Strasbourg, 5 May 2022 **T-PVS/Inf(2022)31**

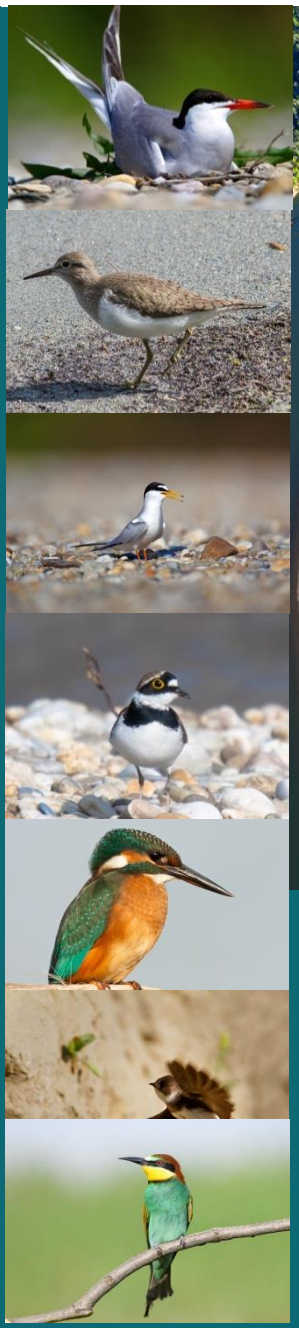
CONVENTION ON THE CONSERVATION OF EUROPEAN WILDLIFE
AND NATURAL HABITATS

Standing Committee

42nd meeting
29 November - 2 December 2022

ACTION PLAN FOR RIVER BIRDS IN THE PLANNED FIVE-COUNTRY BIOSPHERE RESERVE "MURA-DRAVA-DANUBE"

Document prepared by
REVITAL Integrative Naturraumplanung GmbH



Action plan for river birds in the planned five-country Biosphere Reserve "Mura-Drava-Danube"

April 2019

Developed by:

WWF Austria

www.revital-ib.at

Document developed partially within project LIFE14 NAT/HR/000115 – DRAVA LIFE Action A.7 Action plan for river birds

Action plan for river birds in the planned five-country Biosphere Reserve "Mura-Drava-Danube"

WWF Austria

Ottakringerstrasse 114-116

1160 Vienna

Developed by

REVITAL Integrative Naturraumplanung GmbH

Nußdorf 71

9990 Nußdorf-Debant

Tel.: +43 4852 67499-0; Fax: DW 19

office@revital-ib.at; www.revital-ib.at

Authors

Matthias Gattermayr (Revital)

Arno Mohl (WWF)

Andreas Nemmert (Revital)

Project management

Tanja Nikowitz (WWF)

Emöke Györfi (WWF)

Nussdorf-Debant, April 2019

Table of content

1 Summary 7

2 Introduction 8

2.1 Background 8

2.2 Aim of the Action Plan 8

2.3 Action Plan target area and geographical scope 9

2.3.1 Planned Transboundary UNESCO Biosphere Reserve “Mura-Drava-Danube” (TBR MDD)11

3 Method 12

3.1 Definition of characteristic river sections within TBR 12

3.2 Data Analysis 28

4 Characteristics and distribution of key river bird species 29

4.1 Historical development of habitats and distribution of key river bird species 29

4.2 Characteristics and current status – gravel and sand bank breeders 37

4.2.1 Little Tern (*Sternula albifrons*) Spec: 3 37

4.2.2 Common Tern (*Sterna hirundo*) Spec: Non-spec 39

4.2.3 Common Sandpiper (*Actitis hypoleucos*) Spec 3 41

4.2.4 Little Ringed Plover (*Charadrius dubius*) Spec: Non-Spec 43

4.3 Characteristics and overview of current status – steep bank breeders 45

4.3.1 Common Kingfisher (*Alcedo atthis*) Spec: 3 45

4.3.2 Sand Martin (*Riparia riparia*) Spec 3 47

4.3.3 European Bee-Eater (*Merops apiaster*) Spec: Non-spec 49

4.4 Distribution and breeding numbers of the target species within river sections 51

5 Main threats to targeted river birds 53

5.1 Threat 1: Lack of transboundary cooperation and harmonisation 53

5.2 Threat 2: Hydropower plants 53

5.2.1 Sub-threat 2.1: Plans for new hydropower plants 53

5.2.2 Sub-threat 2.2: Hydropeaking along free-flowing Drava 55

5.2.3 Sub-threat 2.3: Interrupted sediment transport 56

5.2.4 Sub-threat 2.4: Water diversion at reservoirs 56

5.3 Threat 3: River regulation 57

5.3.1 Sub-threat 3.1: River training structures (embankments, groins, traverses, rip-rap, etc.) 57

5.3.2 Sub-threat 3.2: Straightening of river course and disconnection of side branch systems (incl. floodplain) 58

5.3.3 Sub-threat 3.3: Sediment extraction 58

5.4 Threat 4: Recreational use (e.g. swimming, hiking/cycling/quad-driving/holiday houses/boating etc.) 59

5.5 Threat 5: Additional threats including agriculture, fishing and navigation 60

6 Goal and objectives for targeted river birds 60

6.1 Goal 60

6.2 Objectives 61

6.2.1 Objective 1: Enhancing transboundary cooperation and establishing an ornithological expert network for the whole TBR MDD 61

6.2.2 Objective 2: 61

Prevent any new hydropower plants 61

6.2.3 Objective 3: 61

Reducing the impact of hydropeaking downstream of the hydropower plant “Donja Dubrava” 61

6.2.4 Objective 4: Enabling natural sediment transport downstream of all existing hydropower plants in Austria, Slovenia and Croatia 61

6.2.5 Objective 5: Restoring residual flow stretches (“Stara Drava”) at reservoirs 62

6.2.6 Objective 6: Free-flowing rivers without training structures 62

6.2.7 Objective 7: Increasing meander capacity 62

6.2.8 Objective 8: To prevent sediment removal from the river system 62

6.2.9 Objective 9: Reducing the impact of human disturbance due to recreational activities along the river 62

6.2.10 Objective 10: Reduce the impact of several other anthropogenic influences .. 62

7 Actions required for achieving the goal and objectives 63

7.1 Threat 1: Lack of transboundary cooperation and harmonisation 63

7.2 Threat 2: Hydropower plants 65

7.2.1 Sub-threat: Plans for new hydropower plants 65

7.2.2 Sub-threat: Hydropeaking along free-flowing Drava 65

7.2.3 Sub-threat: Interrupted sediment transport 67

7.2.4 Sub-threat: Water diversion at reservoirs 68

7.3 Threat 3: River regulation 69

7.3.1 Sub-threat: River training structures (building of embankments, groynes, traverses, rip-raps etc.) 69

7.3.2 Sub-threat: Straightening of river course and disconnection of side-branch systems (incl. floodplain) 70

7.3.3 Sub-threat: Sediment extraction 71

7.4 Threat 4: Recreational use (e.g. swimming, hiking/cycling/quad-driving/holiday houses/boating etc.) 72

7.5 Threat 5: Additional threats including agriculture, fishing and navigation 74

8 Literature 77

9 Acknowledgement 78

10 List of abbreviations 78

11 Appendix 80

11.1 List of contributors of action plan 80

11.2 Timetable 81

11.3 Supplementary material 81

11.3.1 Little Tern (*Sternula albifrons*) 82

11.3.2 Common Tern (*Sterna hirundo*) 83

11.3.3 Common Sandpiper (*Actitis hypoleucos*) 84

11.3.4 Little ringed plover (*Charadrius dubius)* 85

11.3.5 Common Kingfisher (*Alcedo atthis*) 86

11.3.6 Sand Martin (*Riparia riparia*) 87

11.3.7 European Bee-Eater (*Merops apiaster*) 88

1 Summary

Natural and high dynamic riverine systems rank among the most species-rich ecosystems. Due to continuous engineering measures for the purpose of hydropower production and flood protection, numbers of free-flowing river sections are decreasing. This also applies to the Drava River in Slovenia, Croatia and Hungary, and the adjacent river stretches of the Mura in Austria and Slovenia as well as the river Danube. Together, this region forms a Transboundary UNESCO Biosphere Reserve (TBR), consisting of a connected network of 12 different protected areas. As a 700-kilometre "green belt," the TBR connects almost 900,000 hectares of highly valuable natural landscapes, including important breeding sites for several endangered bird species.

To aid long-term preservation, an "Action plan for river bird species" has been developed for this area under the scope of the "Drava Life" project LIFE14 NAT/HR/000115. Additionally, this action plan also forms a basis for actions in the project restoration sites, a baseline for the planned Natura 2000 management plan but also a conservation tool for various hydraulic engineering projects along the rivers.

The "Action plan for river birds" covers seven characteristic bird species of natural riverine systems. These species are four gravel/sand bar breeders (Little Tern (*Sternula albifrons*), Common Tern (*Sterna hirundo*), Common Sandpiper (*Actithis hypoleucos*), Little Ringed Plover (*Charadrius dubius*)) and three steep bank breeders (Kingfisher (*Alcedo atthis*), Sand Martin (*Riparia riparia*), European Bee-Eater (*Merops apiaster*)).

In a first step – and for the first time – the current distribution of the seven bird species and their breeding numbers have been worked out for the large TBR region in cooperation with local ornithologists. As shown below, the three rivers Drava, Mura and Danube host regionally important numbers of breeding pairs. For instance, more than 7,000 Sand Martin pairs, on average, are still breeding at natural breeding sites along the rivers. Furthermore, the target area hosts one of the last natural inland breeding sites of the rare Little Tern within the Balkan Peninsula.

In a second step, main threats for these river bird species have been identified. Existing hydropower plants as well as river regulation (straightening of river courses, river training structures) are the most important hazards for river bird species today, mainly because they reduce natural dynamics and have various complex consequences such as interrupted sediment transport, hydropeaking, etc.

In a third step, 10 objectives and, finally, 43 preservation actions have been worked out on workshops with experts and stakeholders, which are to reverse these negative trends. The proposed actions are based on the point of view of ornithological and nature conservation. Due to different attitudes of stakeholders and project partners, a common wording could not be found for a few actions. For these actions, footnotes indicate the different points of view.

Still, the final action plan works as a baseline for future conservation of river bird species within the sensitive riverine ecosystem of Mura, Drava and Danube. Transboundary cooperation will be the crucial factor for its implementation.

2 Introduction

2.1 Background

Breeding birds depending on habitats created in highly dynamic riverine ecosystems, such as steep banks, gravel and sand banks, are endangered on the European level, mainly due to habitat loss. This is also true in the transboundary river system of the Mura, Drava and Danube. The area, shared between Austria, Slovenia, Croatia, Hungary and Serbia, is to be designated as the Transboundary Biosphere Reserve "Mura-Drava-Danube" (TBR MDD). Though this river system is one of Europe's most ecologically important, it has suffered from numerous man-made changes in the past. Within the last 100 years, about 70 % of gravel and sand banks and more than 50 % of natural river banks have been lost to hydropower dams, navigation improvements and flood protection (FLUVIUS, 2013). This has a tremendously negative impact on the distribution and the population sizes of river birds, affecting species like Common and Little Tern (*Sterna hirundo* and *Sternula albifrons*), Common Sandpiper (*Actitis hypoleucos*), Little Ringed Plover (*Charadrius dubius*), Kingfisher (*Alcedo atthis*), Sand Martin (*Riparia riparia*) and Bee-Eater (*Merops apiaster*). For instance, only 2-3 colonies of Little and Common Tern remain in the entire Mura-Drava-Danube river system. In the last 30 years, there has also been a considerable Sand Martin decline along the Drava, dropping from approximately 30,000 in the 1980s to approximately 7,000 between 2011 and 2016 (Grlica, unpublished) nowadays. The long-term preservation of those river birds depends on the future management of the transboundary riverine ecosystem.
Animals ignore borders and so far, no harmonised conservation actions for river birds along the Mura, Drava and Danube rivers exist across these borders. Therefore, a comprehensive action plan on a transboundary level for these species is urgently needed.

2.2 Aim of the Action Plan

Due to a long history of engineering measures along the Mura, Drava and Danube rivers for the purposes of hydropower production, navigation and flood protection, and to the consequent degradation of the natural riverine ecosystem, several bird species dependent on dynamic river habitats have become endangered. The development of an action plan is the first step for the establishment of long-term preservation measures, which can help to ensure the survival of these species.

This action plan focuses on the following seven characteristic key river bird species, which are, based on their breeding ecology, separated into two groups:

a) Gravel/sand bank breeders: Little Tern (*Sternula albifrons*), Common Tern (*Sterna hirundo*), Common Sandpiper (*Actitis hypoleucos*), Little Ringed Plover (*Charadrius dubius*)
b) Steep bank breeders: Kingfisher (*Alcedo atthis*), Sand Martin (*Riparia riparia*), European Bee-Eater (*Merops apiaster*)

This action plan will serve as a baseline document for comprehensive and harmonised conservation actions for those particular species across the entire transboundary Mura-Drava-Danube river system. It is the first species conservation plan developed on a transboundary level within the future Transboundary UNESCO Biosphere Reserve "Mura-Drava-Danube" and therefore a reference document for other species actions plans in the region and beyond. In particular, the action plan for river birds along the Mura, Drava and Danube Rivers is aimed to support the:

- implementation of targeted conservation actions for river birds

- restoration and ecological management of the Mura, Drava and Danube rivers
- implementation of the planned Transboundary UNESCO Biosphere Reserve “Mura-Drava-Danube”
- development and implementation of Natura 2000 management plans for the area
- development and implementation of yearly work plans of the Protected Area Management Authorities of the TBR MDD a river development plan for the river sections.

The river bird plan has been coordinated and developed together with ornithologists and various stakeholders across the five countries within 2 workshops.

2.3 Action Plan target area and geographical scope

The area analysed and targeted by the present action plan (hereinafter called “target area”) includes all river stretches of the planned Transboundary Biosphere Reserve “Mura-Drava-Danube”, which is shared between Austria, Slovenia, Hungary, Croatia and Serbia. Furthermore, it includes the stretches of the Drava River used for hydropower generation in Slovenia from the Croatian border to Maribor, which are protected under Natura 2000 and proposed to be included in the future TBR MDD. The “target area” encompasses about 760 river kilometres (river stretches at hydropower plant sections are counted double because of residual water stretches and channel stretches in the area). Whereas generally only the river and side channels were analysed, in some important parts connected habitats of the wider area were also included in the analysis. These are some limestone terraces and loess hills (at Erdut and Batina) along the Danube and the artificial fishponds at Donji Miholjac, which were included due to their significance for breeding birds. An overview of the target area is given in Figure 2-5.

Despite diverse anthropogenic influences along these sections of the three rivers, the target area still possesses vast floodplain areas (Figure 2-3) and river sections of completely natural and dynamic river stretches, which serve as important breeding areas for river bird species (see Figure 2-2 and Figure 2-4).

Figure 2-1: Mura, natural border between Slovenia and Croatia © A. Mohl/WWF

Figure 2-2: Kopački Rit Nature Park at the Drava-Danube confluence is one of the largest wetlands in Central Europe © M. Romulić

Figure 2-3: Gravel banks of the Drava River in Croatia are important breeding habitats of the Little Tern © A. Mohl

Figure 2-4: Natural steep river banks along the Drava host large colonies of Sand Martin © A. Mohl

2.3.1 Planned Transboundary UNESCO Biosphere Reserve "Mura-Drava-Danube" (TBR MDD)

Spanning Austria, Slovenia, Hungary, Croatia and Serbia, the lower courses of the Drava and Mura Rivers and related sections of the Danube are among Europe's most ecologically important riverine areas. The three rivers form a "green belt" 700 kilometres long, connecting almost 1.000,000 hectares of highly valuable natural and cultural landscapes, including a chain of 12 individual protected areas and 3.000 km2 of Natura 2000 sites.

This is the reason why, in 2009, the Prime Ministers of Croatia and Hungary signed a joint agreement to establish the Mura-Drava-Danube Transboundary Biosphere Reserve across both countries. Two years later, in 2011, Austria, Serbia and Slovenia joined this initiative. Together with Croatia and Hungary, the five respective ministers of environment agreed to establish the world´s first five-country Biosphere reserve and Europe´s largest river protected area.

Step by step the TBR MDD is being realized: Hungary and Croatia (in 2012), Serbia (in 2017), and Slovenia (in 2018) achieved UNESCO designation. Currently, about 840,000 hectares of natural and cultural landscape along the rivers Mura, Drava and Danube are protected by UNESCO. Austria will follow in 2019, and the pentalateral designation is aimed for in 2020 (SCHNEIDER-JACOBY & MOHL, 2012), WWF Austria (2006, 2014, 2018).

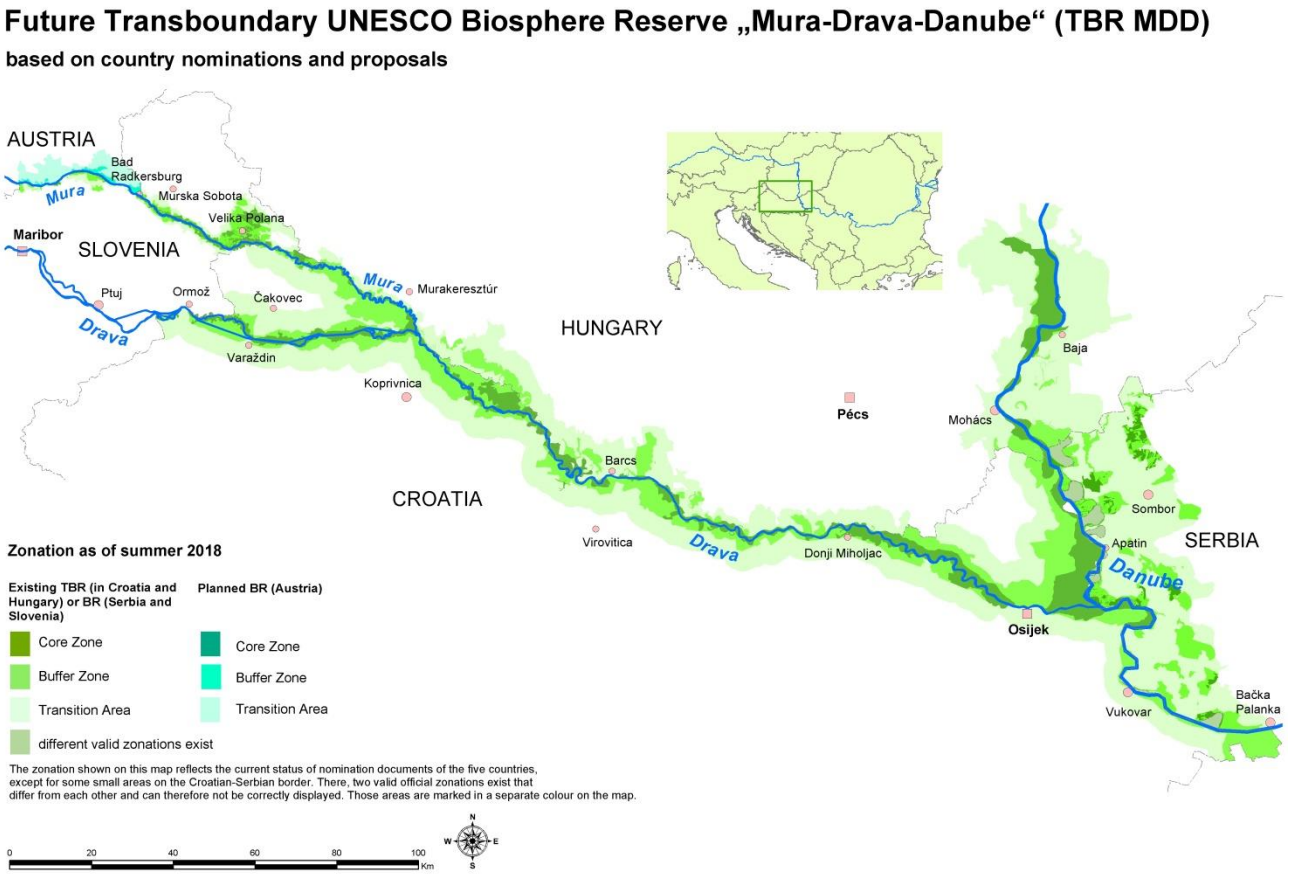


Figure 2-5: The planned five-country Biosphere Reserve with the Mura, Drava and Danube river stretches targeted by the action plan for river birds.

3 Method

3.1 Definition of characteristic river sections within TBR

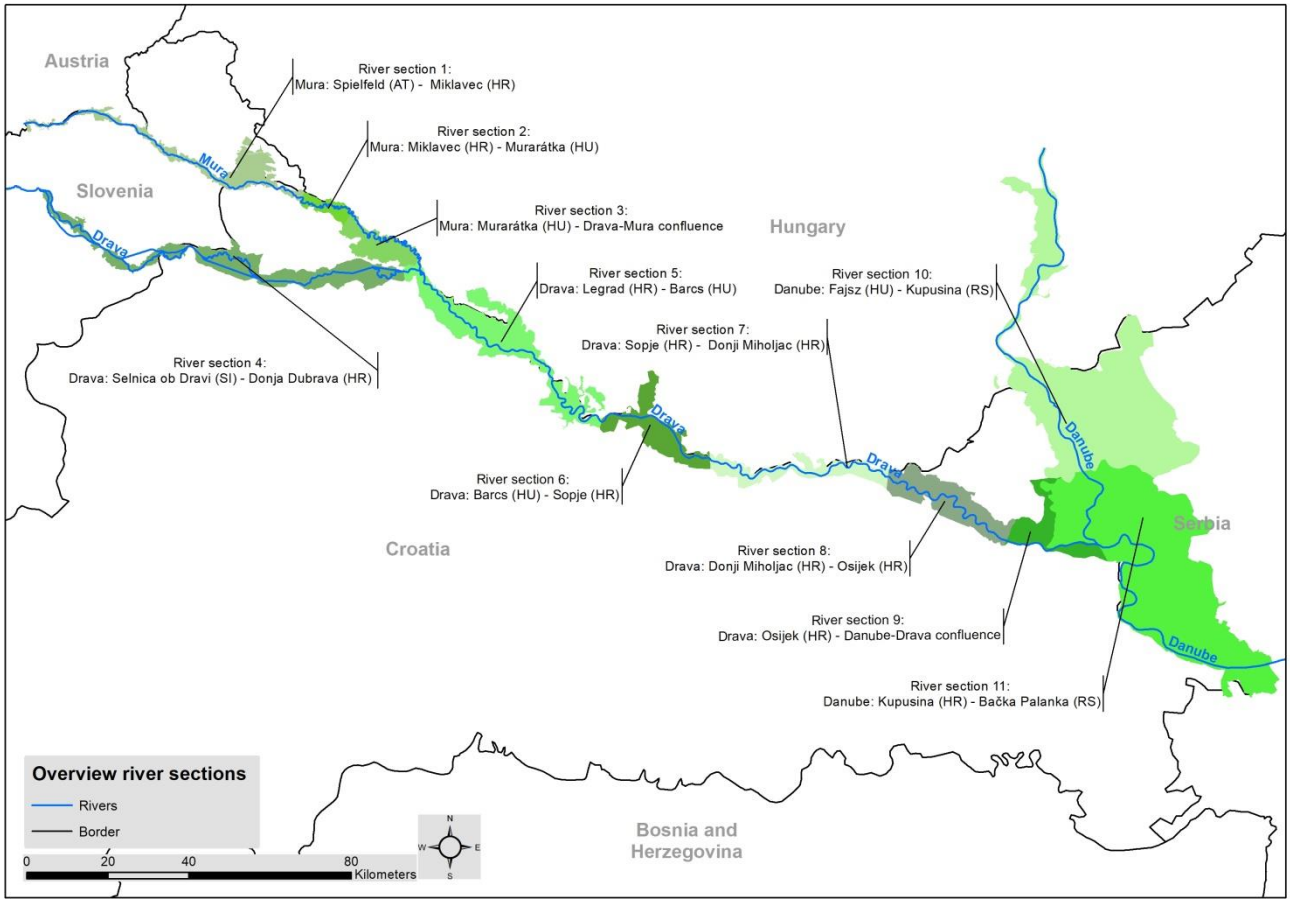
As shown in chapter 2.3, the target area is very large and the scale and degree of the human impact on the natural river ecosystem, through existing hydropower dams, navigation and flood protection measures, varies from river section to river section. Therefore, the distribution of appropriate habitats for river birds along the three rivers is very inhomogeneous. A good tool for defining the naturalness of riverine systems and the suitability of a river stretch for certain river bird species is the assessment of the condition of river banks. Therefore, existing and comprehensive GIS data provided by FLUVIUS about the status of river banks, which is available for the entire target area, has been used. FLUVIUS classified banks according to their degree of human impact (FLUVIUS, 2013) into:

a) Natural highly dynamic banks (point banks, steep and shallow banks)
b) Mostly near natural banks (miscellaneous types of banks)
c) Impacted banks (various types of embankments at the river or the tailrace canal or cross-section infrastructures, including groynes and bottom sills)

Based on this data, river stretches with similar degree of anthropogenic influences of river banks have been grouped into individual, homogenous “river sections”. Each river section represents an area adjoining both river banks and which is included in the core and/or buffer zone of the planned TBR MDD. For the demarcation between river sections, the occurrence of river bird species had been considered as well.

As an initial step, a visual expertise in ArcGIS, starting with the western (upper) parts of Mura and Drava in Austria and Slovenia, was done. Due to the large survey area, the minimum length of a river section was set at 20 kilometres. In total, 11 river sections within the planned TBR were defined in collaboration with WWF Austria (see Figure 3-1). Due to its large size and heterogeneity, river section 4 was additionally divided into three sub-sections based on the three categories listed above. The sub-section named “near natural[1]” includes the old Drava river bed along existing hydropower dams within section 4, also known as “Stara Drava”. The sub-section named “regulated” includes two parts within section 4 affected by river training structures. The sub-section named “artificial” includes several parts of river section 4 which are completely man-made, e.g. reservoirs and tailrace canals with concrete walls.

For the total length of waterbodies considered in this action plan, the geographical length of waterbodies of section 4 is taken into account instead of the official river kilometres (133 km, see Table 3-2). Thus, the sum is approximately 760 kilometres. These 11 river sections will be described shortly on the subsequent pages. Due to the different sizes of the river sections, scales differ between figures.



[1] Despite its good morphology, Stara Drava has been assessed as “near natural” due to the fact that its hydrology has been highly modified. Throughput rate (flow rate) and seasonal changes are not natural.

Figure 3-1: Overview of the 11 river sections of the TBR MDD, with the target area (rivers), for which objectives and actions for river bird species have been defined. The border of the individual river sections corresponds to the core and buffer zones of the TBR MDD. In Serbia, it corresponds to the transition zone.

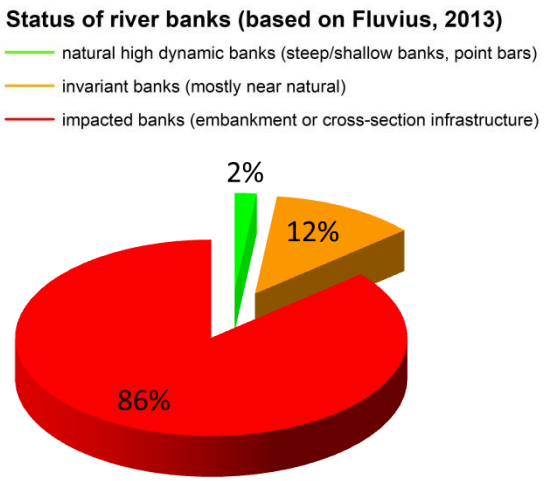
Table 3-1: Overview of the 11 river sections, each with river kilometres based on the official river kilometres of the three rivers (start, end kilometre) and total river kilometres (e.g. difference between start and end kilometre). The river kilometres listed in the table below correspond to each river sections' down- and upstream limits; not to the municipalities' corresponding river kilometres.

