blotzheim *et al.* 1975, Cramp 1985). Along Velika Plaža we saw adults with chicks from early May onwards, mainly in freshly flattened sand dunes, along unpaved roads amidst tussocks of high rushes, and in graveled parking areas, often close to rain puddles or other wet patches. Therefore, in comparison to other waders, *Ch. dubius* may have even benefited from the bulldozing of sand dunes, from unpaved access roads and the construction of extensive parking lots.

5. Conservation

Shortly after the last Yugoslav Wars, the regional DEG Master Plan for Tourism (2003) acknowledged the natural habitats along Velika Plaža as an extra asset for the development of sustainable tourism. Based on the DEG Master Plan and extensive field surveys, Schneider-Jacoby *et al.* (2006) suggested to protect the whole delta of the Bojana-Buna River as a Biosphere Reserve. According to their zonation concept the eastern part of Velika Plaža and Ada Island, aside of the already existing nudist resort that includes 750 m of the beach on Ada Island, should be strictly protected as core areas (categories 1a and 1b) within the proposed Bojana-Buna Delta Marine Park (cf. Map 5 in Schneider-Jacoby *et al.* 2006).

In the recently adopted national strategy for coastal zone management (Knezevic 2015), Velika Plaža, Ada Island and the prodelta of the Bojana-Buna are again explicitly mentioned as potential protection areas. Whereas, according to the European Union's Birds Directive, Rubinić *et al.* (2019) identified the Bojana-Buna Delta and the Ulcinj Salina as potential Special Protection Areas (SPAs). Nevertheless, until now the proposed Marine Park has not been realized. Even so, there was some progress during the last years through the enforcement of the existing hunting ban along Velika Plaža and on Ada Island that helped to secure the function of the delta as a significant migration corridor and resting site for migratory birds (Schneider-Jacoby *et al.* 2006, Sackl *et al.* 2014).

However, the loss of natural habitats, disturbances and the decline of shorebird breeding numbers, in particular on Velika Plaža, results from weak, if any, enforcement of already existing development planning and management strategies. Despite the rec-

ommendations of the DEG Master Plan (2003), new projects and infrastructure are realized without assessing environmental impacts, while an effective visitor management that regulates access to protection areas and core shorebird habitats is - aside of the small fenced-off conservation area on Velika Plaža - still missing. Additionally, the former nesting area of Eurasian Thick-knee and Kentish Plover (cf. Fig. 2 and 3) in the shallow lagoon on the Montenegrin side in the estuary of the Velika Bojana is currently almost totally covered by plastics and other waste from the Bojana-Buna River. Consequently, the sandy beach and sand bars in the river mouth are largely unsuitable for nesting.

To improve the situation for shorebirds that breed along the delta front, it will be necessary to restrict and control access to the coastal strip on Ada Island, outside of the already existing tourist resort. In addition, the clean-up of the beach in the mouth of the Velika Bojana could restore otherwise largely undisturbed shorebird habitats. And the construction of sand bars and small artificial breeding islets that are save from terrestrial predators, swimmers and beachgoers through a 20 – 40 m wide protection zone in the mouth of the Mala Bojana will attract Little Tern and Kentish Plover. On Velika Plaža sand dunes and sensible wetlands behind the beach should be better protected from unauthorized construction of new buildings, access roads and the uncontrolled intrusion of tourists. The same applies to the breeding areas of Eurasian Thick-knee in the narrow strip of dry grasslands behind the coastal marshes and in the pasturelands in Stoj with its large population of ground-nesting European Bee-eater *(Merops apiaster)*. Finally, in the eastern part of Velika Plaža, near the small fenced-off protection zone, habitat restoration and an artificial lagoon that is connected to the sea through a narrow canal could provide new shorebird breeding habitat and an additional tourist attraction.

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