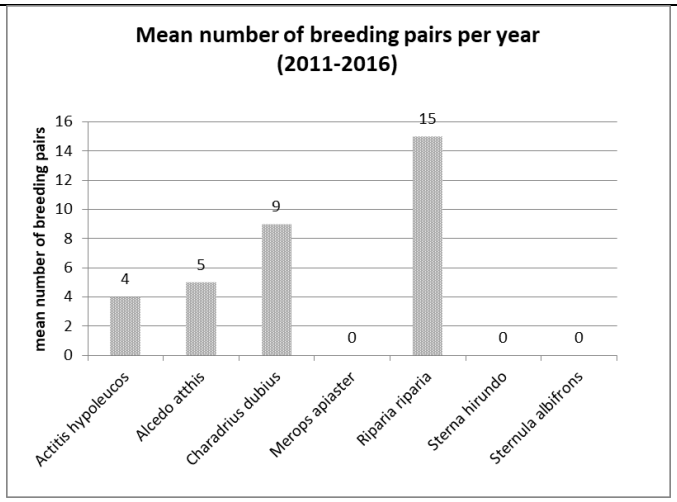
River section Nr.	Name of river section	River kilometres	Total river kilometres
1	Mura: Spielfeld (AT) - Miklavec (HR)	Mura: 54.5 - 137.5	83
2	Mura: Miklavec (HR) – Murarátka (HU)	Mura: 35.5 - 54.5	19
3	Mura: Murarátka (HU) – Drava-Mura confluence	Mura: 5.5 - 35.5	30
4	Drava: Selnica ob Dravi (SI) – Donja Dubrava (HR)	Drava: 218 - 351	133
5	Drava: Legrad (HR) – Barcs (HU)	Drava: 140 - 218	78
6	Drava: Barcs (HU) – Sopje (HR)	Drava: 108.5 - 140	31.5
7	Drava: Sopje (HR) – Donji Miholjac (HR)	Drava: 58.5 - 108.5	50
8	Drava: Donji Miholjac (HR) – Osijek (HR)	Drava: 20.5 - 58.5	38
9	Drava: Osijek (HR) – Danube-Drava confluence	Drava: 0 - 20.5	20.5
10	Danube: Fajsz (HU) – Kupusina (RS)	Danube: 1408 - 1508	100
11	Danube: Kupusina (HR) – Bačka Palanka (RS)	Danube: 1295 - 1408	113
Sum TBR			**696**

Table 3-2: Because of existing hydropower plants within river section 4, the official river kilometres only exists for "Stara Drava". In the subsequent analysis, river kilometres of all waterbodies within river section 4 have been considered. Thus, river stretches at hydropower plant-sections are counted double because of residual water stretches and channel-stretches occurring in this section.

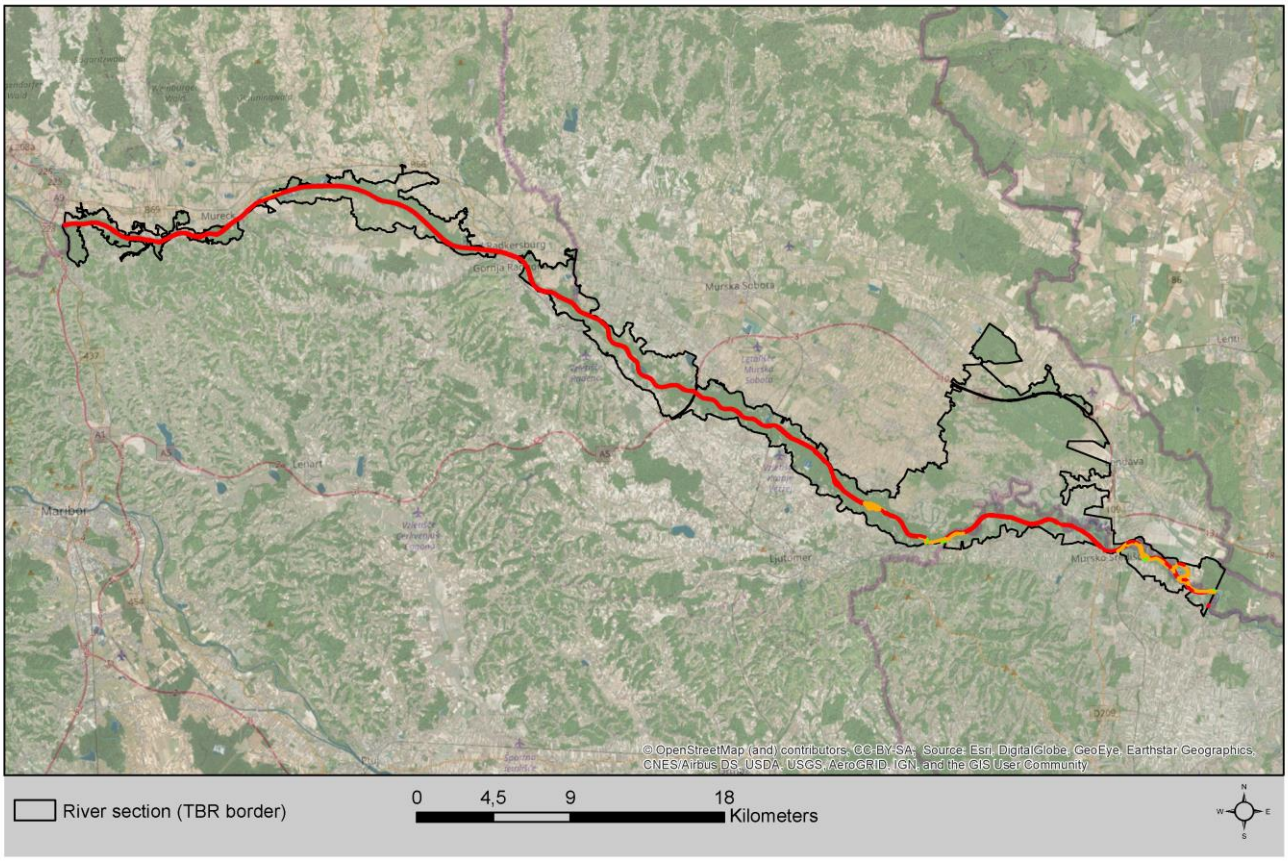
River section Nr.	Name of river section	Geographical length of waterbody
4 a	Hydropower stretch "near natural" - "Stara Drava": mostly near natural banks	70
4b	Hydropower stretch "regulated" – affected banks and riverbed; river training structures	24
4c	Hydropower stretch "artificial" – tailrace canals and reservoirs	107
Sum 4		**201**

River section 1: Mura: Spielfeld (AT) - Miklavec (HR)
83 river kilometres





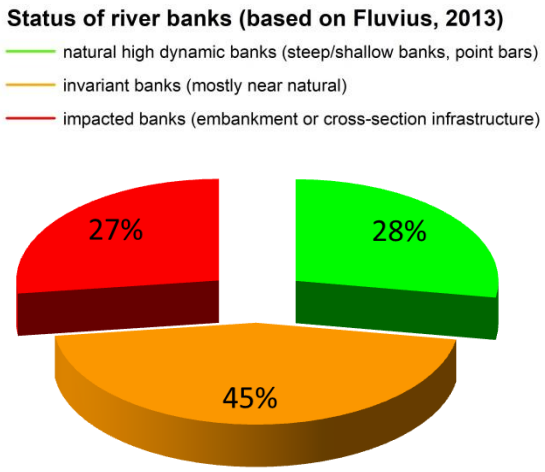
Data source for breeding birds: see chapter 3.2

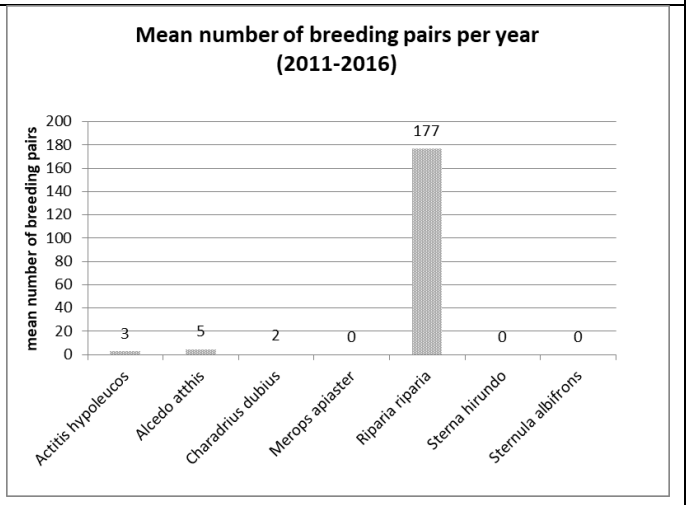


River section 1 includes the Mura stretch at the border between Austria/Slovenia, the inner Mura in Slovenia and part of the Mura stretch at the border between Slovenia/Croatia. The 83-kilometre stretch is highly regulated, with almost 90 % of its total length regulated by river training structures. This leads to a very narrow river bed and furthermore a scarcity of proper river banks or gravel islands for river bird species. The occurrence of the Sand Martin is restricted to the part of the Mura river which forms part of the border between Austria and Slovenia, the “Grenzmur”. However, its breeding sites are mainly in the hinterland of the Mura in gravel-sand pits, not directly along the river.

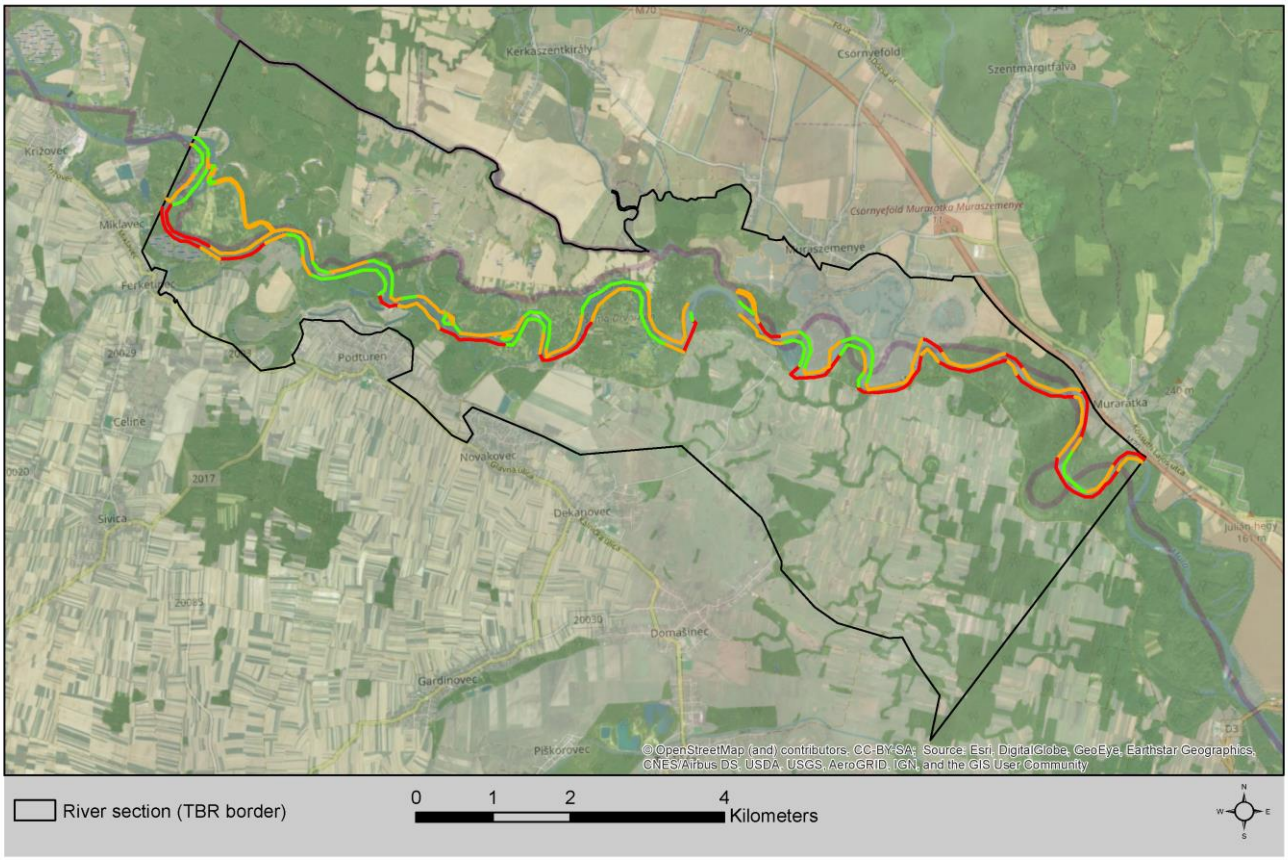
River section 2: Mura: Miklavec (HR) – Murarátka (HU)

19 river kilometres





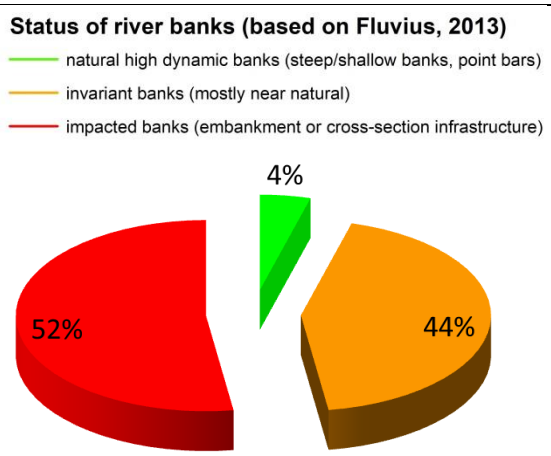
Data source for breeding birds: see chapter 3.2

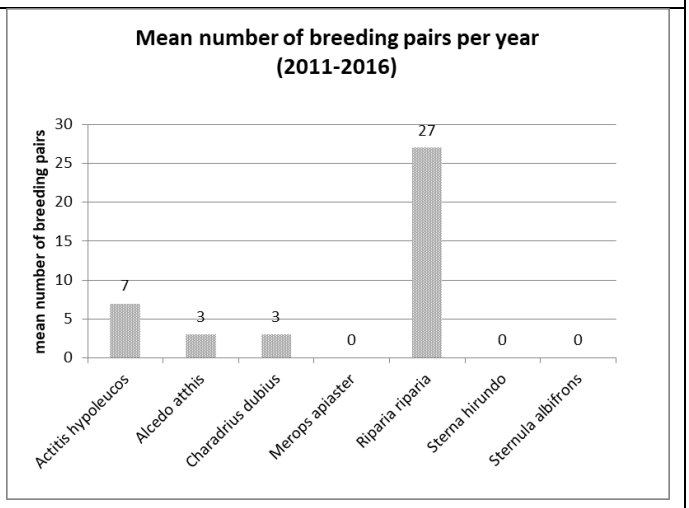


River section 2 is defined by a natural stretch of the Mura between Slovenia and Croatia, and between Croatia and Hungary. More than two thirds of the river banks of this section are natural or at least near natural. The section begins close to the village of Miklavec (Croatia) and ends southeast of the village of Murarátka (Hungary). It is the most natural section of the entire Mura. Despite its mostly natural and uninfluenced river, the river bed is very narrow. Proper habitats for gravel or sand bank breeders are missing, resulting in very low numbers of Little Ringed Plover and Common Sandpiper. South of the Hungarian village of Muraszemenye in the eastern part of this river section, a large Sand Martin colony exists which hosts almost the total number of Sand Martin within this section.

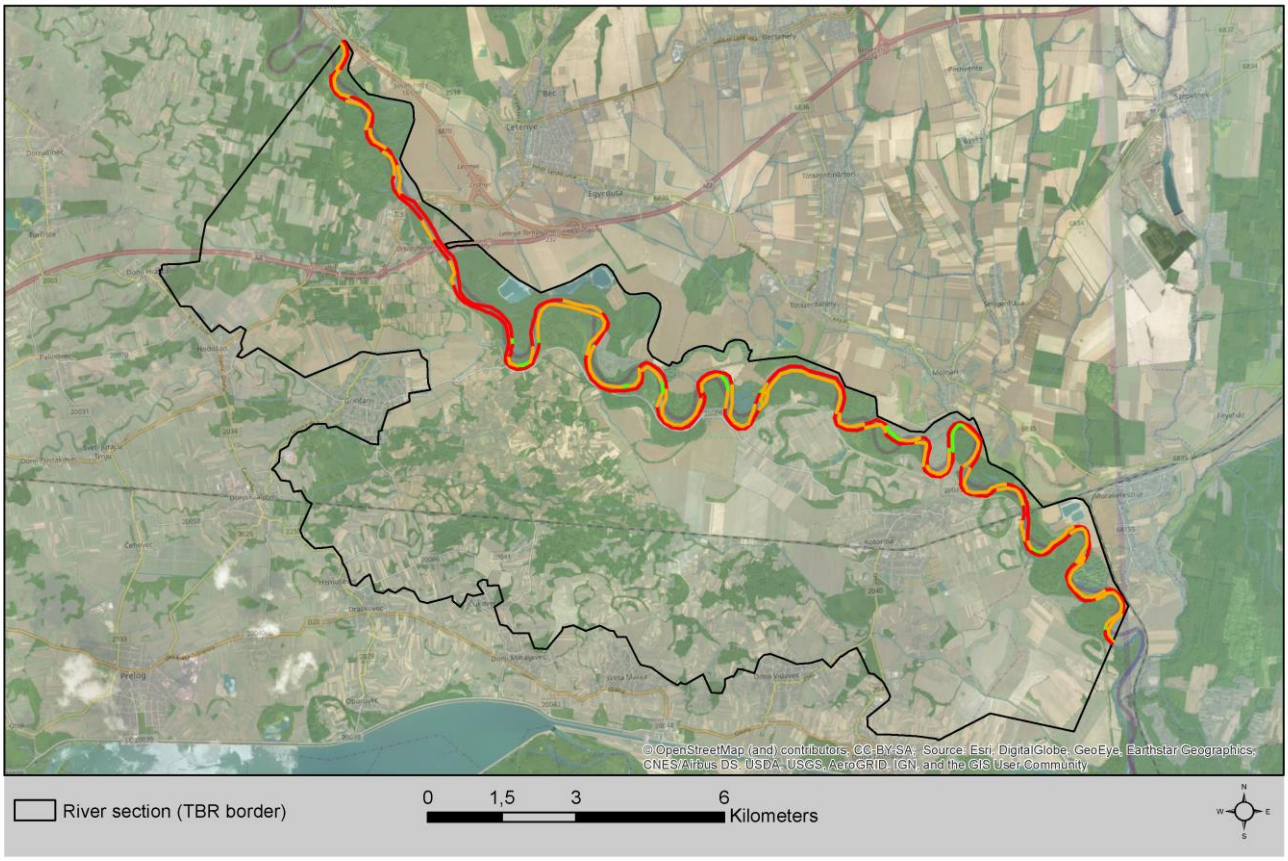
River section 3: Mura: Murarátka (HU) – Drava-Mura confluence

30 river kilometres



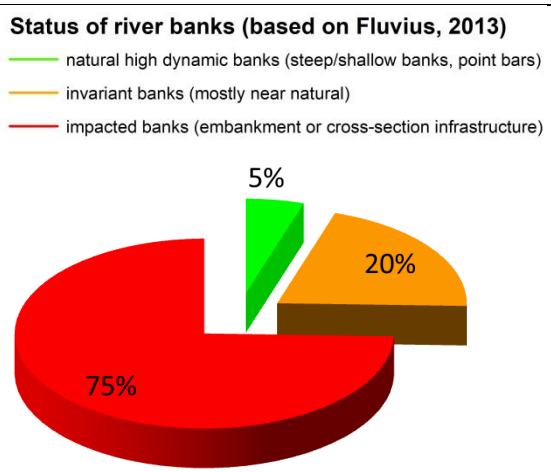


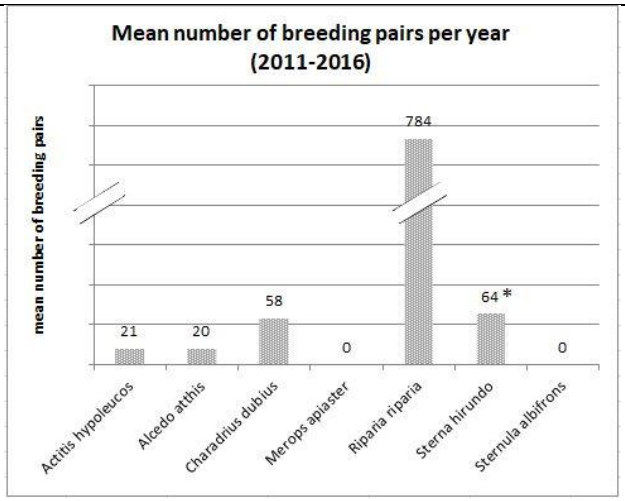
Data source for breeding birds: see chapter 3.2



River section 3 differs from river section 2 by its extent of river regulation. Today, this stretch of the Mura between Croatia and Hungary includes more than 50 % embanked, mostly steep river banks. The section begins southeast of the village of Murarátka (Hungary) and ends between the village of Donja Dubrava (Croatia) and the village of Murakeresztúr (Hungary). Despite the high degree of embankments, the meanders within this river section are still preserved. As in the upper river sections, proper habitat for gravel and sand bank breeders are limited to single spots.

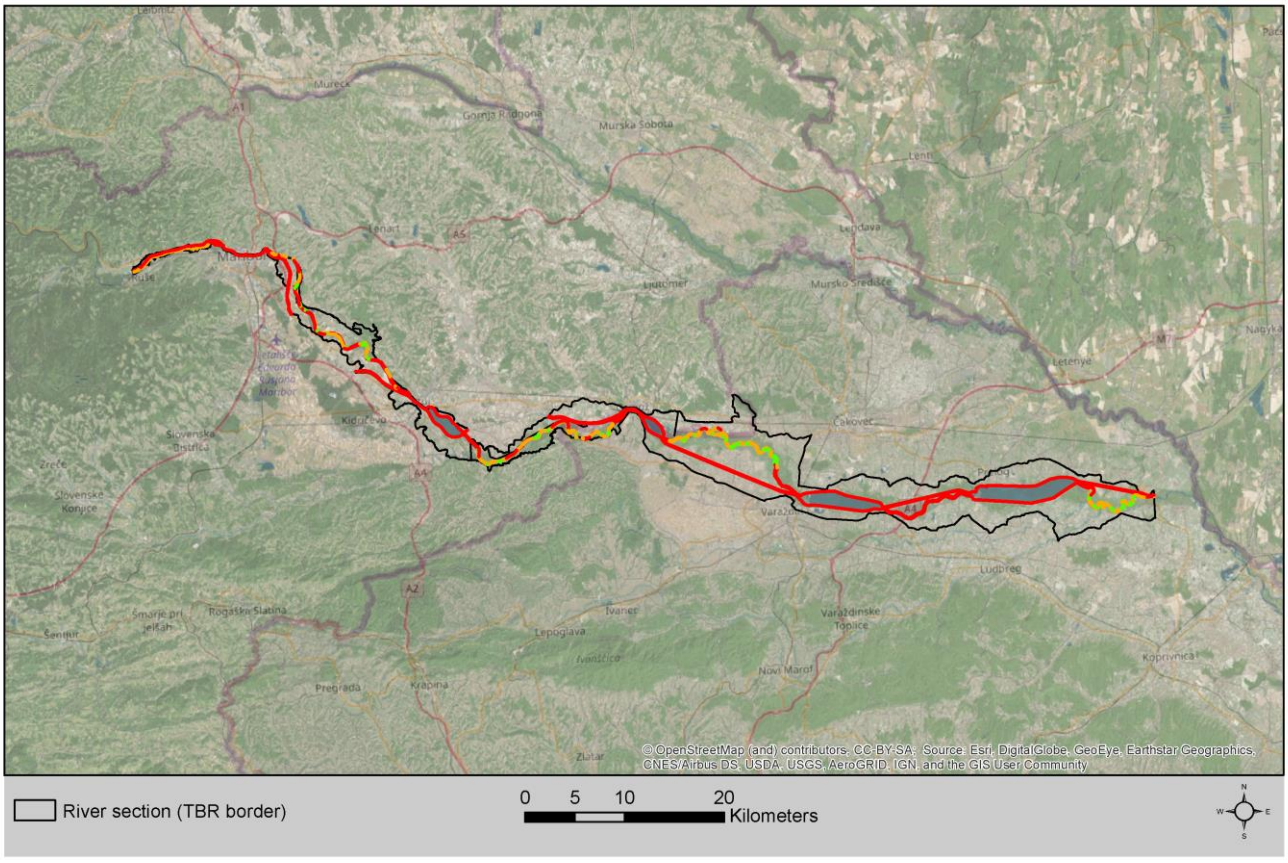
River section 4: Drava: Selnica ob Dravi (SI) – Donja Dubrava (HR)
133 river kilometres





*breeding pairs only on artificial breeding platforms on Ptuj reservoir

Data source for breeding birds: see chapter 3.2



River section 4 includes the Drava River between Selnica ob Dravi (Slovenia) and Donja Dubrava (Croatia) close the Drava-Mura confluence. It is strongly influenced by hydropower plants, five of which are situated within this river section. Due to heterogeneous sections which include natural regulated residual flow stretches and artificial canals/reservoirs, this river section was divided into **three river sub-sections**.

4a: Hydropower sub-section "near natural": Four stretches of the residual flow with a total length of 70 river kilometres still preserve near natural features ("Stara Drava"). Due to its many gravel banks and islands, this river section hosts high numbers of Common Sandpipers and Little Ringed Plovers. Additionally, steep river

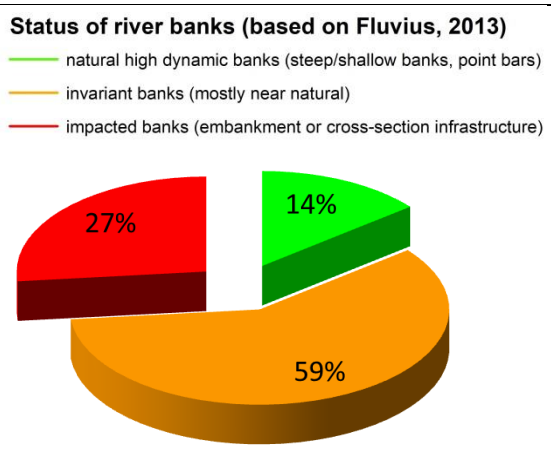
banks with breeding spots for Kingfisher and Sand Martin exist within these four sections.

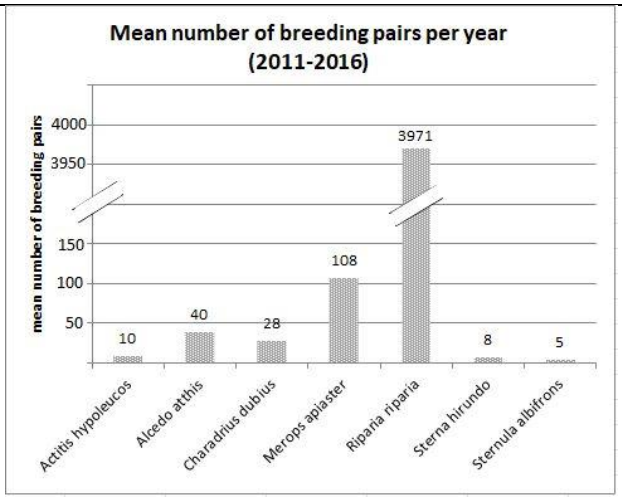
4b: Hydropower sub-section "regulated": Two sections with more than 90 % of regulated and impacted river banks and riverbed with a total length of 24 river kilometres. Proper breeding habitats for river bird species are missing almost everywhere. Thus, river bird species are missing during breeding season within these sections.

4c: Hydropower sub-section "artificial": This connected sub river section with a total length of 107 river kilometres is characterised by its completely artificial tailrace canals as well as four artificial reservoirs with concrete banks. Basically, river bird species are not present during breeding season, aside from artificial breeding platforms established in the reservoir at Ptuj in Slovenia. At these platforms, the yearly average of Common Tern breeding pairs is 64.

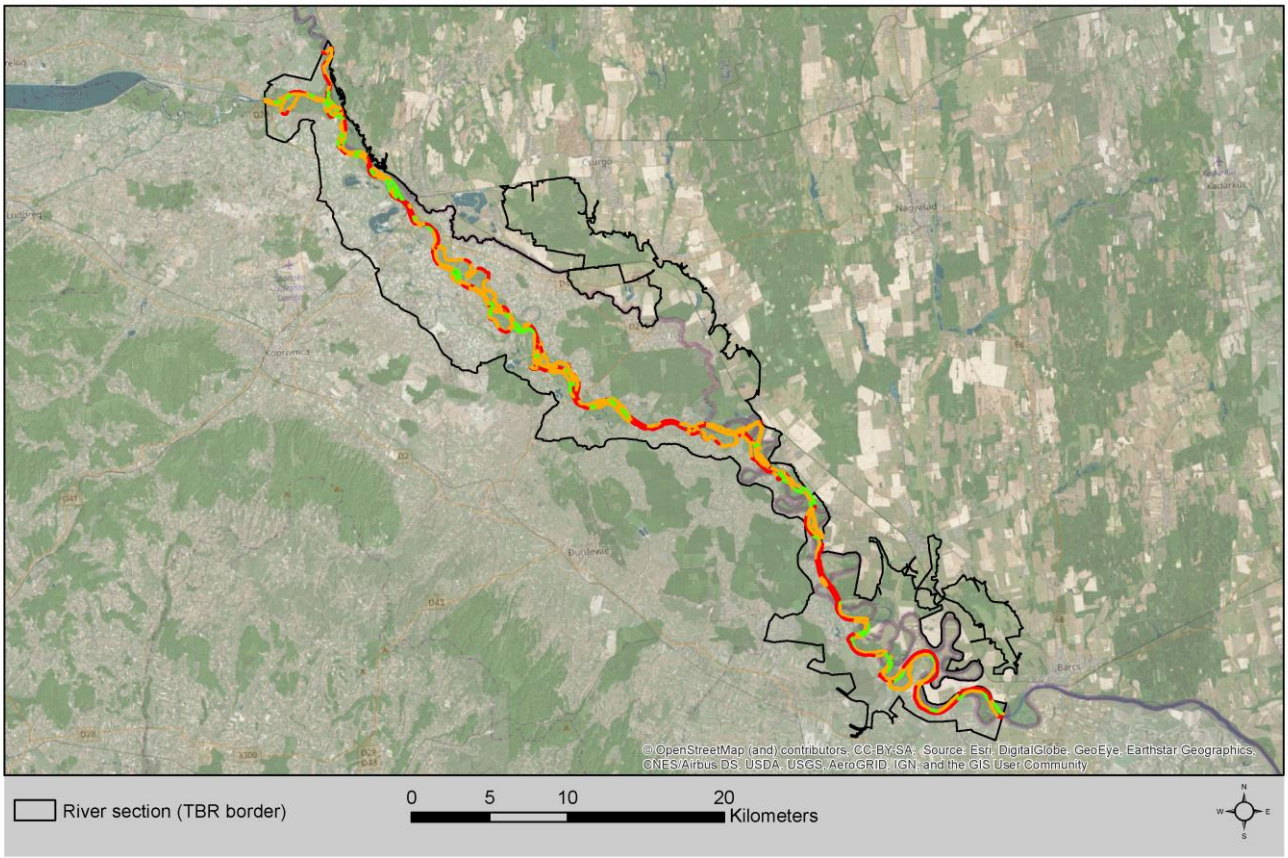
River section 5: Drava: Legrad (HR) – Barcs (HU)

78 river kilometres





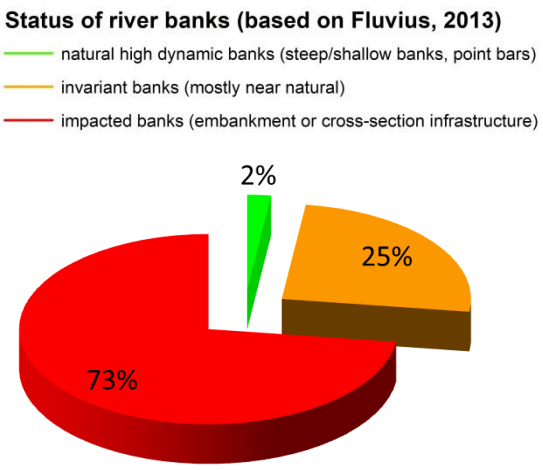
Source of data for breeding birds: see chapter 3.2

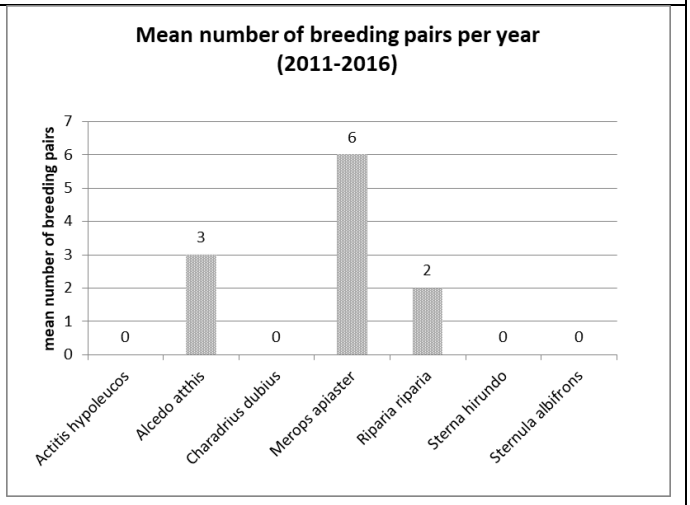


River section 5 begins a few kilometres upstream of the Drava-Mura confluence (Croatia) and ends downstream right before the city of Barcs (Hungary). Despite hydropeaking, this 78-kilometre river section is a mostly very natural, free-flowing river stretch. More than 70 % of the river banks are natural or at least near natural, including several large gravel banks as well as steep river banks. In regard to river bird species, this river section is currently the best along the Drava river. It is the only section which hosts all seven river bird species, even several pairs of Little Tern, which are breeding on natural gravel banks every year. Furthermore, large colonies of Sand Martin and European Bee-Eater exist.

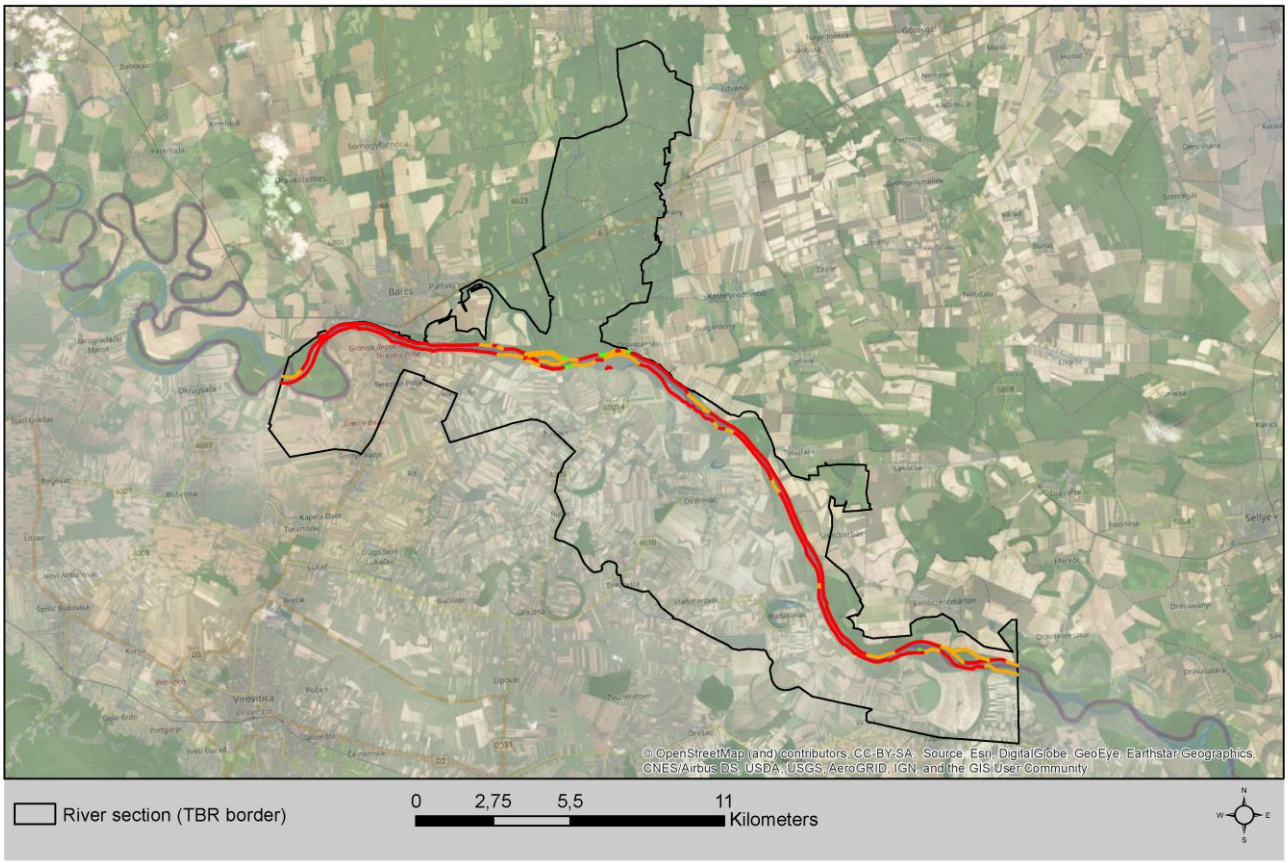
River	section	6:	Drava:	Barcs	(HU)	–	Sopje	(HR)

31.5 river kilometres



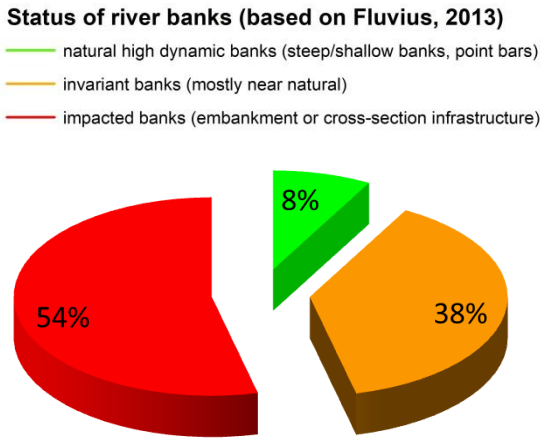


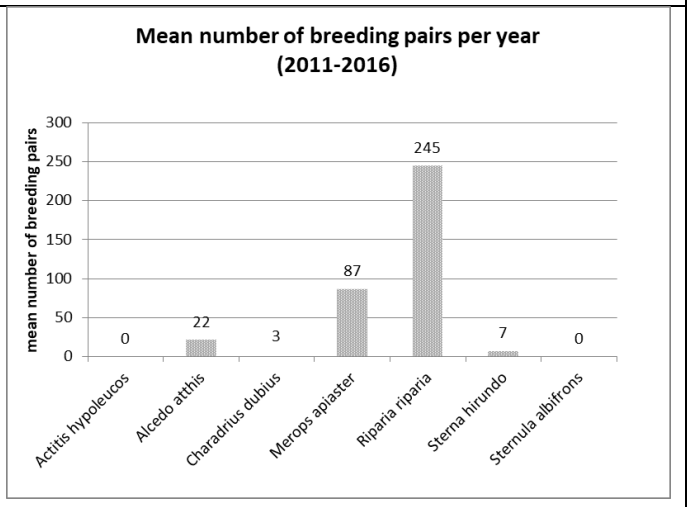
Data source for breeding birds: see chapter 3.2



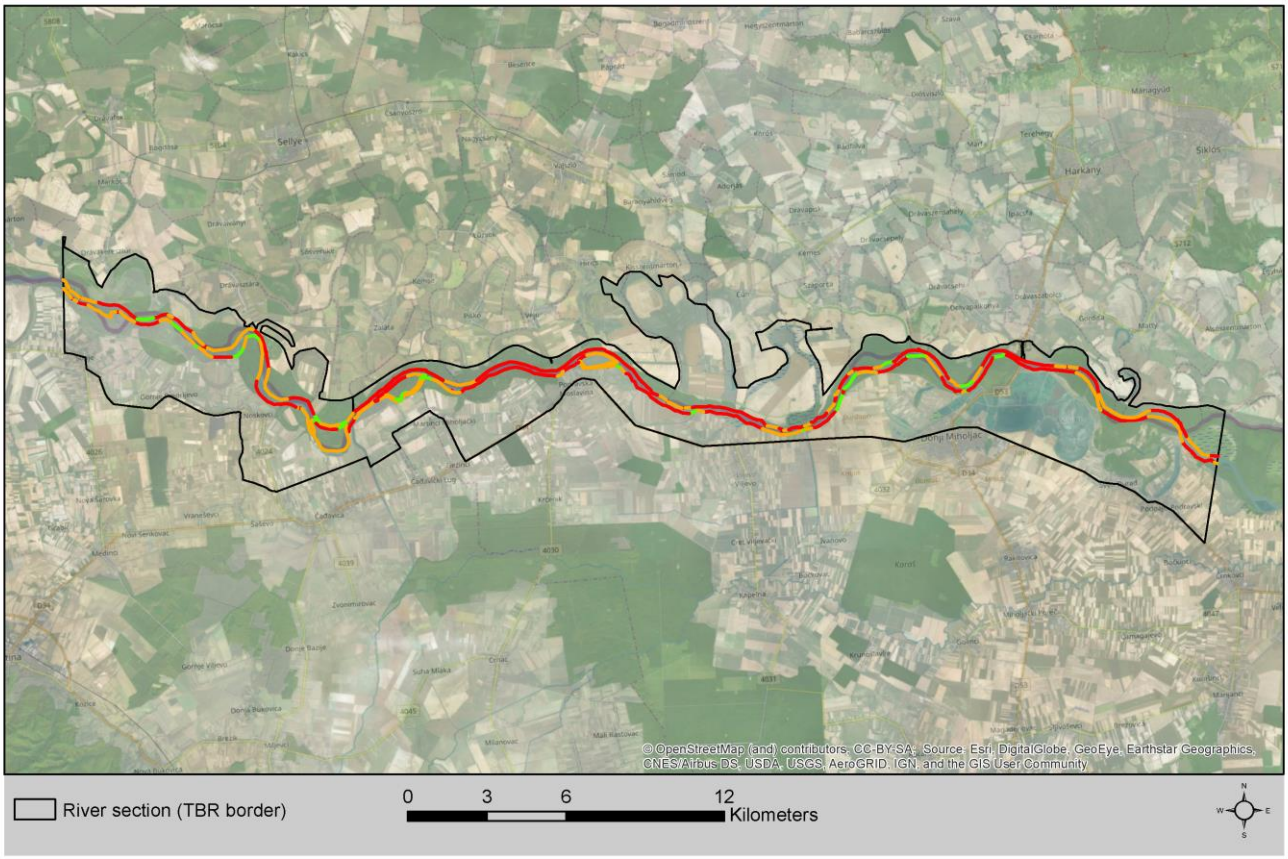
River section 6 begins west of the city of Barcs (Hungary) and ends about 31.5 kilometres north of the village of Sopje (Croatia). In contrast to section 5, this is a strongly regulated part of the Drava. More than 70 % of the river banks on this section are modified by river training structures. Except for a few breeding pairs of European Bee-Eater and a single small colony of Sand Martin, restricted to a short near natural stretch north of the village of Žlebina (Croatia), river bird species cannot find proper breeding habitats within this river section and thus are missing during breeding season.

River section 7: Drava: Sopje (HR) – Donji Miholjac (HR)
50 river kilometres



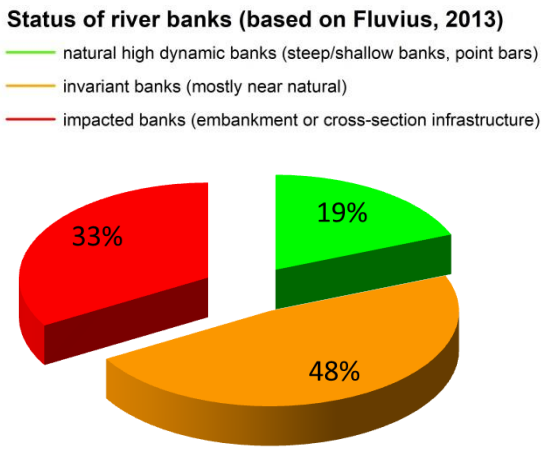


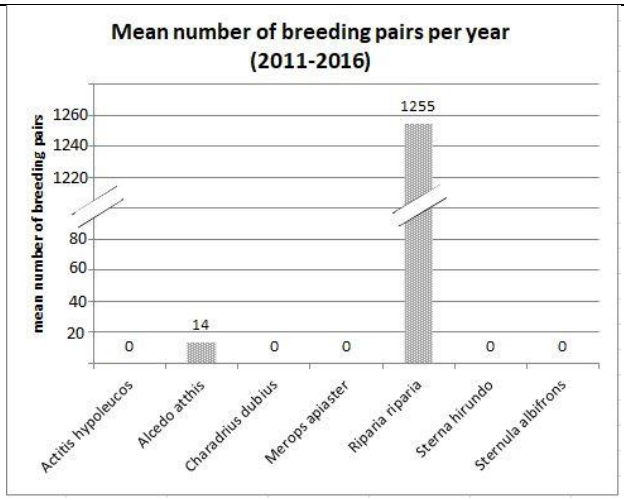
Data source for breeding birds: see chapter 3.2



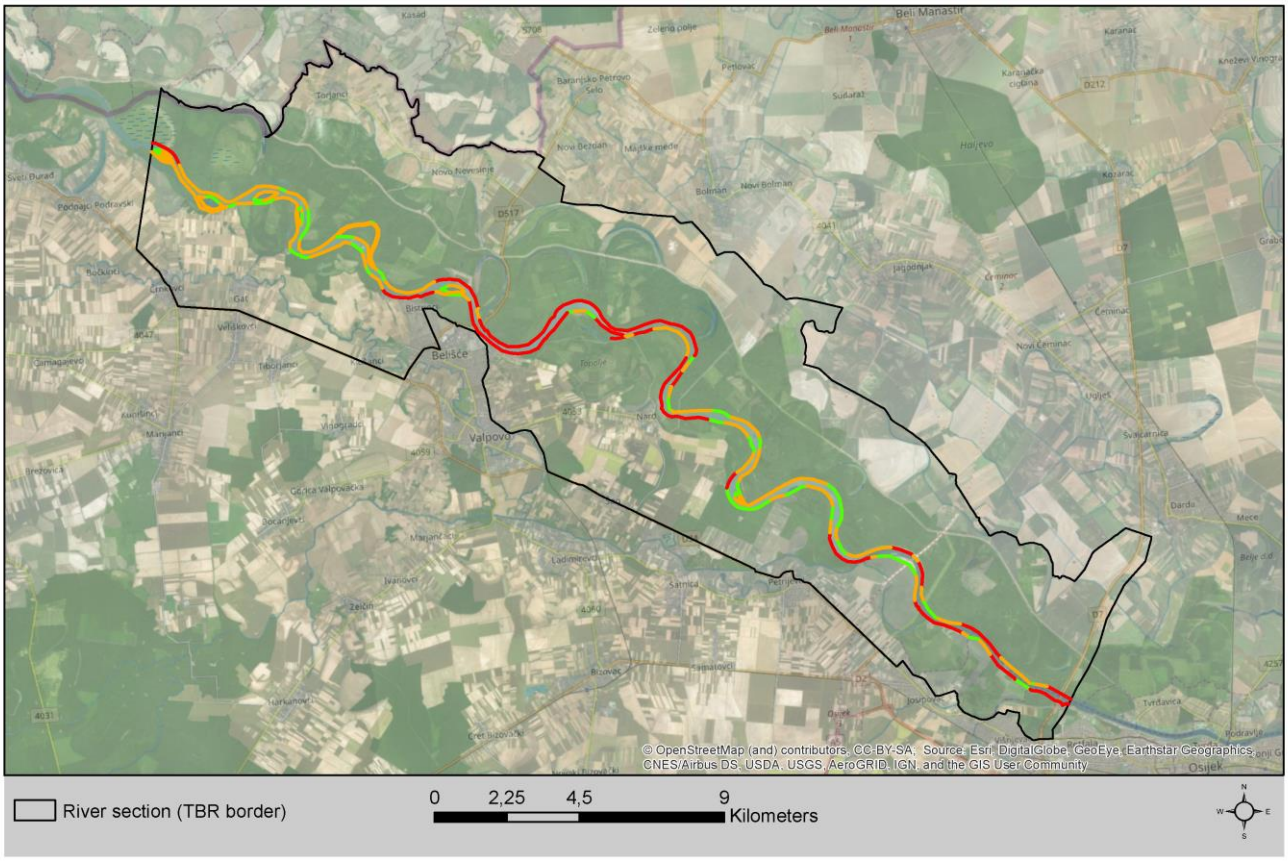
River section 7 begins north of the village of Sopje (Croatia) and ends downstream of the city of Donji Miholjac (Croatia). Similar to the upstream river section 6, more than 50 % of river section 7 is regulated. However, in contrast to section 6, several small natural or near natural sections are still present, which are important especially for steep bank breeders. Besides natural or semi-natural river stretches, fish ponds east of the city of Donji Miholjac offer important secondary habitats for Common Tern and other river bird species.

River section 8: Drava: Donji Miholjac (HR) – Osijek (HR)
38 river kilometres





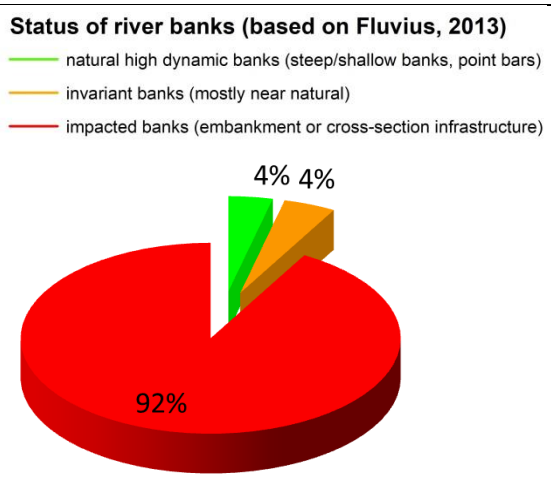
Data source for breeding birds: see chapter 3.2

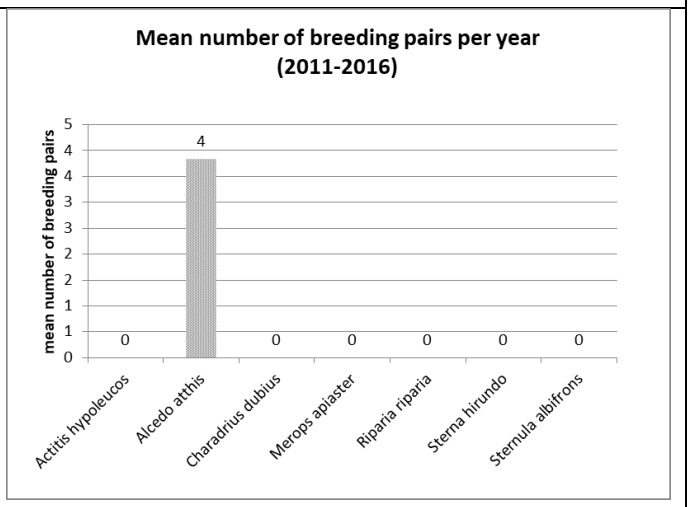


River section 8 begins downstream of Donji Miholjac (Croatia) and ends upstream of the Croatian city of Osijek. Two thirds of the river banks are natural or near natural, so the Drava river is able to form meanders. A regulated section is located between the city of Belišće and the village of Nard (both in Croatia) and is approximately 15 kilometres long. Despite the high amount of natural or near-natural river banks, gravel or sand bank breeders are missing within this section. However, this river section hosts a very important Sand Martin breeding site upstream of the village Bistrinci (Croatia) with up to 1900 breeding pairs. Due to the presence of landmines within this section, the floodplain along the left bank is partly inaccessible.

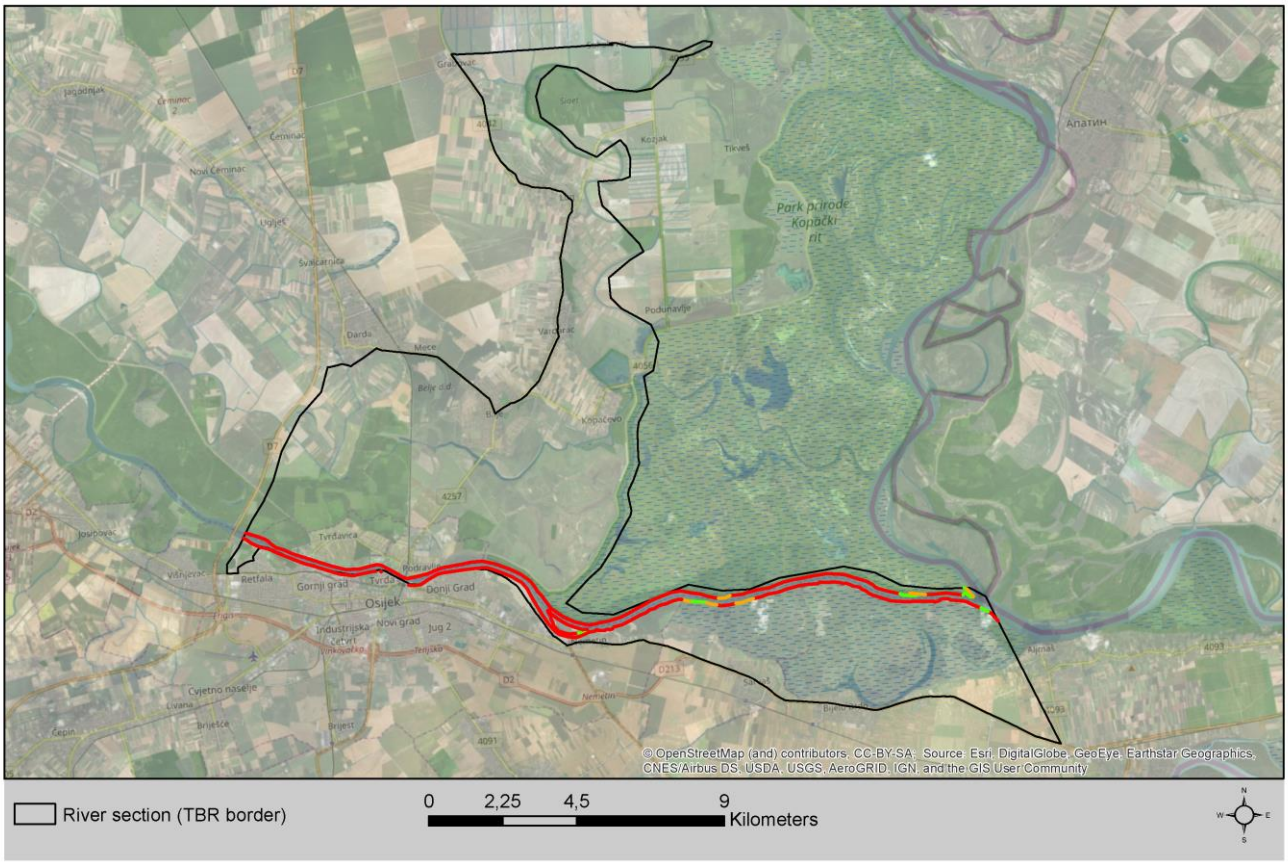
River section 9: Drava: Osijek (HR) – Danube-Drava confluence

20.5 river kilometres





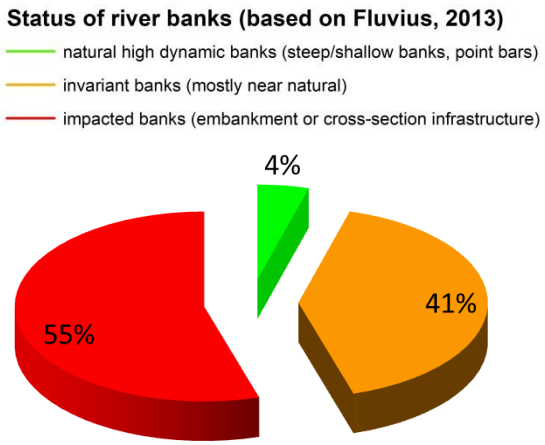
Data source for breeding birds: see chapter 3.2

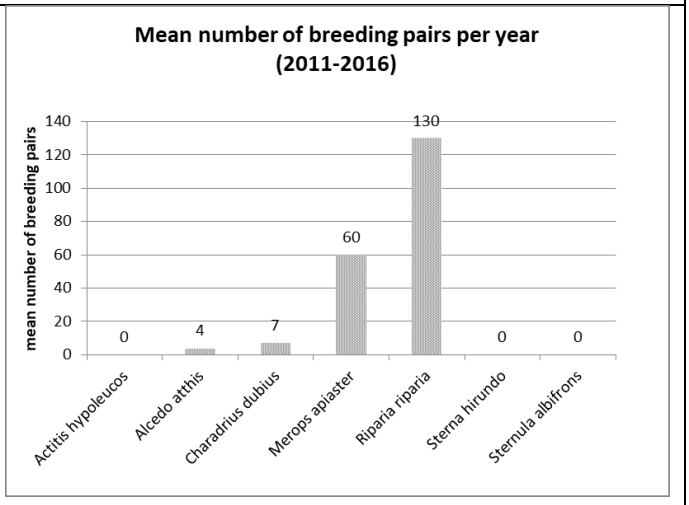


River section 9 begins upstream of the Croatian city of Osijek and ends 20.5 kilometres downstream at the Drava-Danube confluence. Excepting some small natural or near-natural parts, this river section is characterized by regulated river banks throughout. Thus, this river section currently hosts no proper habitat for gravel or sand bank breeders. Within this section, one large Sand Martin colony existed downstream of Donji Grad. It hosted up to 400 breeding pairs in 2012 but was destroyed by embankment construction.

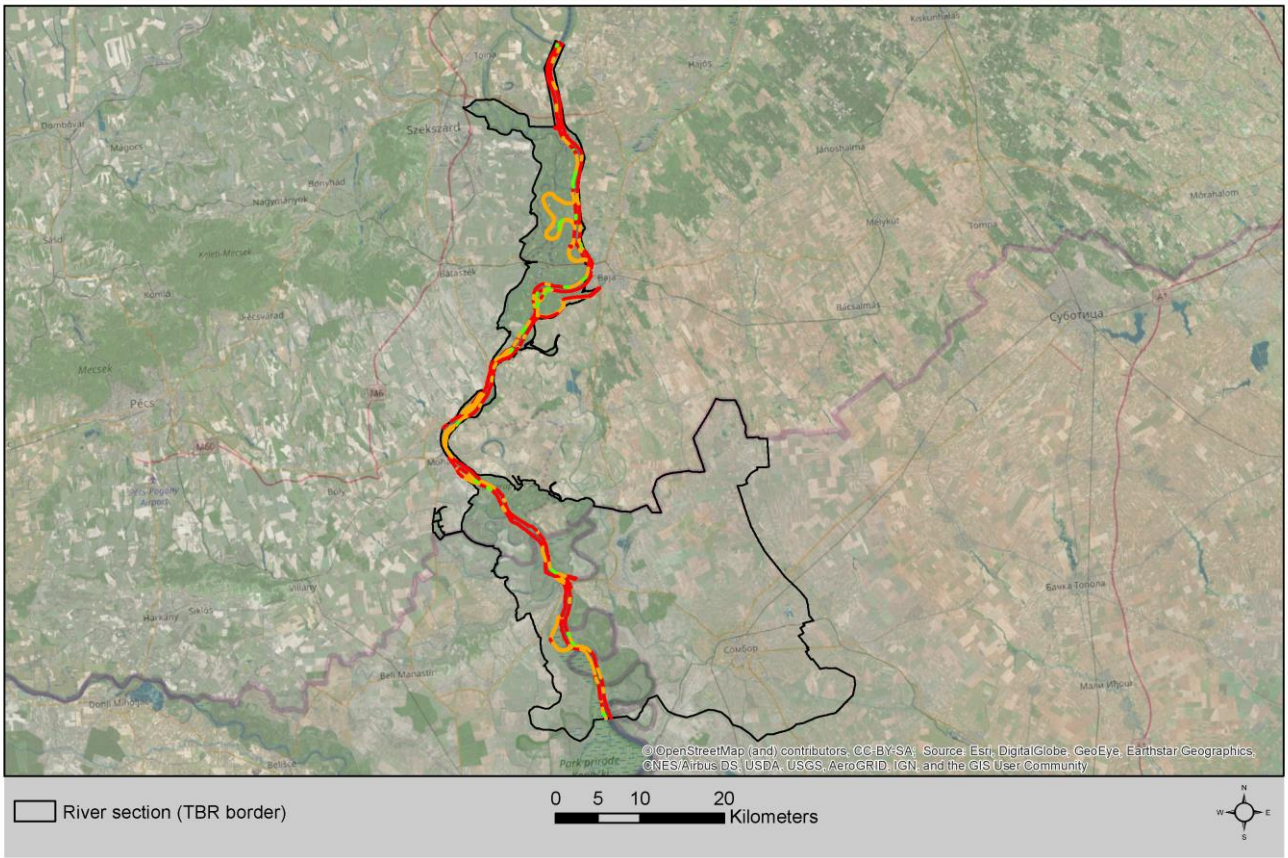
River section 10: Danube: Fajsz (HU) – Kupusina (RS)

100 river kilometres





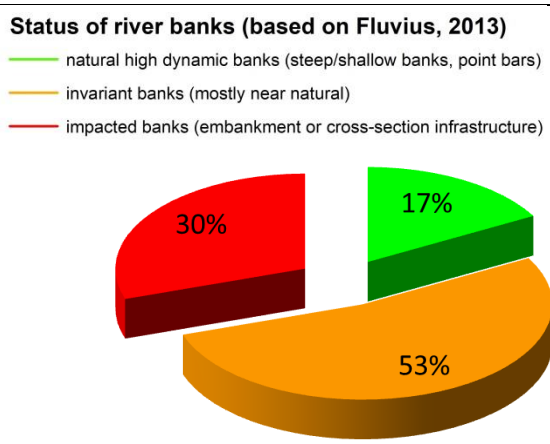
Data source for breeding birds: see chapter 3.2

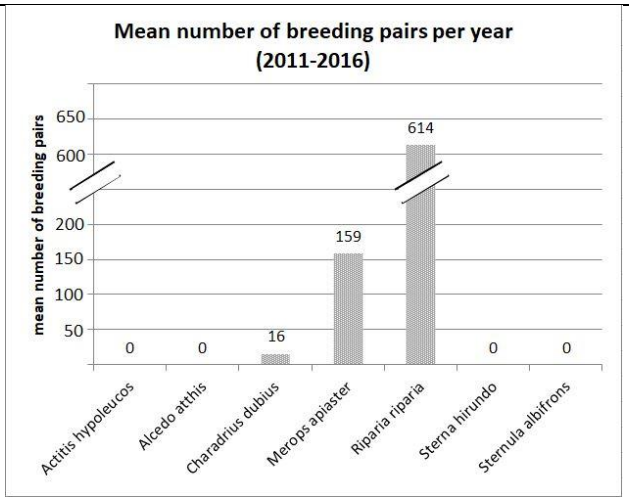


River section 10 begins at the northern end of the TBR in Hungary and ends approximately 100 kilometres downstream, in the border area of Serbia and Croatia upstream of Kopački Rit Nature Park. In this river section more than 50 % of the river banks are regulated. This means that proper breeding habitats for gravel or sand bank breeders are limited to very few areas. This is also true for the Sand Martin, where only very few breeding places are known within this river section.

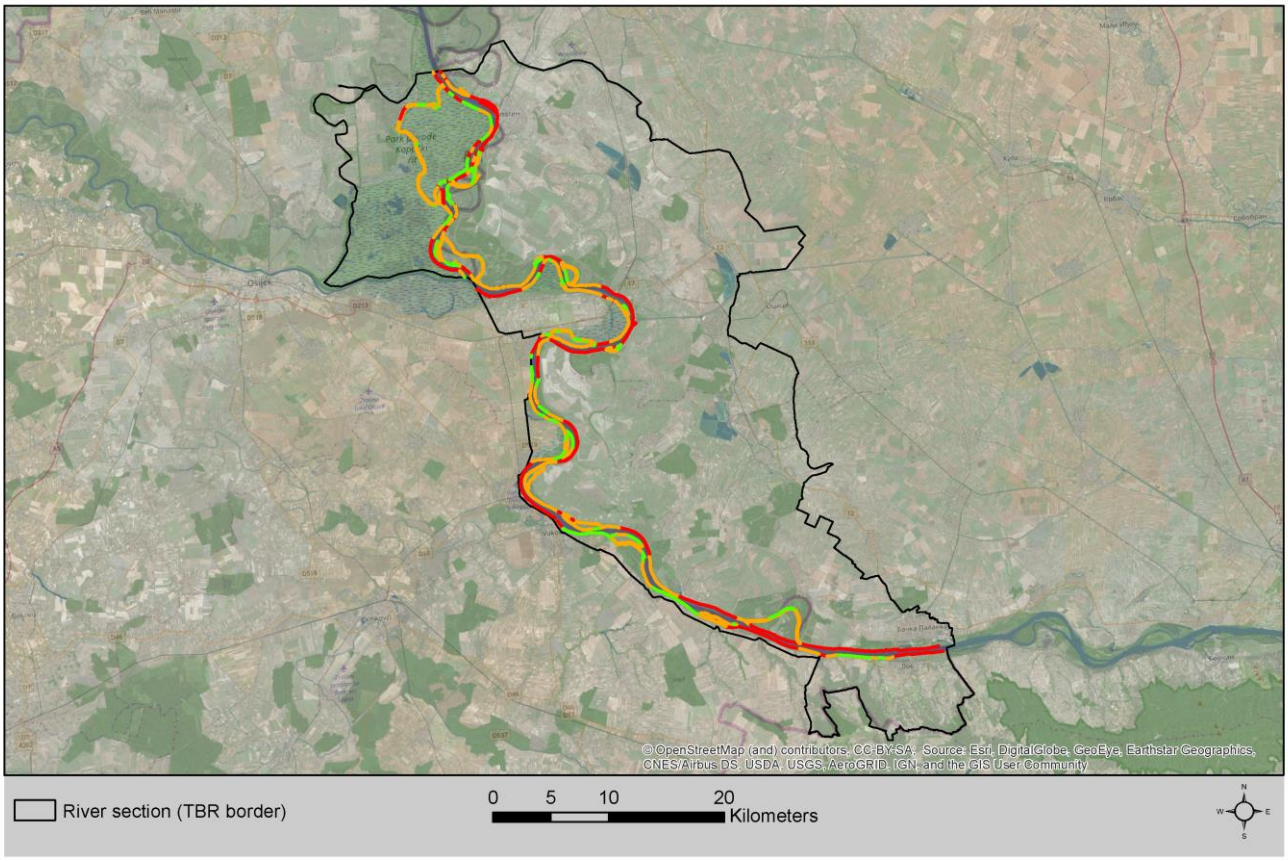
River section 11: Danube: Kupusina (HR) – Bačka Palanka (RS)

113 river kilometres





Data source for breeding birds: see chapter 3.2



River section 11 begins near the village of Kupusina (HR). It includes the main and most important part of Kopački Rit Nature Park, the southern part of Gornje Podunavlje Special Nature Reserve as well as the area around the Drava-Danube confluence. It ends at the southern border of the TBR MDD, between the cities of Bačka Palanka (Serbia) and Ilok (Croatia). Except for the Little Ringed Plover, sand or gravel bank breeders are missing in this section. Because of several loess hills in the north-eastern part of Croatia and high loess terraces along the right Danube bank downstream of Vukovar and Ilok, which are no longer being shaped by the Danube's erosive forces, this is an important river section for the European Bee-Eater, hosting large numbers.

3.2 Data Analysis

Alongside information regarding the rivers' hydromorphology and the state of the river banks, the breeding numbers of river birds of each species were an important element for defining the goals and the objectives of the present action plan.

Normally, data on breeding numbers is available for single countries or single protected areas, but not for transboundary regions. Therefore, for the analysis of the current distribution and rough estimates of the breeding numbers along the three rivers within the target area, ornithologists and experts of all five countries were asked via e-mail to provide data from surveys and existing monitoring programs for the seven bird species. To create baseline data concerning distribution, breeding status and breeding numbers, they were also requested to include the following parameters for each data record: date/time of record, species (scientific name), bird activity or breeding status (e.g. „singing", „on nest" etc.), number of birds, sex (if available), age (if available) and geographic coordinates.

Darko Grlica (Natural History Society "Drava") provided his long-term data from regular surveys along the Mura, Drava and Danube rivers in Croatia, including the border stretches with Hungary (Mura, Drava) and Serbia (Danube), where observation has been conducted on both river banks also. Data from observations on the Drava has been collected from 2004 onwards, for the rivers Mura and Danube, from 2008. Together with site-specific data collected by Tibor Mikuška on regular basis in Osijek County, focused on the fishponds at Donji Miholjac, on the nature park Kopački Rit as well as the loess hills along the Danube, these sets of data cover the largest parts of the TBR MDD target area. For the Mura River in Slovenia, BirdLife Slovenia (DOPPS) provided raw data from their database. For the Drava River in Slovenia, precise data from a long-term study conducted by Slovenian ornithologists was also provided by DOPPS (Božič & Denac, 2017). For the Mura River in Austria, BirdLife Austria provided all relevant data from their database. For the Danube, data was provided by the Hungarian National Park Duna-Drava Directorate, but also by Darko Grlica and Tibor Mikuška. In total, more than 2.500 data points on river bird species were provided for 2004-2017, including exact coordinates.

For the subsequent GIS analysis and the rough estimation of breeding numbers, only data including numbers of breeding pairs were considered. Additionally, only data with direct connection to the rivers Mura, Drava and Danube were used. Data from within the target area but outside of the river bed (e.g. artificial ponds, gravel pits, etc.) were almost wholly removed. The exceptions are two cases where the river still plays an important role for breeding birds, and which host a significant amount of breeding pairs within the particular river section. These two sites are the fish ponds at Donji Miholjac and the loess hills around Batina, Aljmaš and Erdut in the eastern part of Croatia and the target area. To increase the accuracy of the analysis, data was considered only from those years where reliable data exist for the whole target area. Duplicate data resulting from different monitoring programs on the same river section was removed. More than 1.900 data points from 2011-2016 met these criteria and were thus considered in the analysis.

Since breeding numbers vary from year to year, the number of breeding pairs per river section in the graphic representation is the mean (see supplementary materials: breeding pair maps). Where the numbers fluctuated considerably between years within river section, the median was used instead. Additionally, the breeding pair numbers per river section were validated by ornithological experts of each river section during the compilation of this report. The population trend for each of the seven bird species targeted by the action plan is taken from the IUCN Red List of threatened species and concerns the trend in each individual country. However, depending on available breeding pair data from the target area over the last years and combined with the involved experts' assessments, estimated population trends for each species within the target area were also created.

4 Characteristics and distribution of key river bird species

4.1 Historical development of habitats and distribution of key river bird species

Up to the end of the 18th century, the Mura, Drava and Danube were free-flowing, dynamic rivers characterized by completely natural riverine habitats such as gravel and sand banks, steep banks, side channels, oxbows and floodplain forests. Sand and gravel banks as well as steep banks were constantly being altered by the rivers. Depending on the intervals and intensity of floods, the location and shape of these typical riverine habitats changed on a regular basis. In the 18th and 19th century, anthropogenic influence increased, starting with the first larger river regulation measures, such as cutting meanders. In the second half of the 20th century, the impact on the river ecosystem continued to increase. Systematic dike construction to protect arable land and settlements, groyne building and the hard armouring of the natural river banks with stones, as well as hydropower dams in the upper Drava and Mura courses, drove further degradation of the free-flowing stretches. The originally free-flowing rivers became ever straighter, more narrow and deeper (SCHWARZ & MOHL, 2009).

Next to different kinds of river regulation measures, the construction of hydro power plants in the second half of the 20th century had further severe impacts on the rivers and its habitats. The effects of chains of hydropower plants along the rivers Mura and Drava themselves as well as along their tributaries are cumulative, causing sediment deficit and consequent river bed degradation on the remaining free-flowing stretches of the rivers downstream of the last hydropower plants. A study (BONACCI & OSKORUŠ, 2010) conducted on the Croatian Drava on the river section between Botovo and Ferdinandovac clearly illustrates these effects. Ever since the construction of two hydropower plants, there has been a massive downstream bed load deficit. Furthermore, since the Drava has no further tributaries downstream of the last power plant, the bed load input is limited to lateral erosion on this stretch of the river.

These influences have decimated natural riverine habitats for river birds. In the last 120 years, for instance, gravel and sand banks at the Drava River in Croatia between Botovo and Ferdinandovac (approx. 40 river kilometres) decreased from 1400 ha in 1879 to 110 ha in 1997, which represents a loss of 92 %. The surface area of the river and side-branches decreased from 2492 ha to 865 ha, or 65 %, over the same period. A comparison of the development of different habitat types between 1879 and 1997 shows a massive decrease of high quality habitats (MOHL & SCHWARZ, 1998; see Figure 4-1). In 2005, only 21 % of the steep Mura and Drava banks between Mursko Središče (Slovenia) and Osijek (Croatia) remained uncovered, that is, almost 80 % of the banks were reinforced with artificial protection infrastructure (WWF, 2005).

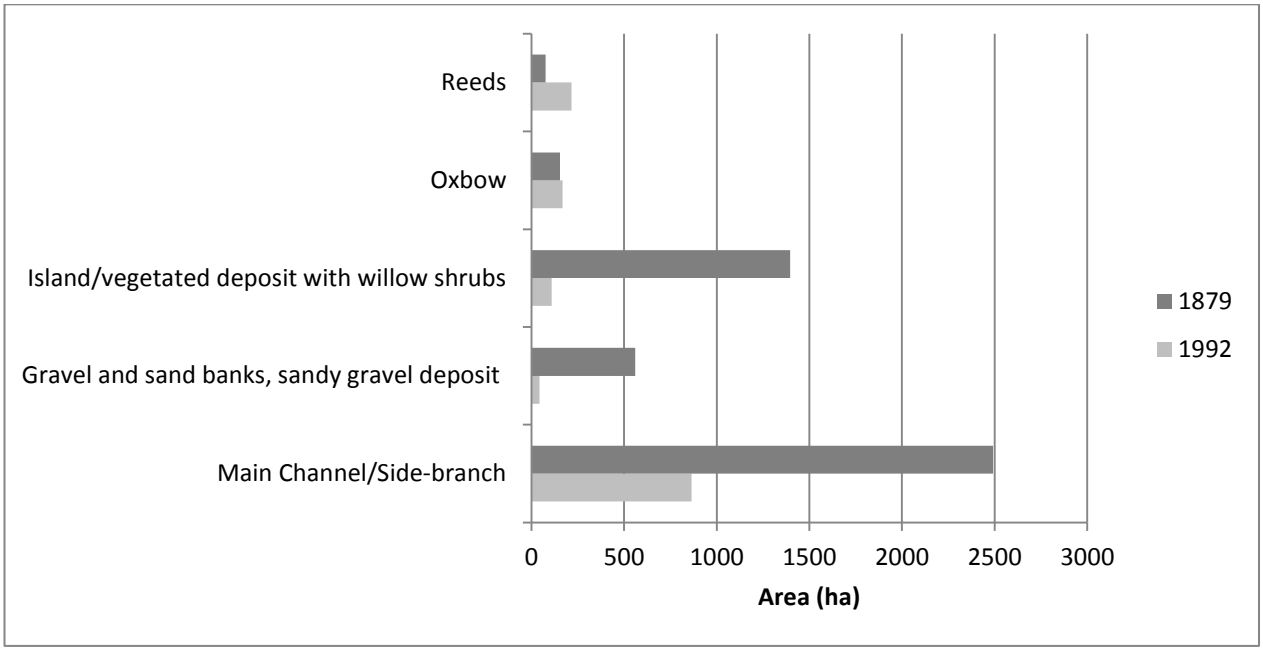


Figure 4-1: Area development of waterbodies and habitat types between 1879-1997 at Drava river in Croatia between Botovo and Ferdinandovac (river kilometres 226-185.5) (MOHL & SCHWARZ, 1998).

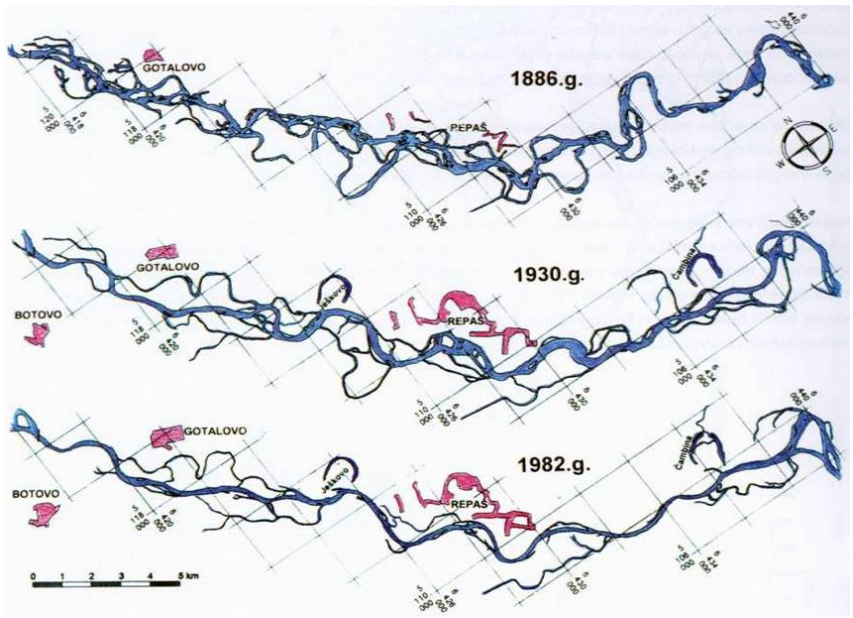


Figure 4-2: The river bed of the Drava between Botovo and Ferdinandovac in Croatia changed from natural braiding into a straighter, more narrow and deeper form over a period of hundred years (Hrvatska Elktroprivreda, 2000). This has had a big impact on natural river habitats and river bird species (Hrvatska Elektroprivreda 2000).

Comparing aerial photos from 1968 of certain river sections of the Drava and Mura (before construction of the first hydropower plants on the Drava in Croatia) with recent photos, the dramatic loss of natural riverine habitats is obvious (see following figures). The choice of these sections was mainly based on the availability of good quality aerial photos from 1968. The sections were then further restricted to those for which changes between then and today were well recognizable.

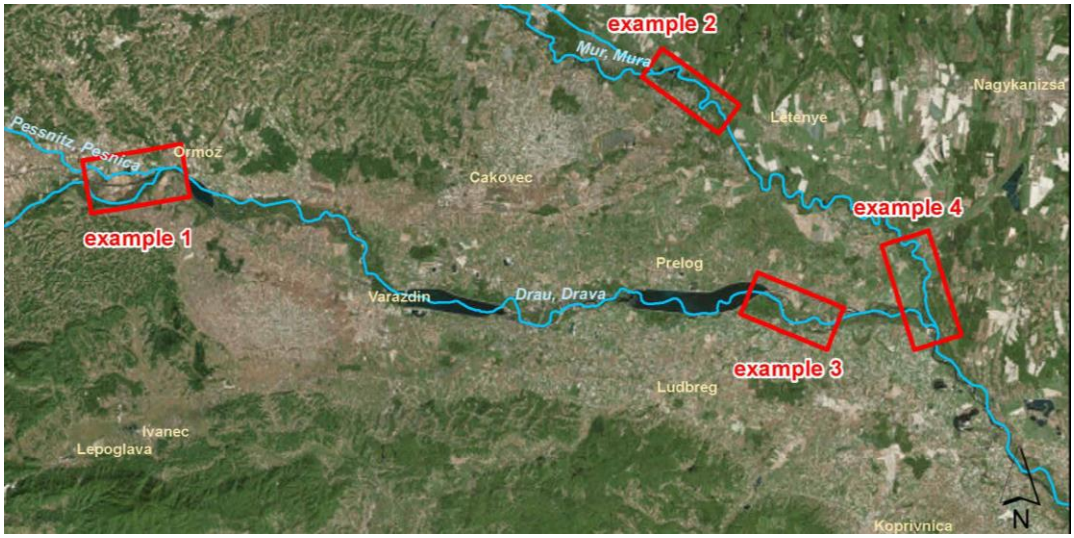
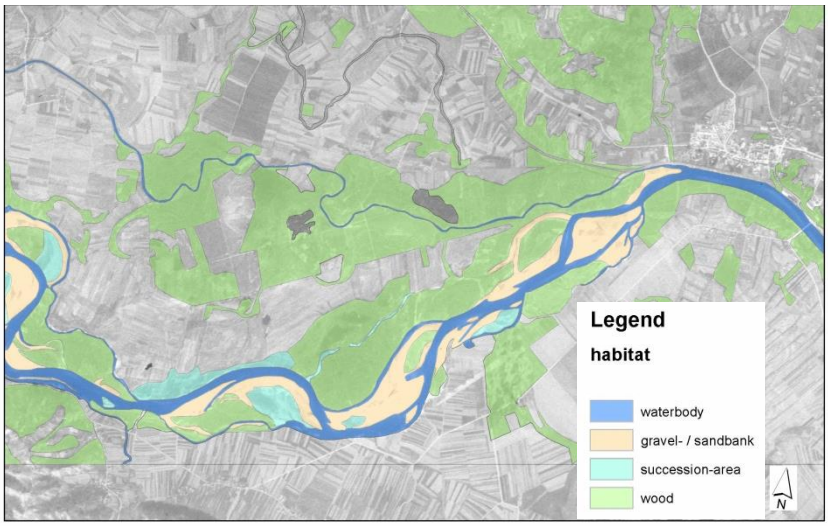


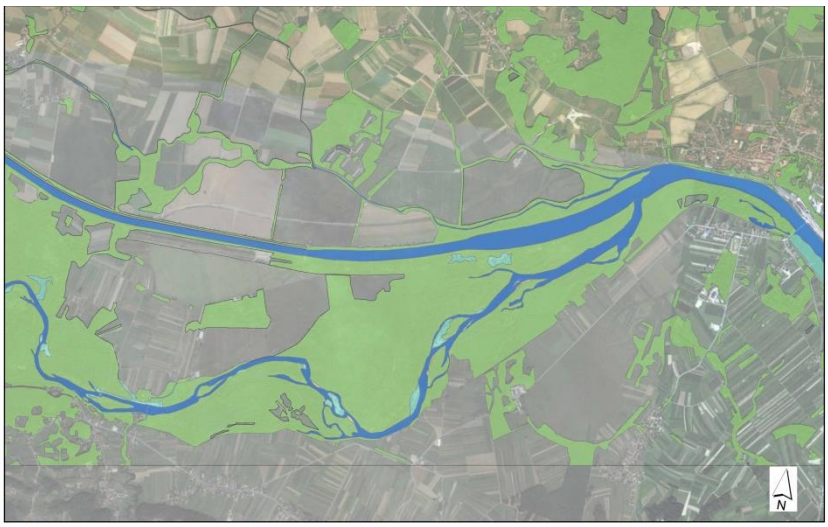
Figure 4-3: Overview over the geographic location of the four river sections chosen to illustrate habitat changes along the Drava (example 1 and 3), Mura (example 2) and the Drava-Mura confluence (example 4).

Example 1: Drava



1968 (area in ha):

habitat	1968 (ha)
waterbodies	284
- river	258
- side-branch	26
gravel/sand bank	253
succession area	106

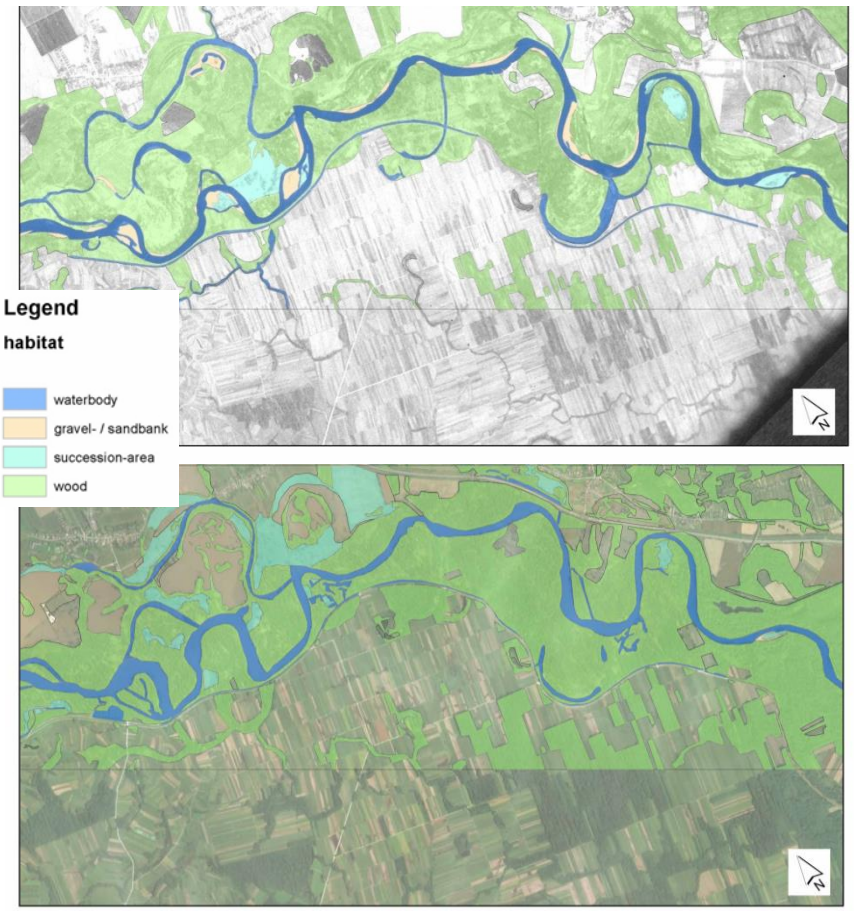


Today (2011-2014):

habitat	Today (ha)	Change from 1968
waterbodies	296	+ 5 %
- river	91	- 34 %
- side-branch	34	+ 375 %
- tailrace channel	171	
gravel/sand bank	2	- 99 %
succession area	39	- 63 %

In example 1, more than 250 hectares of gravel and sand banks along this approx. 8.3 km stretch of the Drava at Ormož, in the Croatian-Slovenian border section, were lost compared to 1968. This was of due to building of the hydropower plant at Ormož (the artificial tailrace canal of the plant holds most of the water flow, but the old Drava bed ("Stara Drava") remained). It is safe to assume that this massive habitat loss was accompanied by a similarly large loss of breeding pairs of sand- and gravel bank breeders. The increase in the total length of side channels is a result of the newly built Drava tailrace canal north of the old flow length.

Example 2: Mura



1968 (area in ha):

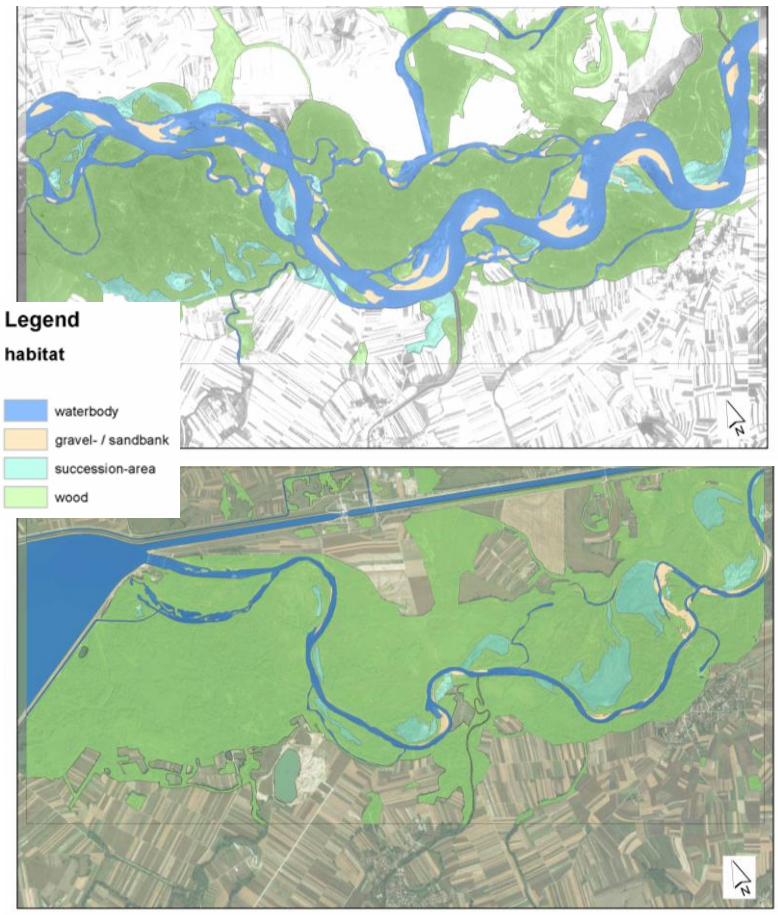
habitat	1968 (ha)
waterbody	279
- river	168
- side-branch	111
gravel/sand bank	49
succession area	49

today (2011-2014):

habitat	Today (ha)	Change from 1968
waterbodies	269	- 4 %
- river	195	+ 16 %
- side-branch	74	- 34 %
gravel/sand bank	1	- 97 %
succession area	169	+ 245 %

Example 2 shows an approx. 11 km stretch of the Mura downstream of the village of Muraszemenye (HU). As shown above, gravel and sand banks have been almost completely lost – their area has shrunk to only 1.4 ha. Conversely, succession areas today occupy an area more than three times larger than 1968, which is a good indicator for the loss of dynamic at this flow length.

Example 3: Drava



1968 (area in ha):

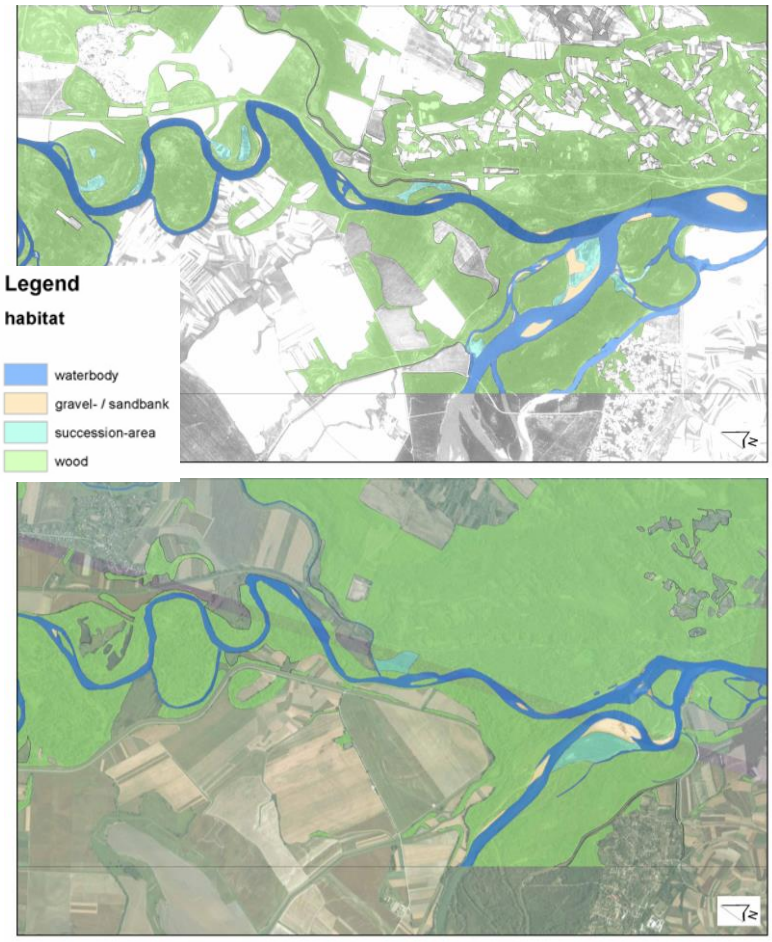
habitat	1968 (ha)
waterbodies	697
- river	499
- side branch	198
gravel/sand bank	112
succession area	195

today (2011-2014):

habitat	Today (ha)	Change from 1968
waterbodies	418	- 40 %
- river	106	- 46 %
- side branch	52	- 74 %
- tail race canal	260	
gravel/sand bank	31	- 72 %
succession area	180	- 8 %

Example 3 shows an approx. 7 km stretch at the Drava upstream of Donja Dubrava. The construction of the hydropower plant led to a massive habitat loss of more than 70 % for gravel- and sandbank breeders. Today, only “Stara Drava” hosts appropriate breeding habitats for them (Common Sandpiper and Little Ringed Plover).

Example 4: Drava-Mura confluence



1968 (area in ha):

habitat	1968 (ha)
Total waterbodies	480
- river	377
- side branch	104
gravel/sand bank	61
succession area	62

today (2011-2014):

habitat	Today (ha)	Change from 1968
Total waterbodies	316	- 36 %
- river	288	- 24 %
- side branch	29	- 72 %
gravel/sand bank	25	- 58 %
succession area	42	- 33 %

Example 4 shows an approx. 8 km stretch at the Mura-Drava confluence. As a consequence of the less dynamic flow, almost 60 % of proper breeding habitats for gravel- and sandbank breeders have been lost, compared to 1968. Additionally, the total area covered by the waterbodies of both rivers decreased by more than 20 %.

The dynamic of the untamed river and associated gravel and sand banks as well as steep banks visible on old maps (18th and 19th century), and still on 1960s satellite images of the Mura, Drava and Danube support a conclusion that large populations of river birds must have inhabited this river ecosystem in the past. At the few still preserved dynamic river ecosystems in Europe, such as those of the Loire and Allier (France), Vistula (Poland) or Po (Italy), their large populations of river birds are living proof of this assumption.

Furthermore, a comparison between historical and current hydromorphology clearly illustrates the great loss of specific riverine habitats and also hints at a great loss of bird species depending on them as breeding, hunting or resting grounds. Species decline has been caused by hydropower generation, river regulation, sediment extraction and their long-term consequences. The Little Tern (*Sternula albifrons*) and Stone Curlew (*Burhinus oedicnemus),* two indicator species for intact river dynamics, stopped breeding on the Drava in Slovenia due to hydropower development since the 1980s. On the Croatian Drava, the Stone Curlew is extinct. The Little Tern still returns yearly to the Drava, but in very small number (10-12 breeding pairs).

Steep bank breeders such as the Bee-Eater (*Merops apiaster*) and the Sand Martin (*Riparia riparia*) have fewer and less steep cut-off slopes available for breeding in. The Sand Martin used to be a widespread and common breeding bird everywhere along the Drava River in Croatia. Although no exact dates are available, the number

of breeding pairs in the 1980s was still estimated to have been around 30.000 on the free-flowing river section downstream of the Drava-Mura confluence. Their population has decreased by approx. 60 %, to 12.000, in 2005 and thence to less than 6.000 pairs in 2018. This means a reduction of about 80 % from the 1980s until today, and also a decrease of about 50 % within the last 13 years (Grlica, unpublished). This establishes a steep downwards trend of their population (see Figure 4-16), which is related to the construction of embankment structures and sediment deficit. The population decrease is so significant that other factors such as hydropeaking fluctuations and food scarcity due to the decrease of insect and mosquito populations have had a proportionally bigger impact on their populations. If no action is taken, the trend is unlikely to reverse.

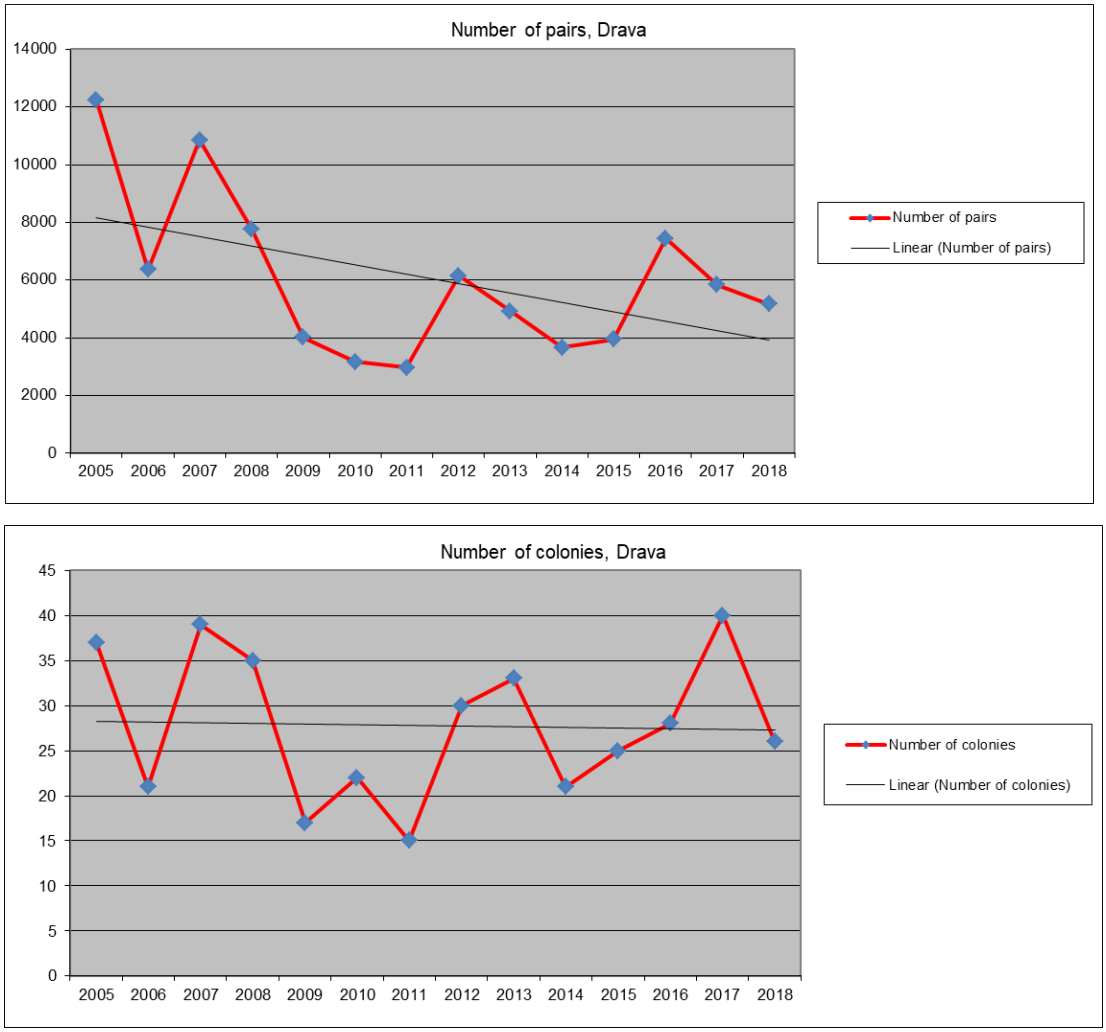


Figure 4-4: Development of Sand Martin breeding pairs (upper figure) and breeding colonies (bottom figure) along the Drava river between the Mura-Drava confluence and the Drava-Danube confluence between 2005 and 2018 (Grlica & WWF, unpublished data, 2018)

Despite the documented major habitat losses, there is evidence that river ecosystems have a strong regeneration capacity under certain conditions. Evidence for this can be seen in the consequences of a water spill from the reservoir at the hydropower dam Donja Dubrava in 1995 (SCHNEIDER-JACOBY, 1996). Since the incident happened only six years after creation of the reservoir, siltation at the bottom was minimal. Because of this, the old braided riverbed with its main and side-branches, as well as vast gravel and sand banks reappeared while the reservoir remained empty throughout the coming months of dam maintenance. Over the course of three months during spring and summer, without any flood events, the Drava regained its former dynamicity: The riverbed shifted laterally by over a hundred metres, thereby creating new open sand and gravel surfaces. Silver and Black Poplar (*Populus alba* and *Populus nigra),* the typical softwood gallery forest species, grew two me-

tres high within one summer. The unexpectedly recreated bird paradise drew many different species that had disappeared with the construction of the dam. Ornithologists and locals observed 25-30 breeding pairs of Common Tern (*Sterna hirundo*) and 12-15 pairs of Little Terns (*Sternula albifrons*) colonizing the new gravel bars and even a few individual Stone Curlew *(Burhinus oedicnemus*) joined them. Over 100 breeding pairs of Little Ringed Plover (*Charadrius dubius*) and several pairs of Sandpiper (*Actitis hypoleucos)* were observed in the area. Even long-disappeared bird species, such as the Ferruginous Duck (*Aythya nyroca*), and the Red-Crested Pochard (*Netta rufina*) were spotted. The end of the summer brought a colony of 700 Sandpipers that used the gravel bars as a resting place. Over 200 Common Tern used the area to hunt and more than 600 Wood Sandpiper *(Tringa glareola*) and 300 Common Snipe (*Gallinago gallinago*) used the muddy wetlands and braided structure of the old river as a resting and feeding place. An Osprey (*Pandion haliaetus*) used the same area as a hunting ground (SCHNEIDER-JACOBY, 1996). The event's described effects offer a clue to the biodiversity likely typical to this area before economic development began leaving its marks on the river.

Figure 4-5: Drava River east of the town of Barcs. © C. Ragger

4.2 Characteristics and current status – gravel and sand bank breeders

4.2.1 Little Tern (*Sternula albifrons*) Spec: 3[2]

Biology and main characteristics: Strongly migratory small tern which usually fishes in very shallow water. European population is estimated at 36.000-53.000 pairs, most of them breeding along the European coastlines. Only few rivers with suitable habitats have remained for this small tern species (IUCN RED LIST, 2015).

Breeding habitat: The Little Tern is a widespread but patchily distributed summer visitor to much of Europe, breeding along the coastline as well as inland, where it prefers bare or sparsely vegetated gravel- or sandbanks of large rivers. To avoid ground predators, the Little Tern prefers islands (GLUTZ VON BLOTZHEIM & BAUER, 1999, BAUER ET AL., 2012, BIRDLIFE, 2016g).

Breeding density: Usually breeds in small colonies between 2-20 (50) pairs. Distance range between nests: 3-10 metres.

General threats: Like many other gravel or sand bank breeders, loss of suitable nest sites is often caused by habitat destruction (river regulation, gravel and sand extraction, new hydropower dams) or human disturbance. Especially during breeding season, the Common Tern is vulnerable to human disturbance at breeding sites. Flooding of nest sites caused by human-induced flooding can be problematic, especially in the case of hydropeaking.

Distribution within target area: The only breeding area for Little Tern in the target area is the part of the Drava in Croatia partly bordering Hungary downstream of the Drava-Mura confluence. This approximately 50-kilometre section offers appropriate gravel and sand banks and feeding grounds. In the 1990s, between four and six breeding pairs were counted by different observers (MOHL, 2001). Currently, four to five pairs on average are breeding regularly, mostly in the company of Common Tern. For an overview of the current distribution, see chapter 11.3.1.

[2] Spec = Species of European Conservation Concern, see chapter 10

Table 4-1: Breeding pairs (country) taken from Article 12 reports except for Serbia (PUZOVIĆ et al., 2016); Red list = category according to Red List of particular country. Population trend taken from IUCN Red List of threatened species: *short-term = 2001-2012, **long-term = 1980-2012; ***in target area = according to expert assessment
TBR MDD = Planned Transboundary Biosphere Reserve "Mura-Drava-Danube": min-max number of breeding pairs between 2011-2016

Little Tern (*Sternula albifrons*)	**Breeding pairs (country)**	**National Red List**	**Population trend**		
			Short-term*	**Long-term****	**In target area*****
Austria	-	RE	-	-	Not breeding
Slovenia	35-72 (last brood in 1981)	*in progress*	increasing	increasing	Extinct – not breeding
Croatia	25-60	EN	decreasing	decreasing	Fluctuating-decreasing
Hungary	2-10	*in progress*	fluctuating	fluctuating	Fluctuating-decreasing
Serbia	25-30	EN	stable	stable	Not breeding
TBR MDD (only target area)	**0-12**	**-**	**-**		**fluctuating/decreasing**

4.2.2 Common Tern (*Sterna hirundo*) Spec: Non-spec

Biology and main characteristics: The Common Tern has a circumpolar distribution and its European population is estimated at 316.000-605.000 pairs. It is a strongly migratory bird which uses a wide variety of different habitats (IUCN RED LIST, 2015).

Breeding habitat: The species breeds on the ground in a wide variety of habitats in coastal and inland areas. It prefers open, shingle, sandy or gravel river banks or islands in lakes or rivers, which are safe from flooding (GLUTZ VON BLOTZHEIM & BAUER, 1999).

Breeding density: Breeding density ranges from a few pairs to very large colonies with up to several thousand pairs. In large colonies, Common Terns are often socialized with other terns or small gull species.

General threats: Like many other gravel or sand bank breeders, loss of proper nest sites is often caused by habitat destruction (river regulation, gravel and sand extraction, new hydropower dams) or human disturbance. Especially during breeding season, the Common Tern is vulnerable to human disturbance at breeding sites. Flooding of nest sites caused by human induced flooding can be problematic, especially in the case of hydropeaking. At some sites, vegetation overgrowth or predation from ground predators are also important concerns (GLUTZ VON BLOTZHEIM & BAUER, 1999, BAUER ET AL., 2012, BIRDLIFE, 2016f).

Distribution within target area: Drava in Croatia partly bordering Hungary downstream of the Drava-Mura confluence, mostly on the same sites along the river as the Little Tern, with which it breeds in mixed colonies. Additionally, there is a large breeding colony at Ptuj Lake in Slovenia, breeding on artificial platforms in the reservoir as well as occasionally in gravel pits or fish ponds. Numbers fluctuate over the years, with 79 breeding pairs on average. For an overview of the current distribution, see chapter 11.3.2.

Table 4-2: Breeding pairs (country) taken from Article 12 reports except for Serbia (Puzović et al., 2016) Red list = category according to Red List of particular country Population trend taken from IUCN Red List of threatened species: *short term = 2001-2012, **long term = 1980-2012; ***in target area = according to expert assessment TBR MDD = Planned Transboundary Biosphere Reserve "Mura-Drava-Danube": min-max number of breeding pairs between 2011-2016

Common Tern (*Sterna hirundo*44)	**Breeding pairs (country)**	**Red List**	**Population trend**		
			Short-term*	**Long-term****	**In target area*****
Austria	400-500	NT	increasing	increasing	not breeding
Slovenia	147-202	*in progress*	decreasing	increasing	In short term increasing
Croatia	400-700	NT	decreasing	probably increasing	decreasing
Hungary	400-1.500	*in progress*	fluctuating	fluctuating	decreasing
Serbia	216-280	VU	stable	increasing	not breeding
TBR MDD	**77-140**	-	-	-	**decreasing**

4.2.3 Common Sandpiper (*Actitis hypoleucos*) Spec 3

Biology and main characteristics: The Common Sandpiper is a widespread breeder across most of Europe. Its European population is estimated at 794.000-1.460.000 pairs, with most of the breeding population located in Russia (IUCN RED LIST, 2015).

Breeding habitat: The species breeds on the ground in a wide variety of habitats in coastal and inland areas. Inland it prefers pebbly, sandy or rocky margins of (fast-flowing) rivers. Breeding sites are often at least sparsely vegetated with pioneer vegetation.

Breeding density: During breeding season, the Common Sandpiper is territorial. Depending on the width of the riverbed, the number of territories per kilometre in middle Europe ranges from 0.5 up to 3 pairs at very near-natural rivers (GLUTZ VON BLOTZHEIM et al., 1985, BIRDLIFE, 2016a).

General threats: Main threats are habitat destructions (caused by river regulation, new hydropower dams) and human recreational activities during breeding season (BIRDLIFE, 2016a). Flooding of nest sites caused by human induced flooding can be problematic, especially in the case of hydropeaking.

Distribution within target area: Within the target area, Common Sandpipers breed at the Mura and Drava rivers. The species' distribution is restricted to dynamic and natural, more or less free-flowing sections, with islands and near-natural river banks. High breeding densities can be found at the Drava upstream of the town of Barcs, Hungary. Further downstream, natural breeding sites are restricted to a few places due to the high percentage of armoured banks. On average, 45 pairs of Common Sandpiper are breeding within target area, although breeding pair numbers within the target area fluctuate. For an overview of the current distribution, see chapter 11.3.3.

Table 4-3: Breeding pairs (country) taken from Article 12 reports except for Serbia (Puzović et al., 2016) Red list = category according to Red List of particular country Population trend taken from IUCN Red List of threatened species: *short term = 2001-2012, **long term = 1980-2012; ***in target area = according to expert assessment TBR MDD = Planned Transboundary Biosphere Reserve "Mura-Drava-Danube": min-max number of breeding pairs between 2011-2016

Common Sandpiper (*Actitis hypoleucos*)	**Breeding pairs (country)**	**Red List**	**Population trend**		
			Short-term*	**Long-term****	**In target area*****
Austria	250-350	EN	stable	unknown	unknown
Slovenia	185-300	*in progress*	decreasing	decreasing	unknown
Croatia	350-400	VU	stable	unknown	unknown
Hungary	100	*in progress*	fluctuating	unknown	unknown
Serbia	90-180	unknown	decreasing	decreasing	unknown
TBR MDD	**7-89**	-	-	-	**unknown**

4.2.4 Little Ringed Plover (*Charadrius dubius*) Spec: Non-Spec

Biology and main characteristics: The Little Ringed Plover has a wide distribution, ranging from the Palaearctic region to the Ethiopian and Oriental Regions. It is fully migrant in much of its range. Its European population is estimated at 134.000-262.000 pairs (IUCN RED LIST, 2015).

Breeding habitat: During breeding season, the Little Ringed Plover prefers bare or sparsely vegetated, sandy or pebbly shores of slow-flowing rivers and clear freshwater lakes. Additionally, this species breeds in artificial habitats such as gravel pits, industrial wastelands and fishponds. Similar to most shorebirds, the Little Ringed Plover nests on the ground. In Europe, the species prefers lowland habitats, thus it is rarely found above 800 m (GLUTZ VON BLOTZHEIM ET AL., 1999, BIRDLIFE, 2016c).

Breeding density: The Little Ringed Plover is a territorial species, with densities along rivers generally lower than one pair per kilometre. In gravel pits, densities up to one pair per ha are known.

General threats: The species is mainly threatened by the degradation and loss of its preferred habitats, e.g. because of river regulation, new hydropower dams or sediment extraction. Locally, the threat posed by recreational activities can be another main factor for the decrease of breeding population (BIRDLIFE, 2016c).

Distribution within target area: The Little Ringed Plover is widely spread throughout the target area. Due to its habitat preferences, the species is missing in those parts of the river stretch where no river islands or sparsely vegetated, sandy shores can be found. Thus, there are only a few breeding sites at the upper part of the Mura River upstream of Mursko Središće (Slovenia) and on the Drava downstream of Barcs (Hungary). This is also true for the Danube, where only few breeding sites are known. On the other hand, the most detection points are known from the Drava River in Croatia between the Mura-Drava confluence and Barcs (Hungary) or Virovitica (Croatia), respectively. Additionally, good occurrence of Little Ringed Plovers can be found at semi-natural habitats at the Drava ("Stara Drava") in Slovenia, between Maribor and the Croatian border. On average, 110 breeding pairs of Little Ringed Plover are breeding annually within target area. For an overview of the current distribution, see chapter 11.3.4.

Table 4-4: Breeding pairs (country) taken from Article 12 reports except for Serbia (PUZOVIĆ et al., 2016); Red list = category according to Red List of particular country. Population trend taken from IUCN Red List of threatened species: *short-term = 2001-2012, **long-term = 1980-2012; ***in target area = according to expert assessment
TBR MDD = Planned Transboundary Biosphere Reserve "Mura-Drava-Danube": min-max number of breeding pairs between 2011-2016

Little Ringed Plover (*Charadrius dubius*)	**Breeding pairs (country)**	**Red List**	**Population trend**		
			Short-term*	**Long-term****	**In target area*****
Austria	300-450	VU	unknown	unknown	unknown
Slovenia	300-500	*in progress*	decreasing	decreasing	increasing due to conservation measures
Croatia	> 1.000	NT	unknown	unknown	unknown
Hungary	800-1.500	*in progress*	unknown	unknown	unknown
Serbia	600-900	unknown	stable	decreasing	Unknown
TBR MDD	**29-221**	-	-	-	**unknown**

4.3 Characteristics and overview of current status – steep bank breeders

4.3.1 Common Kingfisher (*Alcedo atthis*) Spec: 3

Biology and main characteristics: The Common Kingfisher has a wide distribution, ranging from the Palaearctic region to the Oriental Region. Its European population is estimated at 97.500-167.000 pairs (IUCN RED LIST, 2015).

Breeding habitat: Due to its main prey, small fish, the species prefers standing or gently flowing water with a high amount of prey species and good visibility. The presence of branches and shrubs on the bank, used as perches for hunting, is important. For breeding, the Common Kingfisher digs burrows into steep river banks, which should be at least 50 cm deep (GLUTZ VON BLOTZHEIM & BAUER, 1980, BIRDLIFE, 2016b).

Breeding density: During breeding period, the Common Kingfisher is territorial. The number of pairs per kilometre depends on habitat suitability and width of riverbed.

General threats: Especially in northern populations, one of the most significant threats to this species is hard winters. Chemical and biological river pollution as well as canalization of streams and of vegetation clearing were found to be further main threats.(BIRDLIFE, 2016b).

Distribution within target area: The Common Kingfisher is the only species treated in this action plan more or less evenly distributed all over the target area, missing only at the large reservoirs in Slovenia and Croatia (however, it is present on the old riverbed next to the reservoirs). Breeding pair density is lower downstream of Barcs (Hungary). At the Danube, breeding density is very low, caused by a lack of suitable breeding habitats (steep banks). Estimates of breeding numbers within the target area range from 58 to 292 pairs. For an overview of the current distribution, see chapter 11.3.5.

Table 4-5: Breeding pairs (country) taken from Article 12 reports except for Serbia (PUZOVIĆ et al., 2016); Red list = category according to Red List of particular country. Population trend taken from IUCN Red List of threatened species: *short-term = 2001-2012, **long-term = 1980-2012; ***in target area = according to expert assessment
TBR MDD = Planned Transboundary Biosphere Reserve "Mura-Drava-Danube": min-max number of breeding pairs between 2011-2016

Common Kingfisher (*Alcedo atthis*)	**Breeding pairs (country)**	**Red List**	**Population trend**		
			Short-term*	**Long-term****	**In target area*****
Austria	350-550	NT	stable	unknown	unknown
Slovenia	200-300	*in progress*	decreasing	decreasing	unknown
Croatia	700-1.000	NT	fluctuating	stable	unknown
Hungary	600	*in progress*	unknown	unknown	unknown
Serbia	2.400-3.500	unknown	stable	stable	unknown
TBR MDD	**58-292**	-	-	-	**unknown**

4.3.2 Sand Martin (*Riparia riparia*) Spec 3

Biology and main characteristics: The Sand Martin has an almost worldwide distribution, only missing in Australia. Its European population is estimated at 3.640.000-8.000.000 pairs (IUCN Red List, 2015).

Breeding habitat: The Sand Martin breeds in colonies in steep banks of rivers, streams, lakes and coastal cliffs. Periodical erosion at these sites is crucial as birds prefer to have new nesting holes every year due to parasite accumulation. Besides natural breeding sites, the Sand Martin also uses artificial habitats including roads cutting into the landsca, excavation sites or gravel pits (GLUTZ VON BLOTZHEIM & BAUER, 1985, BIRDLIFE, 2016e).

Breeding density: The size of colonies varies from between 20 to 40 breeding pairs up to several thousand. Most of the inland colonies consist of 50 to 200 breeding pairs.

General threats: Loss of breeding sites due to human activities, including river regulation, is the most important threat. The use of pesticides can lead to a loss of prey species, such as insects (BIRDLIFE, 2016e).

Distribution within target area: Generally, Sand Martin colonies are widespread in the target area. However, the location of colonies as well as the number of breeding pairs vary strongly from year to year. Additionally, colonies are often found in steep banks of gravel pits or fish ponds outside the target area. Important areas for Sand Martin within the target area are located on the Upper Drava section in Croatia downstream of its confluence with the Mura, with a lower bound at the village of Repaš. Some important breeding sites can also be found further downstream, for instance between the villages Heresznye and Barcs (Hungary), as well as between Donji Miholjac and Osijek (Croatia). Around Libanovec (Croatia), annual monitoring data gathered by the WWF puts the current population of the Sand Martin at 1.100 breeding pairs, making it one of the biggest Sand Martin breeding colonies of the Drava. Some breeding colonies can also be found at the Danube. Due to the fluctuation in colony size over the observation period, the average numbers of breeding pairs are difficult to estimate. Thus, estimates for the target area range from 3.900 to over 13.300 breeding pairs. For an overview of the current distribution, see chapter 11.3.6.

Table 4-6: Breeding pairs (country) taken from Article 12 reports except for Serbia (PUZOVIĆ et al., 2016); Red list = category according to Red List of particular country. Population trend taken from IUCN Red List of threatened species: *short-term = 2001-2012, **long-term = 1980-2012; ***in target area = according to expert assessment
TBR MDD = Planned Transboundary Biosphere Reserve "Mura-Drava-Danube": min-max number of breeding pairs between 2011-2016

Sand Martin (*Riparia riparia*)	**Breeding pairs (country)**	**Red List**	**Population trend**		
			Short-term*	**Long-term****	**In target area*****
Austria	6.000-9.000	NT	decreasing	unknown	unknown
Slovenia	500-2.000	*in progress*	fluctuating	unknown	unknown
Croatia	5.000-8.000	VU	decreasing	decreasing	decreasing
Hungary	15.000-50.000	*in progress*	decreasing	decreasing	unknown
Serbia	38.000-46.000	unknown	decreasing	decreasing	unknown
TBR MDD	**3.972-13.315**	-	-	-	**decreasing**

4.3.3 European Bee-Eater (*Merops apiaster*) Spec: Non-spec

Biology and main characteristics: European population estimated at 2.800.000-5.050.000 pairs (IUCN RED LIST, 2015). In Europe it is a strongly migratory bird which winters almost entirely within Africa.

European population trend: Short-term (2000-2012) population trend is stable.

Breeding habitat: During breeding season, the European Bee-Eater inhabits a wide variety of sun-exposed habitats, ranging from broad river valleys to cultivated land, meadows and plains. Due to its diet of mainly Hymenoptera, a rich supply of these insects is necessary. Insects are often hunted in flight or from perches. It breeds in burrows mostly dug into the soil (GLUTZ VON BLOTZHEIM & BAUER, 1980, BIRDLIFE, 2016d).

Breeding density: Breeding density depends on quality and size of cliffs and reaches from single breeding pairs to large colonies.

General threats: Main threats are the loss of breeding habitats along rivers due to river regulation and the decrease of Hymenoptera populations due to wide-spread pesticide use. Additionally, large numbers are shot and killed during migration in the Mediterranean Region (BIRDLIFE, 2016d).

Distribution within target area: Like most of the other target species, the distribution of the European Bee-Eater within the target area is very wide, with known breeding sites along all three rivers. Due to similar breeding site requirements, it can often be found near or even within Sand Martin colonies. However, there are fewer breeding sites of the European Bee-Eater along the rivers than those of Sand Martin. Most of these can be found along the Drava River in Croatia, at the river stretch between the Mura-Drava confluence and Donji Miholjac. As the European Bee-Eater also uses steep banks in gravel pits as well as loess hills along the Danube for nesting, colonies are often situated outside the target area. On average, 420 European Bee-Eater breeding pairs per year were counted during the survey period. For an overview of the current distribution, see chapter 11.3.7.

Table 4-7: Breeding pairs (country) taken from Article 12 reports except for Serbia (PUZOVIĆ et al., 2016); Red list = category according to Red List of particular country. Population trend taken from IUCN Red List of threatened species: *short-term = 2001-2012, **long-term = 1980-2012; ***in target area = according to expert assessment
TBR MDD = Planned Transboundary Biosphere Reserve "Mura-Drava-Danube": min-max number of breeding pairs between 2011-2016

European Bee-Eater (*Merops apiaster*)	Breeding pairs (country)	Red List	Population trend		
			Short-term*	Long-term**	In target area***
Austria	1.000-1.100	NT	increasing	increasing	unknown
Slovenia	45-80	*in progress*	increasing	unknown	unknown
Croatia	5.000-10.000	LC	unknown	unknown	unknown
Hungary	17.000-24.000	*in progress*	stable	unknown	unknown
Serbia	5.600-7.400	unknown	increasing	increasing	unknown
TBR MDD	**277-696**	-	-	-	**unknown/increasing**

4.4 Distribution and breeding numbers of the target species within river sections

The means of breeding pairs per bird species (based on expert estimations) in the TBR are listed in the following table.

Table 4-8: Mean numbers of breeding pairs (bp) between 2011 and 2016. Numbers are based on expert observations and estimates. Minima and maxima are also included to illustrate the range of variation.

River bird species	Mean bp (2011-2016)	Minimum bp (2011-2016)	Maximum bp (2011-2016)
Little Tern *(Sternula albifrons)*	**5**	0	12
Common Tern *(Sterna hirundo)*	**79**	77	140
Common Sandpiper *(Actitis hypoleucos)*	**45**	7	89
Little Ringed Plover *(Charadrius dubius)*	**110**	29	221
Common Kingfisher *(Alcedo atthis)*	**135**	58	292
Sand Martin *(Riparia riparia)*	**7.220**	3.972	13.315
European Bee-Eater *(Merops apiaster)*	**420**	277	696

Table 4-9: Calculated means from expert observations and estimates (2011-2016) of river bird species per section
! = 25-50 % of total TBR population are breeding in this section
!! = 50-75 % of total TBR population are breeding in this section
!!! = 75-100 % of total TBR population are breeding in this section
*= on breeding platform

River section	River	Gravel/Sand bank breeders		Steep bank breeders	
River section 1 (83 km)	Mura	Little Tern	**0**	Common Kingfisher	**5**
		Common Tern	**0**	Sand Martin	**15**
		Common Sandpiper	**4**	European Bee-Eater	**0**
		Little Ringed Plover	**9**		
River section 2 (19 km)	Mura	Little Tern	**0**	Common Kingfisher	**5**
		Common Tern	**0**	Sand Martin	**177**
		Common Sandpiper	**3**	European Bee-Eater	**0**
		Little Ringed Plover	**2**		
River section 3 (30 km)	Mura	Little Tern	**0**	Common Kingfisher	**3**
		Common Tern	**0**	Sand Martin	**27**
		Common Sandpiper	**7**	European Bee-Eater	**0**
		Little Ringed Plover	**3**		
River section 4 (133 km)	Drava	Little Tern	**0**	Common Kingfisher	**20**
		Common Tern	**64**	Sand Martin	**784**
		Common Sandpiper	**21**	European Bee-Eater	**0**
		Little Ringed Plover	**58**		
River section 4 a (near natural-70 km)	Drava	Little Tern	**0**	Common Kingfisher	**20**
		Common Tern	**0**	Sand Martin	**784**
		Common Sandpiper	**21!**	European Bee-Eater	**0**
		Little Ringed Plover	**58!!**		

River section 4 b (regulated – 24 km)	Drava	Little Tern	**0**	Common Kingfisher	**0**
		Common Tern	**0**	Sand Martin	**0**
		Common Sandpiper	**0**	European Bee-Eater	**0**
		Little Ringed Plover	**0**		
River section 4 c (artificial – 107 km)	Drava	Little Tern	**0**	Common Kingfisher	**0**
		Common Tern	**64!!!***	Sand Martin	**0**
		Common Sandpiper	**0**	European Bee-Eater	**0**
		Little Ringed Plover	**0**		
River section 5 (78 km)	Mu-ra/Drava	Little Tern	**5!!!**	Common Kingfisher	**40!**
		Common Tern	**8**	Sand Martin	**3.971!!**
		Common Sandpiper	**10**	European Bee-Eater	**108!**
		Little Ringed Plover	**28!**		
River section 6 (31.5 km)	Drava	Little Tern	**0**	Common Kingfisher	**3**
		Common Tern	**0**	Sand Martin	**2**
		Common Sandpiper	**0**	European Bee-Eater	**6**
		Little Ringed Plover	**0**		
River section 7 (50 km)	Drava	Little Tern	**0**	Common Kingfisher	**22**
		Common Tern	**7**	Sand Martin	**245**
		Common Sandpiper	**0**	European Bee-Eater	**87**
		Little Ringed Plover	**3**		
River section 8 (38 km)	Drava	Little Tern	**0**	Common Kingfisher	**14**
		Common Tern	**0**	Sand Martin	**1255**
		Common Sandpiper	**0**	European Bee-Eater	**0**
		Little Ringed Plover	**0**		
River section 9 (20.5 km)	Drava	Little Tern	**0**	Common Kingfisher	**4**
		Common Tern	**0**	Sand Martin	**0**
		Common Sandpiper	**0**	European Bee-Eater	**0**
		Little Ringed Plover	**0**		
River section 10 (100 km)	Danube	Little Tern	**0**	Common Kingfisher	**0**
		Common Tern	**0**	Sand Martin	**130**
		Common Sandpiper	**0**	European Bee-Eater	**60**
		Little Ringed Plover	**7**		
River section 11 (113 km)	Danube	Little Tern	**0**	Common Kingfisher	**16**
		Common Tern	**0**	Sand Martin	**614**
		Common Sandpiper	**0**	European Bee-Eater	**159!**
		Little Ringed Plover	**0**		

5 Main threats to targeted river birds

The following chapters describe the main threats to key river bird species. The threat listing is based on the literature and specific local information provided by experts and participants during workshops.

5.1 Threat 1: Lack of transboundary cooperation and harmonisation

The planned TBR MDD stretches across parts of five different countries. Since the Mura, Drava and Danube mark country borders in parts their length within the target area, political and practical cross-border cooperation and coordination is inevitable where conservation is concerned. However, mainly due to their political, but also their cultural and economic diversity, transnational exchange between these countries has been hampered for decades. While bird species are highly mobile and oblivious of national borders, no joint bird species protection strategy for target area exists to this day. Advances in protection measures are uneven across borders, which led to measures conflicting in some situations. For instance, restoration measures to create gravel banks and other habitats on one bank is at cross-purposes with sand and gravel extraction destroying the same habitats on the other side. In these cases, the restoration efforts must fail and there cannot be any positive impact on the targeted species. Meanwhile, four of the five countries are members of the European Union, which provides a framework of several directives and conventions for nature and species protection to be implemented in each country's legal system. The present action plan and its participative elaboration process aim improve transboundary cooperation within the TBR MDD and to steer the countries of the target area towards a more well-integrated implementation of the EU Water Framework, Habitats and Birds Directives.

5.2 Threat 2: Hydropower plants

Today, five hydropower plants are situated on the main course of the Drava within the target area in Croatia and Slovenia. Their effect cumulates with that of the chain of HPPs existing upstream on the Mura, Drava and their tributaries. In general, hydropower plants can have a massive impact on the river itself as well as on the surrounding habitats and their species. Aside from direct habitat loss due to the construction and the area of the flooded reservoir, hydropower plants change the hydrology, sediment regime and the longitudinal connectivity of a river.

The umbrella term and main threat "hydropower plants" encompasses several *sub-threats*, defined in the following sections.

5.2.1 Sub-threat 2.1: Plans for new hydropower plants

Apart from the existing hydropower plants, there are further plans for hydropower plants within the TBR (e.g. Molve 1 and Molve 2 on the Drava in Croatia, 8 planned hydropower dams along the Mura in Slovenia and Austria). The realisation of new hydropower plants is a main threat which will probably lead to the extinction of certain bird species such as the Little Tern.

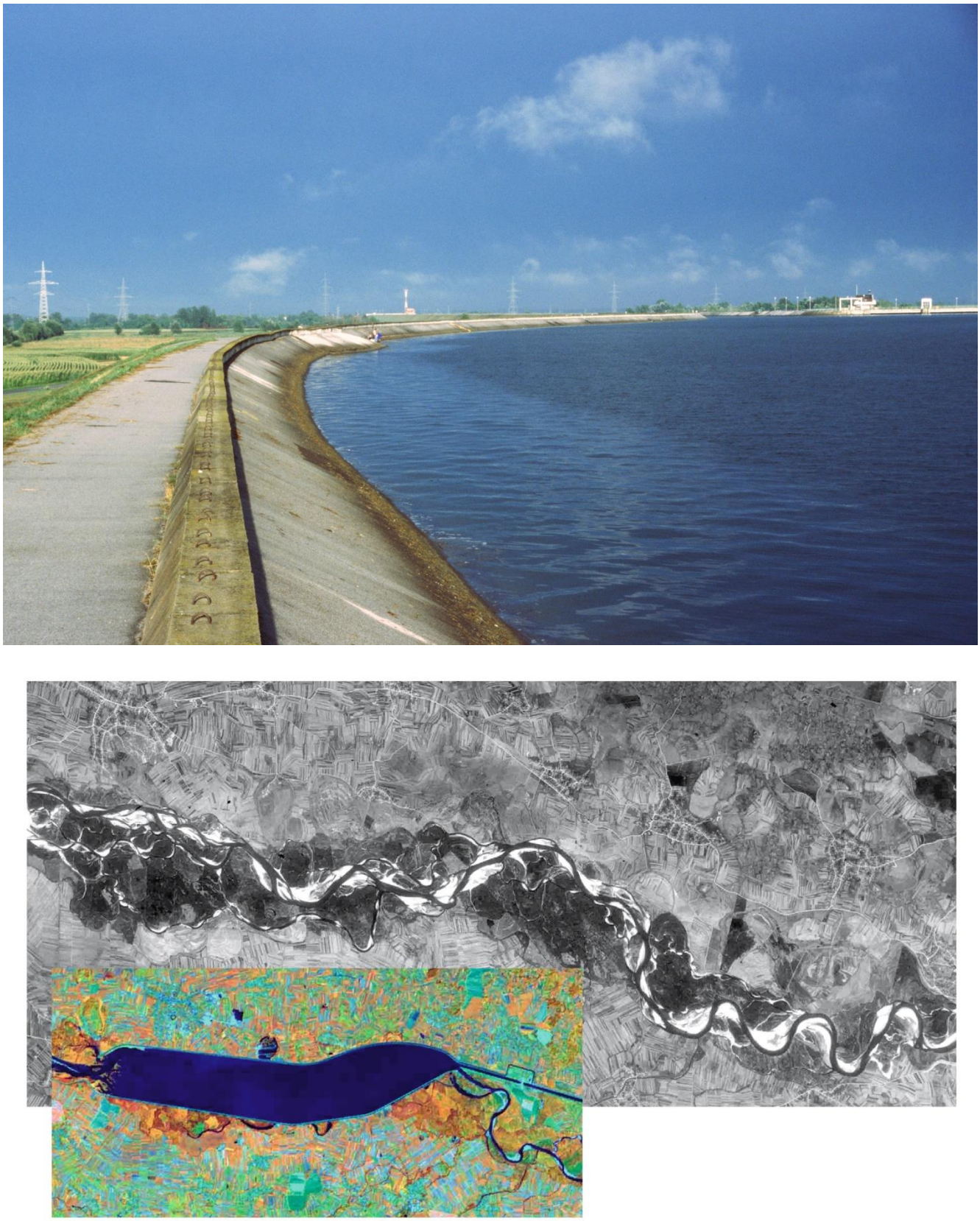


Figure 5-1: The former natural Drava with gravel banks and side branches at Donja Dubrava in Croatia. Such habitats were still present in this section until the 1990s. They hosted ideal habitats for river birds, until they were flooded by a new hydropower dam © A. Mohl, WWF Austria/ 1968 USGS, Google Earth

5.2.2 Sub-threat 2.2: Hydropeaking along free-flowing Drava

Hydropeaking changes the natural discharge of a river. Dams, for instance, are obstacles for longitudinal exchanges along fluvial ecosystems (McCartney, 2009). In addition, the downstream reach experiences a pulsating flow, depending on the intensity of hydropower generation (Byungwoong & Sung-Uk, 2018). These changes have direct and indirect effects on the distribution of species in general as well as on bird species in particular. Species that depend on a highly dynamic, natural flow generally suffer most from the downstream effects of hydropower plants. This is because flow regulation leads to a decrease in the magnitude of flood peaks during a year and an increase in low flows (McCartney, 2009). Rapid fluctuations of downstream water levels can occur several times a day, leading to habitat loss. For example, gravel or sand banks and islands are flooded during the breeding season and are thus no longer suitable habitats for breeding birds. Furthermore, hydropeaking causes an unnatural form of sediment transport. There are several further impacts of hydropeaking on the river ecosystem: For instance, they may clog of the river bed (Korber & Unterlercher, 2012).

Figure 5-2: Daily artificial water level fluctuations caused by upstream hydropower dams, flooding gravel banks and threating breeding bird species. © A. Mohl

Figure 5-3: Drying out of Drava side branch due to peak operation of upstream hydropower dams © A. Mohl

5.2.3 Sub-threat 2.3: Interrupted sediment transport

Dams interrupt sediment transport, which has impacts on the downstream ecosystems. Two of these impacts are relevant for river bird species. First, the reduction of sediment load leads to an increased erosion of the riverbed, resulting in riverbed deepening and thus habitat loss for river bird species. The lack of natural sediment transport significantly reduces the dynamics of a river system. Dynamic processes such as the creation and erosion of gravel banks or the natural erosion and sedimentation along river banks are strongly dependent on natural bedload transport conditions. Second, to reduce sedimentation in reservoirs, they are flushed regularly, leading to unnaturally high concentrations of fine sediments in downstream riverine systems (McCartney, 2009). This high amount of fine sediments covers gravel- and sand-banks, leading to habitat degradation for river bird species that depend on these gravel banks or islands.

5.2.4 Sub-threat 2.4: Water diversion at reservoirs

The natural hydrology is negatively influenced by the diversion of water. Water diversion leads to two completely different flow stretches: The water used for hydroelectric production is separated from the natural river bed, running within a completely artificial flow stretch with concrete dams, i.e. a *tailrace canal*. This artificial flow stretch is, in general, not a suitable habitat for river bird species. At the same time, the annual discharge of the old, natural riverbed is severely reduced (Nilsson & Dynesius, 1994). This residual flow section faces several problems: lack of water leads to uniform hydrologic conditions, a low flow state and, consequently, low dynamicity over long periods for most of the year. Floods are usually also diverted into the natural river bed. During these periods, high amounts of bed load are deposited in the residual flow stretch. Due to the lack of medium high water, these deposited sediments remain in place, becoming stable islands and gravel

banks, covered with vegetation within a few years. In this way, these areas quickly lose their suitability as breeding habitats for open gravel and sandbank breeders such as the Little Ringed Plover or the Little Tern.

5.3 Threat 3: River regulation

River regulation has wide-ranging effects on river bird species, the TBR not excepted. The umbrella term and main threat “river regulation” encompasses several *sub-threats*, defined in the following sections.

5.3.1 Sub-threat 3.1: River training structures (embankments, groins, traverses, rip-rap, etc.)

River training structures mainly serve the aims flood protection and erosion prevention. This reduces lateral erosion and leads to a channelling of the water course, as compared to the natural condition. Due to the lack of space, erosion and sedimentation zones in the river bed are lost, whereas rip-rap bank protections prevent natural erosion and cause the gradual disappearance of steep banks. Because of this loss of natural habitats, gravel and sand bank breeders as well as steep bank breeders are lost.

Figure 5-4: Embankment destroys steep banks for Sand Martin and Kingfisher © A. Mohl

Figure 5-5: A new embankment on the lower Drava River has destroyed one of the largest Sand Martin colonies in the target area. © D. Grlica

5.3.2 Sub-threat 3.2: Straightening of river course and disconnection of side branch systems (incl. floodplain)

For flood protection and land reclamation, side channels have been disconnected from the main river course, severely impacting the river morphology and ecology itself as well as on the wider river ecosystem, including the floodplains. In addition, straight stretches mostly develop few morphologic structures, such as cut banks and slip-off banks, scours and gravel banks. The effect is that of riverbed incision, whereas the cut-off side channels' bottom does not erode to the same extent or at all, due to low water levels. This leads to further disconnection of the side channels from the river bed, even during floods. This in turn changes the vegetation of gallery forests, wetlands and meadows along the side channel: Water-loving plants are replaced by more dryness-resistant plant species, softwood gallery forests are replaced by hardwood forests.

5.3.3 Sub-threat 3.3: Sediment extraction

Natural sediment transport is one of the key elements of dynamic riverine systems. Gravel- and sand extraction from the river bed as well as from gravel and sand banks leads to a loss of sediment and thus to habitat loss for breeding birds relying on gravel and sand banks. Without sufficient sediment supply from upstream, dynamic processes in the river are significantly less powerful. Stretches with a lack of sediment input tend to undergo a gradual stabilization of morphodynamic processes and incision of the river bed and consequently a change from a multi- to a uniform channel system.

Figure 5-6: Gravel extraction contributes to sediment deficit and habitat loss at the Drava © A. Mohl

5.4 Threat 4: Recreational use (e.g. swimming, hiking/cycling/quad-driving/holiday houses/boating etc.)

This threat includes all disturbances due to human recreational activities. Leisure activities and outdoor recreation have a range of negative effects on several different kinds of bird species. Effects are reaching from physiological to immediate behavioural responses (STEVEN ET AL., 2011, MOSS ET AL., 2014). This can have severe consequences for the breeding success or the survival of the species, depending on the duration, intensity and periodicity of disturbances (review by STEVEN, 2011). Recreational uses like swimming, boating or barbecuing are a major problem in the breeding season from March to July, the most sensitive time of the year for river bird species. Along the river sections of the Mura, Drava and Danube within the TBR, recreational use has been concentrated in single areas so far, where locals use river banks or islands for leisure activities. However, many communities and regions seek to increase tourism by offering varied outdoor activities. It is expected that tourism and recreational use will increase along the Mura, Drava and Danube in the near future, increasing the potential of disturbance for sensitive breeding bird species.

Figure 5-7: Unregulated recreation on the Drava River can threaten the breeding success of river birds during breeding season © A. Mohl

5.5 Threat 5: Additional threats including agriculture, fishing and navigation

There are several other threats besides those described above which can have severe impacts on river bird species. Disturbance by fishermen on gravel and sand banks can have a negative impact on the breeding success. Concerning agriculture, intensive herbicide and pesticide use reduces the numbers and diversity of insects, causing a decline in bird species feeding on them. Spraying against mosquitos, as is done at the lower Drava during breeding season, substantially reduces food availability, for instance for the Sand Martin. The conversion of meadows into arable fields leads to an additional decrease of insect biomass.

The maintenance of navigation routes during the breeding period can also have negative effects on breeding birds. Within the target area this threat is restricted to navigable sections of the Drava (only between Osijek and Danube mouth) and Danube.

6 Goal and objectives for targeted river birds

6.1 Goal

Despite the construction of hydropower plants and increasing human utilization, large stretches along the three rivers are still very close to a natural state and thus of very high importance for river bird species. Furthermore, through the connection of Natura 2000 sites, the Mura, Drava and Danube region serves as an im-

portant ecosystem for river bird species (see also chapter 4). The main goal of the Action plan for river birds is the long-term conservation of the seven targeted species within the TBR Mura-Drava-Danube. This means that especially for Little Tern, Common Tern and Sand Martin, population increases are important to ensure their survival in this area. In several regions, a population increase should also be the goal for the two characteristic species of dynamic river systems, the Common Sandpiper and Little Ringed Plover, and beyond these also for the Kingfisher and European Bee-Eater. These goals can be attained by the preservation of existing habitats and by restoration of degraded river stretches. The restoration potential along the three rivers is very high. According to a study commissioned by WWF Austria, about 650 km of river banks could be restored, about 120 major side-channels with a length of 519 km could be reconnected to the rivers and about 165.318 ha of new floodplains areas could be created (FLUVIUS, 2013). As river bird species are good indicators of a dynamic river landscape, many other species also will benefit from measures aiming for their protection.

6.2 Objectives

Based on the threats listed in chapter 5, an objective has been developed for every threat and sub-threat, 10 in total. This chapter describes these.

6.2.1 Objective 1: Enhancing transboundary cooperation and establishing an ornithological expert network for the whole TBR MDD

One important goal is to increase the – currently lacking – transboundary cooperation between ornithology experts across all five countries for the TBR. Enhanced cooperation and collaboration between the five countries of the TBR can be achieved in several ways. One of the most important actions will be the establishment of a transboundary river bird working group. This working group should meet regularly to discuss and perform joint monitoring programs, maintain a transboundary database, oversee the implementation of bird protection measures, etc.

6.2.2 Objective 2: Prevent any new hydropower plants

As hydropower plants have a vastly negative impact on riverine ecosystems, including river birds, one important objective is to prevent any new plant within TBR. This can be achieved, for instance, by designating free-flowing stretches as “no-go” areas for new plants.

6.2.3 Objective 3:Reducing the impact of hydropeaking downstream of the hydropower plant “Donja Dubrava”

As shown above in chapter 5, hydropeaking is one of the most severe threats to river bird species downstream of hydropower plants. Due to several technical constraints, solutions for alleviating the impact of hydropeaking are limited and site-specific. Thus, in a first step, studies on possible measures for a reduction or even stopping of hydropeaking should be elaborated.

6.2.4 Objective 4: Enabling natural sediment transport downstream of all existing hydropower plants in Austria, Slovenia and Croatia

Sediment transport is a crucial factor in riverine ecosystem and the establishment of habitats for river bird species. Due to hydropower plants and river training structures, sediment transport (gravel and sand) along Drava, Mura and Danube within TBR is disturbed and, in sub-sections, far from natural. Developing measures

to improve and establish natural sediment transport is a crucial objective of this action plan throughout the entire Drava basin.

6.2.5 Objective 5: Restoring residual flow stretches ("Stara Drava") at reservoirs

Residual flow stretches of Drava River, the so called "Stara Drava", suffer from the low water flow from reservoirs. To maintain at least near-natural habitats for river bird species at residual flows, the minimum flow should be increased, mimicking a natural hydrological cycle. Additionally, solutions to enhance natural dynamics within residual flows should be developed.

6.2.6 Objective 6: Free-flowing rivers without training structures

Restoring and preserving free-flowing river stretches within TBR is one of the main conservation goals. There will be several options for restoration measures and their implementation. It would, for instance, be possible to purchase land where restoration measures can be planned and realized.

6.2.7 Objective 7: Increasing meander capacity

Related to decreasing river regulation is the objective to increase the meandering capacity of the three rivers within TBR. Possible measures for this objective would be: relocation of dykes, removal of existing river training structures and embankments, restoration of tributaries or the creation of initial channels.

6.2.8 Objective 8: To prevent sediment removal from the river system

As mentioned above, natural sediment transport is a key factor for riverine ecosystem. Beside measures which increase natural sediment input into the river (e.g. enabling lateral erosion), no extraction of sediments (gravel and sand) is to be allowed.

6.2.9 Objective 9: Reducing the impact of human disturbance due to recreational activities along the river

At least at some parts along the rivers, recreational activities can have a severe negative impact on river bird species. There are several options to reduce it. One very important measure is raising the awareness of visitors and local people. Increasing the awareness and knowledge concerning Natura 2000 and nature conservation enables local people and visitors to better understand and respect nature protection's intentions and measures. At very sensitive areas, temporary visitor restrictions and proper visitor management will be necessary, too.

6.2.10 Objective 10: Reduce the impact of several other anthropogenic influences

Beside recreational activities, there are several other negative anthropogenic influences on the rivers which are to be minimized. It is important to reduce agricultural herbicide and pesticide use, but also, for instance the removal of existing illegally built fishing huts.

7 Actions required for achieving the goal and objectives

Referring to the threats listed in chapter 5, the following tables show the actions required for the objectives listed in chapter 6 and the main goal of the action plan, respectively. For a better overview, threats and objectives are listed again.

7.1 Threat 1: Lack of transboundary cooperation and harmonisation

Table 7-1: List of all suggested actions; **Priority:** red = very high, orange = high, yellow = medium; **timeframe:** short = completed within 3 years, medium = completed within 5 years, long = completed within 10 years; permanent = continuous implementation;

Objective 1: Enhancing transboundary cooperation and establishing an ornithological expert network for the whole TBR MDD							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
Action 1: Establish transboundary river bird working group	A TBR MDD-wide working group is a necessary basis for cross-border cooperation and international conservation activities	TBR	All species	Very high	short	TBR MDD-wide river bird working group is established; minutes of regular meetings of TBR MDD-wide river bird working group (at least once per year) available	Protected area managers, NGOs (BirdLife, WWF, etc.)
Action 2: Conduct transboundary monitoring program on a regular basis	Standardized and regularly conducted, TBR-wide monitoring program for river bird species are a crucial basis for all further conservation activities	TBR	All species	Very high	short	Monitoring reports published	Financing: TBR governments; Execution of monitoring programmes: national NGOs (WWF, BirdLife, etc.)
Action 3: Establish and maintain a transboundary data-	Archiving and exchanging data in a common database guarantees	TBR	All species	Medium	medium	Cross-border database established and regularly	River bird working group

Objective 1: Enhancing transboundary cooperation and establishing an ornithological expert network for the whole TBR MDD							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
base	international monitoring, research and conservation activities					updated with new data	
Action 4: Evaluate implemented measures for river birds	Evaluation of already conducted measures to gain state-of-the-art knowledge for future measures	TBR	All species	Medium	medium	Published evaluation report	National NGOs (WWF, BirdLife, etc.), river bird working group
Action 5: Implement EU-directives (e.g. Habitats and Birds Directive, Water Framework Directive) and conventions (e.g. Ramsar Convention, Convention on the Conservation of Migratory Species, etc.)	Implementation of existing EU-directives, regulations and international conventions are legal basis for all actions	TBR	All species	High	medium	Obligatory monitoring programs of EU directives and international conventions implemented, monitoring reports confirm successful implementation	TBR governments;
Action 6: Elaborate a joint and harmonised "river management and development concept" (as a vision and operational)	River development concepts serve as baseline for implementation of future harmonised management measures and integrate all four relevant EU-directives (Habitats, Birds, Water Framework and Floods Directives)	TBR	All species	Medium	long	Published concept report	Water management authorities, Protected area managers, NGOs (WWF, BirdLife, etc.);

7.2 Threat 2: Hydropower plants

7.2.1 Sub-threat: Plans for new hydropower plants

Objective 2: **Prevent any new hydropower plants**							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
Action 7: Stop planned hydro-power plant projects on Mura and Drava Rivers	To prevent further habitat loss for river bird species, no new hydro-power plants should be built.	TBR	All species	Very high	permanent	No plans for new hydro-power plants authorized by national governments	TBR governments
Action 8: Designate the free-flowing stretches along Mura, Drava and Danube as "no-go" areas for new hydropower dams.	To preserve free-flowing stretches along the three main rivers within TBR for the next generations, legally designated "no-go" areas help to preserve free-flowing stretches with-in TBR and must be designated with appropriate legal anchoring.	TBR	All species	Very high	short	Legal document; Official signing and commitment to free-flowing river stretches	TBR governments, EU, NGOs

7.2.2 Sub-threat: Hydropeaking along free-flowing Drava

Objective 3: Reducing the impact of hydropeaking downstream of hydropower plant "Dubrava"							
Action Nr.	Rationale	Geographical	Relevant	Priority	Timeframe	Indicator(s) of success	Action mainly addressed

		scope	species				to/responsibility
Action 9: Prepare a feasibility study to define measures for a reduction or removal of the impact of hydropeaking from of hydropower dams in free-flowing river stretches	Hydropeaking is a major problem not only for fish populations but for gravel-, or sand bank breeding bird species as well. The artificial flow regime negatively impacts natural breeding habitats. Options to reduce or even stop hydropeaking should be developed and elaborated.	River sections 4 and 5	All species, but particularly gravel and sand bank breeders	High	medium	Publication of feasibility-study	Operators of hydropower plants in cooperation with research institutes (e.g. universities)
Action 10: Implement measures to reduce or remove the impact of hydropeaking in free-flowing stretches.	Measures to reduce or even stop hydropeaking help to preserve habitats for river birds.	River sections 4 and 5	All species, but particularly gravel and sand bank breeders	High	medium	Water-hydrographs do not show peak flow anymore	Operators of hydropower plants

7.2.3 Sub-threat: Interrupted sediment transport

Objective 4: Enabling natural sediment transport downstream of all existing hydropower plants in Austria, Slovenia and Croatia							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
Action 11: Prepare a study on methods to enable sediment transport through the chain of HPPs within the Drava River Basin	Lack of sediments due to deposition in hydropower dams is a key reason for riverbed degradation of free-flowing river sections. Increase of sediment input into free-flowing sections through the mobilization of sediments in the catchment area and transport through the reservoirs is key for improved hydromorphodynamics and forming of new gravel and steep river banks. The study should suggest possible measures for enabling sediment transport and regular monitoring of sediment transport along the rivers.	River sections 1 and 5	All species, but particularly gravel and sand bank breeders	Medium	long	Study published	Operator of hydropower plants, in cooperation with research institutes (e.g. universities)
Action 12: Improve gravel transport on the full length of river and through the chain of hydropower plants in the Drava River Basin	Measures to enable gravel transport and input are crucial for occurrence of gravel and steep river banks.	River sections 1 and 5	All species, in particular gravel and sand bank breeders	Medium	long	Implemented measures and published monitoring reports	Operators of hydropower plants
Action 13: Prepare a study for	Fine sediments cover islands and banks and can prevent the	River sections 1 and 4	All species, in particular	Very high	medium	Study published	Operator of hydropower plants in

ecological flushing of fine sediments from reservoirs	growth of plants. There are several options for ecological flushing of a reservoir.		gravel and sand bank breeders				cooperation with research institutes (e.g. universities)
Action 14: Implementation of measures for ecological flushing of fine reservoir sediments	Fine sediments can prevent the growth of plants on islands. According to the study, measures for ecological flushing of reservoir should be implemented	River sections 1 and 4	All species, in particular gravel and sand bank breeders	Very high	medium	Implemented measures and published monitoring reports	Operators of hydropower plants

7.2.4 Sub-threat: Water diversion at reservoirs

Objective 5: Restoring residual flow stretches ("Stara Drava") at reservoirs							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
Action 15: Prepare a study to define measures for increasing minimum flow at residual flow stretches ("Stara Drava") (→"environmental flow")	The water discharge at residual flow stretches is crucial for development of dynamic habitats for river bird species. Preparing a study where possibilities are shown would be the first step.	River section 4	All species, in particular gravel and sand bank breeders	Very high	medium	Study published	Operator of hydropower plants in cooperation with research institute (e.g. university)
Action 16: Increase the minimum flow and promote natural hydrodynamic at residual flow stretches ("Stara Drava")	Raising the minimal flow and promoting of natural dynamic at residual flow stretches is crucial for development of dynamic habitats for river bird species.	River section 4	All species, in particular gravel and sand bank breeders	Very high	long	Independent confirmation of increased minimum flow at Stara Drava	Operator of hydropower plants

7.3 Threat 3: River regulation

7.3.1 Sub-threat: River training structures (building of embankments, groynes, traverses, rip-raps etc.)

Objective 6: Free-flowing rivers without training structures							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
Action 17: Avoid new river training structures within the flood protection dikes and natural terraces	The avoidance of building of further river training structures will preserve existing important habitats for river birds.	TBR	All species	Very high	permanent	Published monitoring report on decrease of numbers of river training structures within TBR; legal documents	Water management authorities
Action 18: Wherever possible, no maintenance or removal of old river training structures	This cost-saving method leads to self-restoration of formerly regulated river stretches	TBR	All species	High	permanent	Published monitoring report on decrease of numbers of river training structures within TBR; legal documents	Water management authorities
Action 19: Where possible, remove embankments	Lateral erosion is one of the key factors concerning mobilisation of sediments improving river dynamics. Apart from protection measures for dikes, roads and other critical infrastructure, embankments should be removed to support lateral erosion processes.	TBR	All species, in particular steep bank breeders	Very high	long	Published project report on decrease of total length of embankments	Water management authorities
Action 20: Plan and implement river restoration projects	Implementation of river restoration measures will have several positive effects on river	TBR	All species	High	long	Published project reports on possible river restoration measures and reports	TBR governments, Water management authorities,

Objective 6: Free-flowing rivers without training structures							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
	bird species.					with implemented river restoration projects on a regular basis	in cooperation with operators of hydropower plants and nature protection authorities, NGOs
Action 21: Purchase of land for river restoration and free flowing rivers	Purchasing land will raise the possibility to implement river restoration measures.	TBR	All species	Medium	medium	Contracts of land-purchase, land registry entries of the land around restoration sites	Water management authorities, nature protection authorities, NGOs

7.3.2 Sub-threat: Straightening of river course and disconnection of side-branch systems (incl. floodplain)

Objective 7: Increasing meander capacity							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
Action 22: No cutting of meanders	Cease meander cut-offs, except in imminent danger, to help the natural dynamic processes	TBR, in particular Mura and Drava	all species	Very high	permanent	Confirmed non-decrease of number of meanders within TBR; legal document	TBR governments, water management authorities, nature protection authorities
Action 23: Relocation of flood	Relocation of flood protection dykes into the hinterland will	TBR, in particular Mura and	all species	Medium	long	Area between flood protection dykes widened	TBR governments, water manage-

protection dykes	increase space for dynamic river course development. Villages and infrastructure remain protected from floods.	Drava					ment authorities, nature protection authorities
Action 24: Build initial channels	Planning and building of initial channels represent important measures for increasing river dynamics.	TBR, in particular Mura and Drava	all species	High	long	Increased number of initial channels for the purpose of river restoration	TBR governments, water management authorities, nature protection authorities
Action 25: Reconnect disconnected side branches with river	Reconnecting old side arms will strengthen the dynamic processes of the river and improve the state of the floodplains.	TBR, in particular Mura and Drava	all species	High	long	Increased number of side branches reconnected with the main river	TBR governments, water management authorities, nature protection authorities
Action 26: Restore tributaries	Tributaries play an important role for the ecosystem of a main river. Where necessary and possible, tributaries should be restored.	TBR	all species	High	long	Increase in number of restored tributaries	TBR governments, water management authorities, nature protection authorities

7.3.3 Sub-threat: Sediment extraction

Objective 8: To prevent sediment removal from the river system							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
Action 27: Prohibit extraction of sediments from the river system and incorporate the prohi-	Natural sediment transport is a key factor of dynamic riverine systems, enabling e.g. the forming of gravel and sand banks. Stopping the extraction of sed-	TBR	In particular sand and gravel bank breeders	Very high	permanent	Official agreement that defines the terms of sediment extraction	TBR governments, water management authorities, nature conservation and protec-

bition into national water and nature protection legislation.	iments river can also reduce bed deepening. If sediment must be extracted, the material should stay in the river system by reintroducing it into the river upstream of the extraction area.						tion authorities
Action 28: Prosecute illegal sediment extraction	Illegal sediment extraction can cause harm to a riverine ecosystem. Illegal extraction should be prosecuted in accordance with the law.	TBR, in particular Mura and Drava	In particular sand and gravel bank breeders	High	permanent	Illegal sediment extraction no longer takes place; Numbers of reported illegal sediment extraction are published and confirm decrease or stop.	Nature protection authorities

7.4 Threat 4: Recreational use (e.g. swimming, hiking/cycling/quad-driving/holiday houses/boating etc.)

Objective 9: Reducing the impact of human disturbance due to recreational activities along the river							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
Action 29: Raise awareness about sensitiveness of river birds against human disturbance among visitors	Awareness raising is necessary for understanding the importance of the riverine ecosystem. For instance, this could be done with the help of info-boards, brochures etc.	TBR, in particular Mura and Drava	All species	high	permanent	Visitor management plans in place and implemented including implemented measures (like constructed info-boards, leaflet, website, etc.)	TBR governments, nature protection authorities, NGOs
Action 30: Establish protected zones (“no-go” areas”)	Within protected areas highly sensitive and ecologically important zones especially for breeding birds, can be found.	TBR, in particular Mura and Drava	in particular breeding sites of colony breeders	very high	short	No infrastructure projects within sensitive breeding areas.	TBR governments, nature protection authorities

Objective 9: Reducing the impact of human disturbance due to recreational activities along the river							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
	These zones are important retreats and should be declared as "no-go" areas for??		(e.g. Little and Common Tern, Sand Martin)				
Action 31: Develop a joint trans-boundary visitor guidance plan	The development of a joint trans-boundary visitor guidance plan is a crucial basis for protecting sensitive areas and is important for raising awareness among locals.	TBR, in particular Mura and Drava	All species	High	short	Visitor guidance plan for Drava and Mura in place	TBR governments (county level), nature protection authorities, spatial planning authorities, NGOs
Action 32: Implement a joint trans-boundary visitor guidance plan	The implementation of a joint trans-boundary visitor guidance plan is crucial for protecting sensitive areas is important for raising awareness among locals.	TBR, in particular Mura and Drava	All species	High	short	Measures defined in the visitor guidance plan implemented	TBR governments (county level), nature protection authorities, spatial planning authorities, NGOs
Action 33: Avoid recreational infrastructure at breeding areas	In sensitive breeding areas, building of new recreational infrastructure should be prohibited.	TBR, in particular Mura and Drava	All species	High	permanent	Breeding areas are free of new infrastructure	Nature protection authorities
Action 34: Introduce regulation for the use of motorboats.	Recreational use of motorboats can have a severe impact on breeding success of river bird species.	TBR, in particular Drava downstream of Donji Miholjac	All species	High	medium	Regulation for use of motorboats in place.	Nature protection authorities
Action 35: Prepare study on the effects of motorboat use in the Drava river	Recreational use of motorboats can have a severe impact on breeding success of river bird species.	TBR, in particular Drava downstream of Donji Miholjac	All species	High	medium	Study published and its proposed measures implemented	Nature protection authorities

Objective 9: Reducing the impact of human disturbance due to recreational activities along the river							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
section downstream of Donji Miholjac							
Action 36: Introduce rangers to the guidance plan, who will inform about, and check for compliance with, the visitor guidance plan	Monitoring the measures of the visitor guidance plan by rangers will guarantee its implementation and additionally raise awareness.	TBR	All species	High	medium	Ranger role established and implemented	Nature protection authorities

7.5 Threat 5: Additional threats including agriculture, fishing and navigation

Objective 10: Reduce the impact of several other anthropogenic impacts							
Action Nr.	Rationale	Geographical scope	Relevant species	Priority	Timeframe	Indicator(s) of success	Action mainly addressed to/responsibility
Action 37: Elaborate a set of criteria for environmentally friendly mosquito control and educate the public on the impacts of mosquito control on wildlife and humans	The spraying of pesticides against mosquitos directly affects biomass and can have severe influence on many species depending on insects as well as humans	TBR, in particular lower Drava and Danube	All species, in particular Sand Martin, Bee-Eater	Very high	Short	Set of criteria in place and applied	Nature protection authorities

Action 38: Remove existing illegal fishing infrastructure (e.g. fishing huts)	Existing illegal fishing huts and other illegal fishing infrastructures within TBR should be removed; special places for fishing and recreation are to be defined in a visitor guidance plan.	TBR, in particular Drava	All species	High	short	No illegal huts exist or are built within TBR	Nature protection authorities; Spatial planning institutions and building inspection; Ministry of Construction and Physical Planning
Action 39: Reduce usage of herbicides and pesticides	Agricultural herbicide and pesticide use near the rivers may lower biomass and diversity of insects, directly causing population declines in bird species feeding on insects.	TBR, particularly active floodplain	All species, in particular Sand Martin, Bee-Eater	High	short	Decrease of amount in pesticide use (incl. BTI – larvae-eating bacteria); increase of key species populations that depend on extensive meadows proven by independent studies	Nature protection authorities, Ministry of agriculture
Action 40: Support and enforce the cultivation of extensive meadows	Extensive meadows play an important role for insect diversity and density.	TBR	All species, in particular Sand Martin and Bee-Eater	High	permanent	Surface area (ha, sqm) of extensively used meadows increasing	Nature protection authorities, Ministry of agriculture
Action 41: Stop conversion of meadows into arable fields	The loss of extensive meadows is one factor in the decline of insect species.	TBR	All species	High	Short	No conversion of meadows takes place any more	Nature protection authorities
Action 42: Maintain the navigation route at Danube with respect to the preservation of river birds and their habitats	To reduce impact of the maintenance of the navigation route on breeding birds, maintenance measures should be conducted outside of the breeding and spawning season, since they can lead to a loss of breeding habitats	River sections 10 and 11 (Danube)	All species, in particular gravel and sand bank breeders	High	medium	Official agreement between operators of navigation route and nature protection authorities regulating the time and the site, where maintenance of navigation route is allowed	Nature protection authorities in cooperation with shipping companies
Action 43: Maintain and estab-	For river sections with hydropower plants, mitigation	TBR, in particular Drava and	All species	Medium	long	Ecological mitigation measures defined and	Nature protection and water man-

lish ecological (mitigation) measures and secondary habitats	measures can reduce negative effects to some extent. For instance, to plan and create secondary habitats within reservoirs or gravel pits (e.g. breeding platforms) is a reasonable solution under certain circumstances.	Mura				implemented	agement authorities in cooperation with operators of hydropower plants

8 Literature

BAUER, H.-G., BEZZEL, E. & FIEDLER, W. (2012): Das Kompendium der Vögel Mitteleuropas. Einbändige Sonderausgabe der 2. Auflage 2005. AULA-Verlag, Wiesbaden, pp. 1430.

BIRDLIFE (2016a). *Actitis hypoleucos.* The IUCN Red List of Threatened Species 2016. Birdlife International.

BIRDLIFE (2016b). *Alcedo atthis*. The IUCN Red List of Threatened Species 2016. Birdlife International.

BIRDLIFE (2016c). *Charadrius dubius*. The IUCN Red List of Threatened Species 2016. Birdlife International.

BIRDLIFE (2016d). *Merops apiaster*. The IUCN Red List of Threatened Species 2016. Birdlife International.

BIRDLIFE (2016e). *Riparia riparia*. The IUCN Red List of Threatened Species 2016. Birdlife International.

BIRDLIFE (2016f). *Sterna hirundo*. The IUCN Red List of Threatened Species 2016. Birdlife International.

BIRDLIFE (2016g). *Sternula albifrons*. The IUCN Red List of Threatened Species 2016. Birdlife International.

BOŽIČ, L. & DENAC, D. (2017): Population dynamics of five riverbed breeding species on the lower Drava River, NE Slovenia. Acrocephalus, 38, pp. 85-126.

BYUNGWOONG, C. & SUNG-UK, C. (2018): Impacts of hydropeaking and thermopeaking on the downstream habitat in the Dal River, Korea. Ecological Informations, 43, pp. 1-11.

FLUVIUS (2013). Assessment of the River and Floodplain Restoration Potential in the Transboundary UNESCO Biosphere Reserve "Mura-Drava-Danube". On behalf of WWF Austria. Vienna, pp. 157.

GLUTZ VON BLOTZHEIM, U. N. & BAUER, K. M. (1980): Handbuch der Vögel Mitteleuropas, Band 9. Columbiformes-Piciformes. Tauben, Kuckucke, Eulen, Ziegenmelker, Segler, Racken, Spechte. Aula Verlag, Wiesbaden, pp. 1150.

GLUTZ VON BLOTZHEIM, U. N. & BAUER, K. M. (1985): Handbuch der Vögel Mitteleuropas, Band 10/1. Passeriformes (1. Teil). Aula Verlag, Wiesbaden, pp. 510.

GLUTZ VON BLOTZHEIM, U. N. & BAUER, K. M. (1999): Handbuch der Vögel Mitteleuropas, Band 8/2. Charadriiformes (3. Teil). Aula-Verlag, Wiesbaden, pp. 570.

GLUTZ VON BLOTZHEIM, U. N., BAUER, K. M. & BEZZEL, E. (1985): Handbuch der Vögel Mitteleuropas, Band 7. Charadriiformes (2. Teil). Aula Verlag, Wiesbaden, pp. 897.

GLUTZ VON BLOTZHEIM, U. N., BAUER, K. M. & BEZZEL, E. (1999): Handbuch der Vögel Mitteleuropas, Band 6. Charadriiformes (1.Teil). Aula Verlag, Wiesbaden, pp. 847.

KORBER, S. & UNTERLERCHER, M. (2012). Alpenrhein - Quantitative Analyse von Schwall/Sunk-Ganglinien für unterschiedliche Anforderungsprofil. Kurzbericht. Im Auftrag der internationalen Regierungskommission Alpenrhein. Vaduz, pp. 35.

MCCARTNEY, M. (2009): Living with dams: managing the environmental impacts. Water policy 11 Supplement 1, pp. 121-139.

MOHL, A. (2001): The nesting of the Little Tern *Sterna albifrons* on the Drava River in Croatia and Hungary. Acrocephalus, 22, pp. 35-39.

MOHL, A. & SCHWARZ, U. (1998). Landschafts- und Gewässerstrukturkartierung an der kroatisch-ungarischen Drau (Flußkilometer 226- 185,5), im Gebiet des geplanten kroatischen Wasserkraftwerks „Novo Virje", unter besonderer Berücksichtigung naturschutzrelevanter und gewässerökologischer Fragestellungen. Universiät für Bodenkultur und Universität Wien, Wien, pp.

MOSS, R., LECKIE, F., BIGGINS, A., POOLE, T., BAINES, D. & KORTLAND, K. (2014): Impacts of human disturbance on capercaillie *Tetrao urogallus* distribution and demography in Scottish woodland. Wildlife Biology, 20, pp. 1-18.

NILSSON, C. & DYNESIUS, M. (1994): Ecological effects of river regulation on mammals and birds: a review. Regulated rivers: research & management, 9, pp. 45-53.

PUZOVIĆ, S., RADIŠIĆ, D., RUŽIĆ, M., RAJKOVIĆ, D., RADAKOVIĆ, M., PANTOVIĆ, U., JANKOVIĆ, M., STOJNIĆ, N., ŠĆIBAN, M., TUCAKOV, M., GERGELJ, J., SEKULIĆ, G., AGOŠTON, A. & RAKOVIĆ, M. (2016). Ptice Srbije: procena veličina populacija i trendova gnezdarica 2008-2013. Društvo za zaštitu i proučavanje ptica Srbije & Prirodno-matematički fakultet, Departman za biologiju i ekologiju, Univerziet u Novom Sadu, Novi Sad, pp.

SCHNEIDER-JACOBY, M. (1996): Drau und Mur - Leben durch Flussdynamik. Natur-Reiseführer durch eine einzigartige Flusslandschaft im Südosten Europas. Naturerbe Verlag Jürgen Resch, pp. 152.

SCHNEIDER-JACOBY, M. & MOHL, A. (2012): Mura-Drava-Danube: Five countries – three rivers – one Biosphere Reserve. Danube News, 25, pp. 2-5.

SCHWARZ, U. & MOHL, A. (2009). Lifeline Drava-Mura 2009-2020. A plan for conserving and restoring the Drava and Mura rivers for nature and people. WWF and Euronatur, Vienna, pp. 34.

STEVEN, R., PICKERING, C. & CASTLEY, J. G. (2011): A review of the impacts of nature based recreation on birds. J. Environ. Manage., 92, pp.

9 Acknowledgement

We would like to thank all people who provided data and contributed with their expert knowledge during the two workshops. We would especially like to thank Tibor Mikuška (Croatia), who supported us with his long-term experience of the whole Drava River in Croatia at both workshops, and Darko Grlica (Croatia) for providing his whole data collection on Drava river birds. Additionally, data was organised or provided, respectively, by Remo Probst (BirdLife Austria), Luka Božič and Damijan Denac (DOPPS Slovenia), Gáborik Àkos (Hungary) and Milan Ružić (BirdLife Serbia). Lastly, we would like to thank Ulrich Schwarz who provided GIS-data concerning the river bank assessment.

10 List of abbreviations

- Classification of European Red List Conservation Status:

  LC **L**east **C**oncern

  NT **N**early **T**hreatened

  VU **Vu**lnerable

  EN **En**dangered

  CR **C**ritically **E**ndangered

- BTI *Bacillus thuringiensis* serotype israelensis; a group of bacteria used as a biological control agent for larvae stages of certain dipterans (“mosquito control”)

- EU **E**uropean **U**nion
- ha hectare
- IUCN **I**nternational **U**nion for **C**onservation of **N**ature
- MDD **M**ura-**D**rava-**D**anube
- NGO **N**on-**g**overnmental **o**rganisation
- SPEC **Sp**ecies of **E**uropean **C**onservation Concern

  SPEC 1: European species of global conservation concern

  SPEC 2: Species whose global populations are concentrated in Europe and its conservation status is unfavourable.

  SPEC 3: Species whose global populations are not concentrated in Europe and its conservation status is unfavourable.

  Non-Spec^{E}: Species whose global populations are concentrated in Europe, but its conservation status in Europe is favourable.

  Non-spec: Species whose global populations are not concentrated in Europe, but its conservation status in Europe is favourable.

- TBR **T**ransboundary **B**iosphere **R**eserve

11 Appendix

11.1 List of contributors of action plan

The present action plan combines expert knowledge from all five countries of the target area. Besides ornithological experts, representatives from different public institutions and organisations also participated in the two workshops and contributed to the action plan by adding comments to the draft documents. All people who participated in the genesis of this action plan are listed in alphabetical order without degree in the following table. Ornithological experts who provided data are printed in bold letters:

Nr.	Surname	First Name	Organization	Email
1	**Božič**	**Luka**	DOPPS - BirdLife Slovenia	luka.bozic@dopps.si
2	Čižmesija	Goran	ZEUS	gcizmesija@gmail.com
3	Czigány	Anna	Balaton-felvidéki National Park Directorate	cziganya@bfnp.hu
4	**Denac**	**Damijan**	DOPPS - BirdLife Slovenia	damijan.denac@dopps.si
	Dumbović Mazal	Vlatka	Croatian Agency for the Environment and Nature	vlatka.dumbovic@dzzp.hr
5	Flajšman	Emil	Hrvatske vode	emil.flajsman@voda.hr
6	**Gáborik**	**Ákos**	Duna-Dráva National Park Directorate	gaborik@indamail.hu
7	Gattermayr	Matthias	REVITAL	m.gattermayr@revital-ib.at
8	**Grlica**	**Ivan Darko**	Prirodoslovno društvo Drava	ivan.darko.grlica@gmail.com
9	Györfi	Emöke	WWF Austria	emoke.gyorfi@wwf.at
9	Ječmenica	Biljana	BIOM	biljana.jecmenica@biom.hr
10	Kereša	Zdenko	Hrvatske vode	zkeresa@voda.hr
11	Kolar	Željka	Javna ustanova za upravljanje zaštićenim dijelovima prirode na području Koprivničko-križevačke županije	zeljka.kolar@zastita-prirode-kckzz.hr
12	Koren	Aleksander	IRSNC Institute or Republic of Slovenia for Nature Conservation	aleksander.koren@zrsvn.si
13	Korn Varga	Ivana	WWF Adria	ikorn@wwfadria.org
14	Kučera	Sonja	Nature Park Directorate Kopacki Rit	sonja.kucera@pp-kopacki-rit.hr
16	Ledić	Nikola	Rafting club Matis	adventure.mor@gmail.com
17	Mesarić	Mihaela	Međimurska priroda – Public Institution for Nature Protection of Međimurje County	mesaric@medjimurska-priroda.info
18	Michor	Klaus	REVITAL	k.michor@revital-ib.at
19	Mikulić	Krešimir	BIOM	kresimir.mikulic@biom.hr
20	**Mikuška**	**Tibor**	Croatian Society for Birds and Nature Protection	tibor.kopacki.rit@gmail.com
21	**Mohl**	**Arno**	WWF Austria	arno.mohl@wwf.at
22	Nikowitz	Tanja	WWF Austria	tanja.nikowitz@wwf.at
23	**Parrag**	**Tibor**	Duna-Dráva Nationalpark Directorate	parragtibor72@gmail.com

Nr.	Surname	First Name	Organization	Email
24	Povijač	Denis	WWF Adria	dpovijac@wwfadria.org
25	**Probst**	**Remo**	BirdLife Austria	remo.probst@birdlife.at
26	**Ružić**	**Milan**	BirdLife Serbia	milan.ruzic@pticesrbije.rs
27	Sabo	Tatjana Arnold	JU za upravljanje zaštićenim dije-lovima prirode i ekološkom mrežom VPŽ	tatjana.arnold.sabo@gmail.com
28	Sadiković	Adela	Zeleni Osijek	adela@zeleni-osijek.hr
29	Sadiković	Jasmin	Zeleni Osijek	jasmin@zeleni-osijek.hr
30	**Šafarek**	**Goran**	Šafarek produkcija	goran@safarek.com
31	Šimleša	Dražen	Institute of Social Science Ivo Pilar	drazen.simlesa@pilar.hr
32	Slocinski	Boleslaw	BIOM	boleslaw.slocinski@biom.hr
33	Španiček	Branka	WWF Adria	bspanicek@wwfadria.org
34	Stadler	Stefanie	WWF Austria	stefanie.stadler@wwf.at
35	Szinai	Peter	Balaton-felvidéki National Park Directorate	szinai@bfnp
36	**Tucakov**	**Marko**	Institute for Nature Conservation of Vojvodina Province	marko.tucakov@pzzp.rs
38	Umgeher	Lukas	REVITAL	l.umgeher@revital-ib.at
39	Wagner	Magdalena	WWF Austria	magdalena.wagner@wwf.at

11.2 Timetable

Within the framework of the development of the action plan for river birds, two workshops were held together with ornithological experts and persons from nature conservation authorities from all five countries (the working group). The workshops served as a platform for experts and nature conservation authorities to exchange knowledge and experience concerning the present status of river bird species, threats and possible management measures for the target area. They also served to provide this know how into the present action plan. The two workshops took place in Croatia and were organised by WWF Austria and WWF Adria.

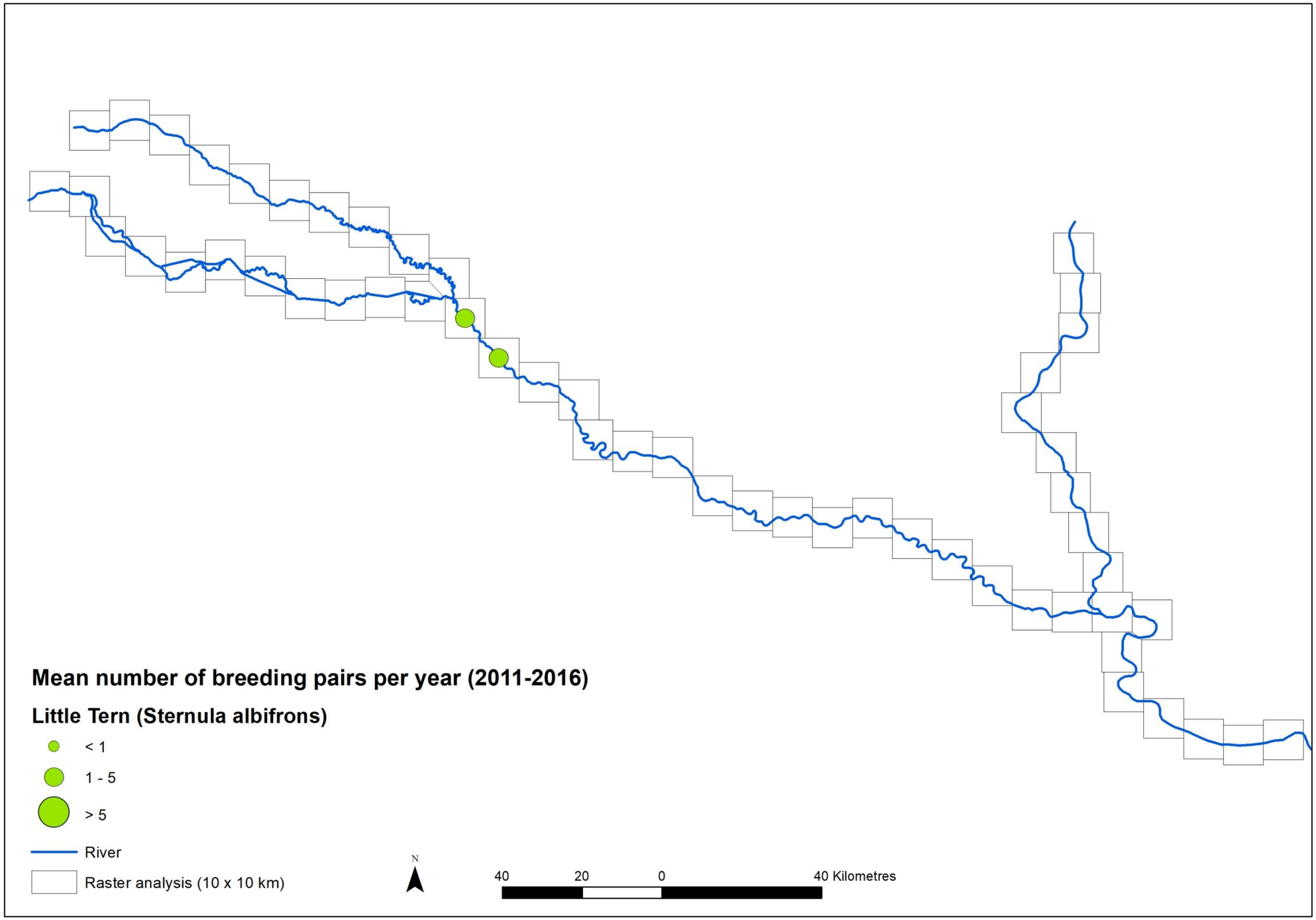
Workshop I: April 5th 2017, Koprivnica, Croatia

Workshop II: November 8th 2017, Kopačevo, Croatia

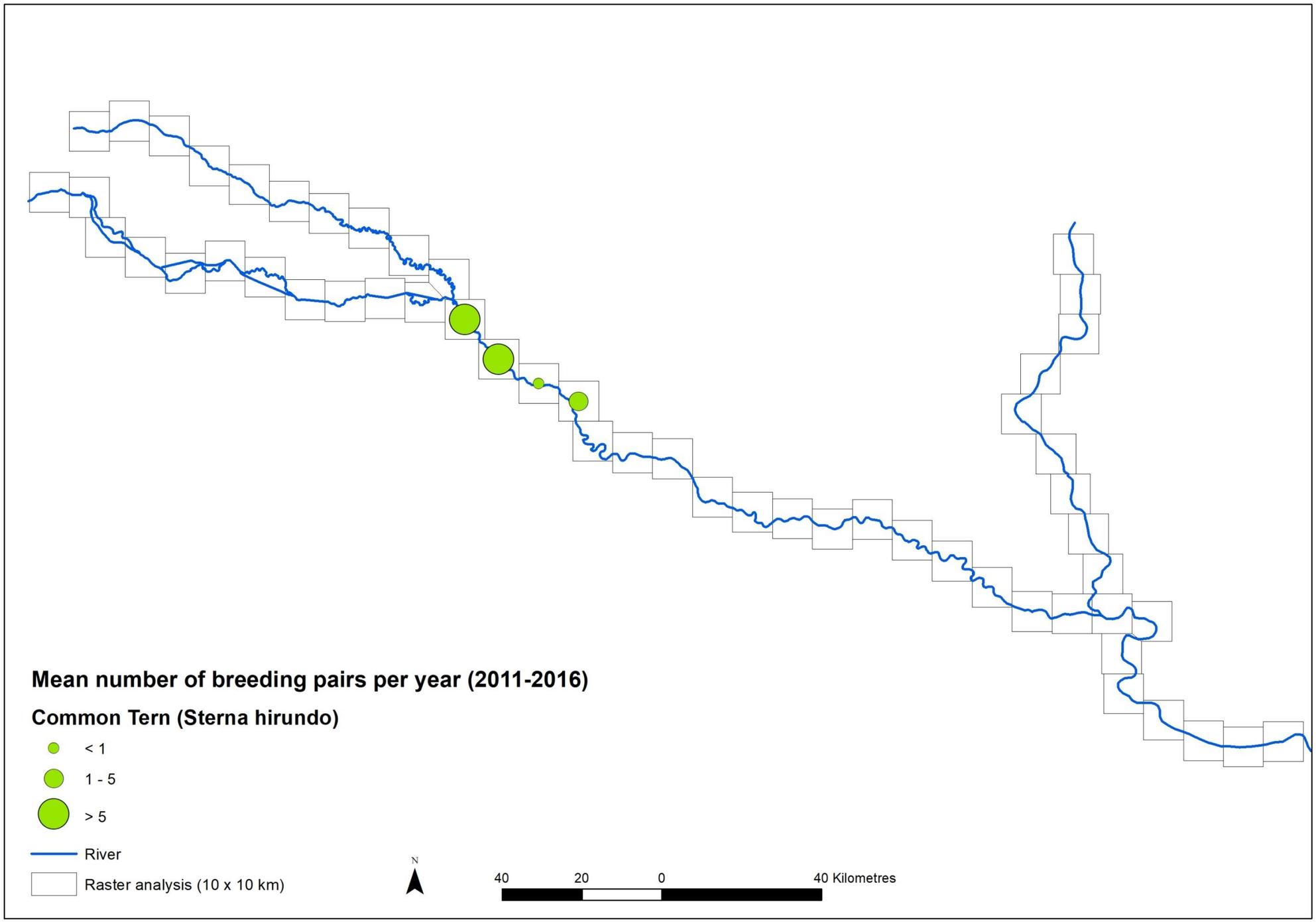
11.3 Supplementary material

The following figures show the distribution of river bird species within target area. Within each 10 x 10 kilometres grid, mean number of breeding pairs between 2011 and 2016 are given.

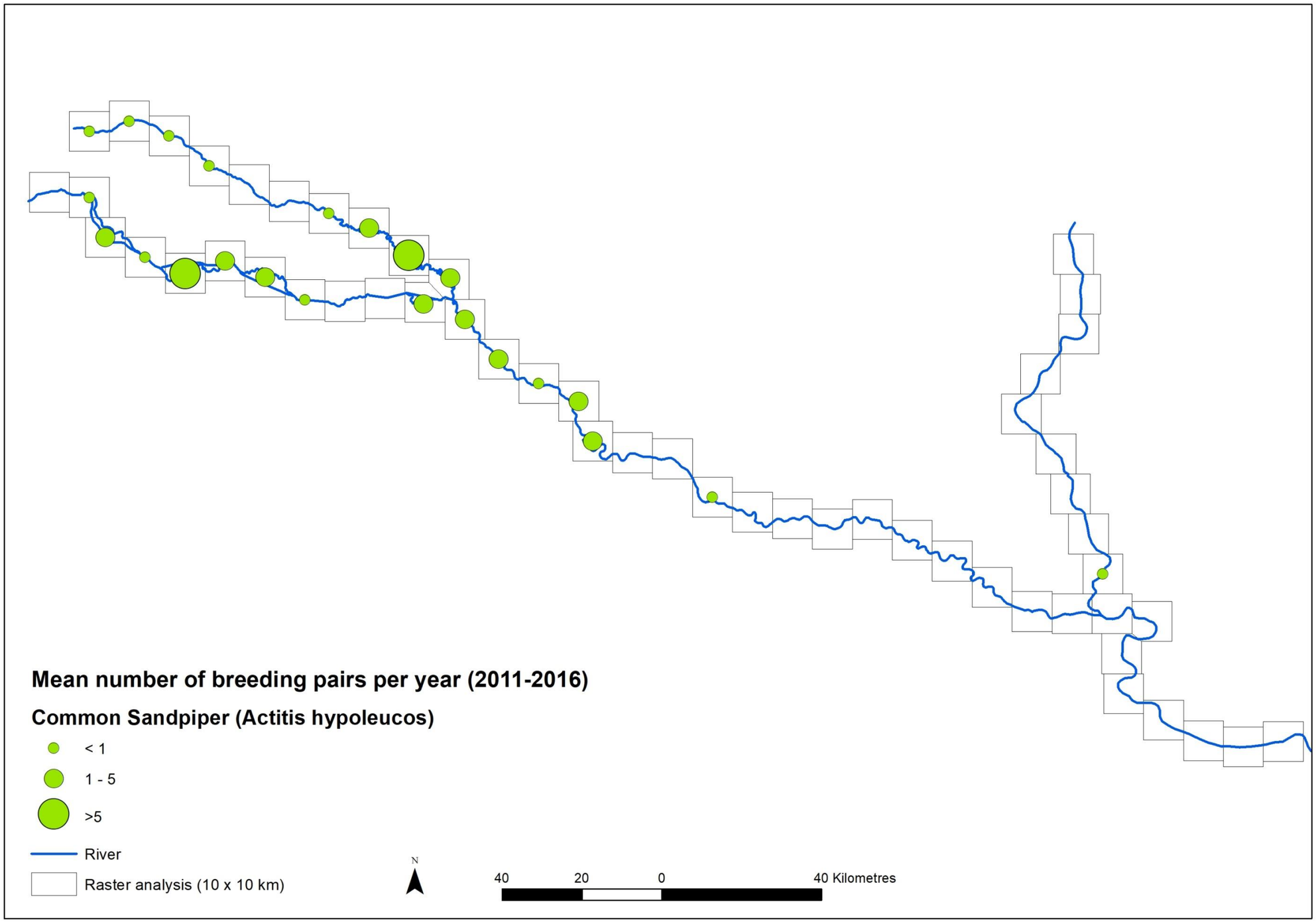
11.3.1 Little Tern (*Sternula albifrons*)



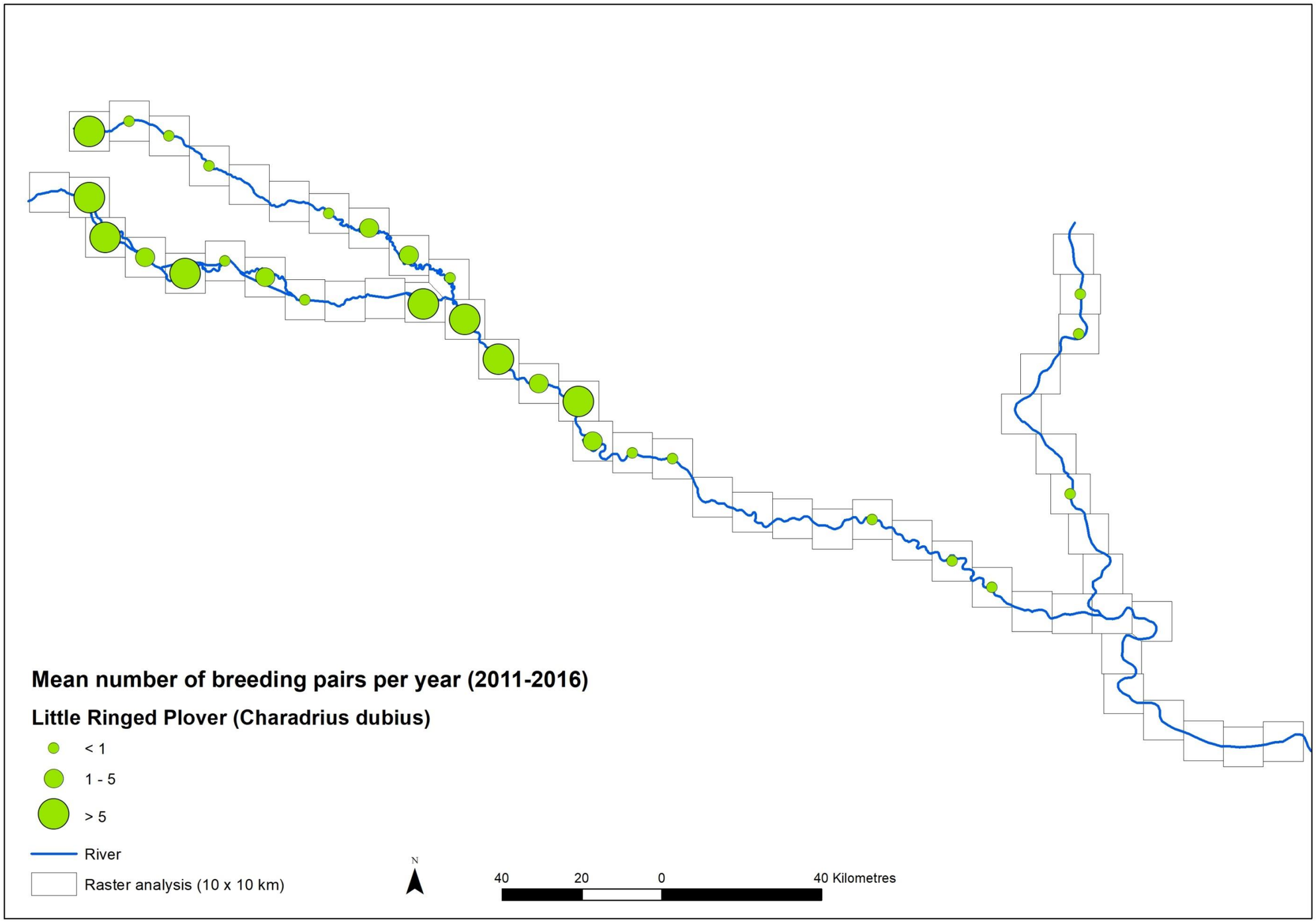
11.3.2 Common Tern (*Sterna hirundo*)



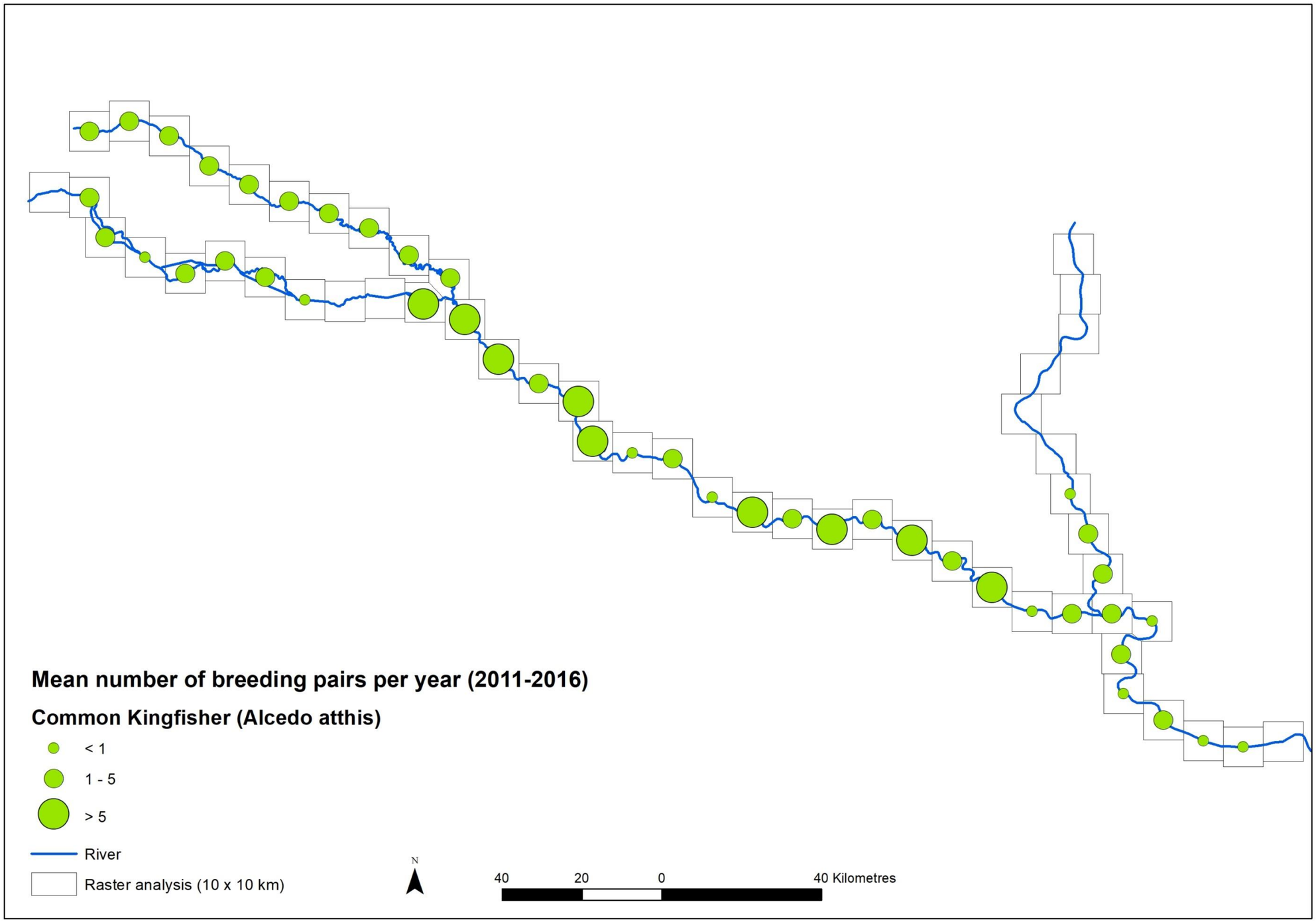
11.3.3 Common Sandpiper (*Actitis hypoleucos*)



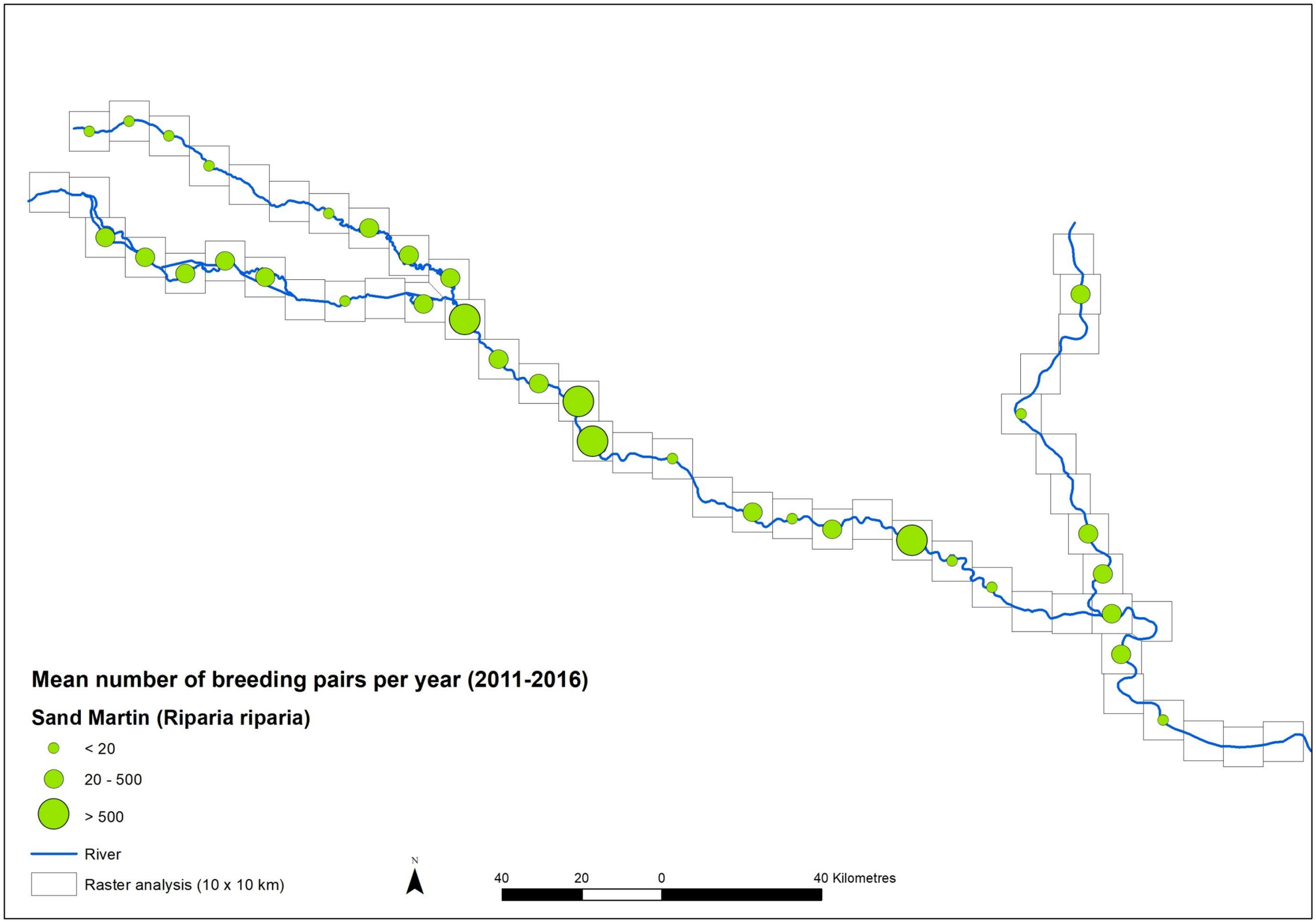
11.3.4 Little ringed plover (*Charadrius dubius)*



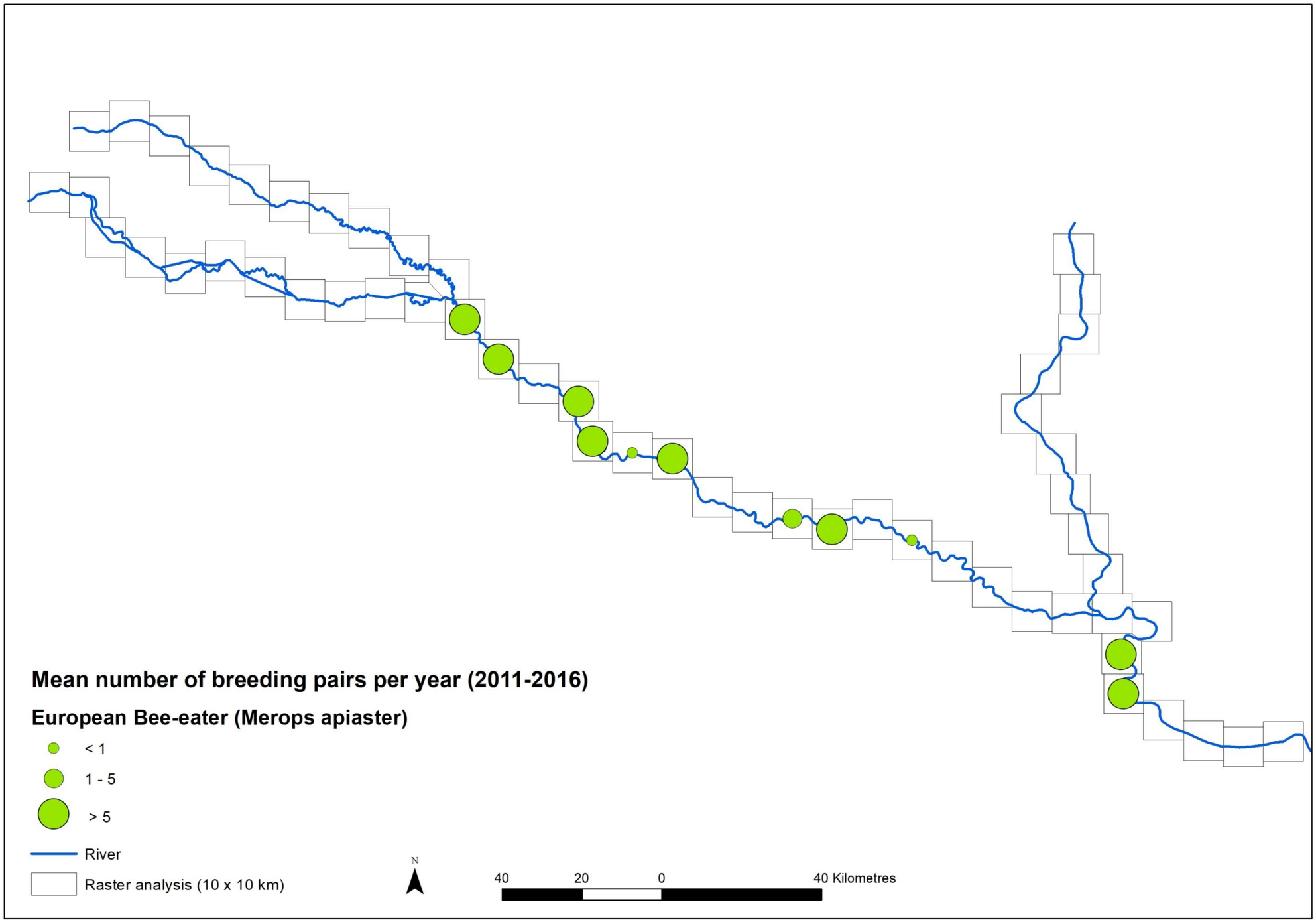
11.3.5 Common Kingfisher (*Alcedo atthis*)



11.3.6 Sand Martin (*Riparia riparia*)



11.3.7 European Bee-Eater (*Merops apiaster*)



REVITAL
Integrative Naturraumplanung GmbH
Nußdorf 71
A-9990 Nußdorf-Debant
Tel.: +43 4852 67499-0; Fax: +43 4852 67499-19
office@revital-ib.at; www.revital-ib.at