Interreg
Danube Transnational Programme
lifelineMDD

Project co-funded by European Union funds (ERDF, IPA)
Project number: DTP3-308-2.3- lifeline MDD

River breeding birds report –

First joint census of selected river breeding birds in 5-country biosphere reserve Mura-Drava-Danube

IRSNC,

WP T1/A.T1.1/D.T1.1.2, 2022

IMPRESSUM

Authors

Monika Podgorelec, Anja Cigan, Uroš Kur, Tadej Törnar | Institute of the Republic of Slovenia for Nature Conservation (IRSNC) / Zavod RS za varstvo narave (ZRSVN) – Tobačna ulica 5, 1000 Ljubljana, https://zrsvn-varstvonarave.si/

Luka Božič, DOPPS Birdlife Slovenia, Slovenia

Darko Grlica, Natural History Society Drava, Croatia

Dimitrije Radišić, University of Novi Sad, Faculty of Science, Department for Biology and Ecology, Serbia

Many thanks to: Tadej Törnar, Aleksander Koren, Uroš Kur & Katja Berden (IRSNC), Branka Španiček (WWF Adria), Marko Tucakov (INCVP), Željko Šalamun, Martina Vida, Larisa Koren, Jasmina Filipič, Matjaž Premzl, Darko Lorenčič, David Knez (DOPPS Birdlife Slovenia), Nikola Veljković, Miroslav Dudok (Serbia).

Editor

Monika Podgorelec: Institute of the Republic of Slovenia for Nature Conservation

Kerstin Böck, Emöke Györfi: World Wide Fund for Nature Austria (WWF Austria) – Ottakringer Straße 114-116, 1160 Wien

Lifeline MDD Project Manager

Kerstin Böck, WWF Austria

Date

Final Version: 28. 12. 2022

Recommendation for Quotation:

Podgorelec, M., Božič L., Grlica D., Radišić D., Cigan A., Kur U., Törnar T., Španiček B., Tucakov M. (2022). First joint census of selected riverbed breeding birds in 5-country biosphere reserve Mura-Drava-Danube; Deliverable report for EU-Interreg DTP project DTP3-308-2.3 "lifelineMDD", IRSNC, Ljubljana.

Photo credits

Cover: Little Ringed Plover, © Anja Cigan

Contents

SUMMARY **7**

1. INTRODUCTION **10**

1.1. General Introduction 10

1.2. State of knowledge and study aims 12

2. METHODOLOGY **14**

2.1. Terms of Reference 14

2.2. Study area 16

2.3. Field survey methods 18

2.4. Data analysis and interpretation of results 21

2.4.1 Data analysis per river sections 23

2.4.2 Data analysis per river segments 5 km (Mura, Drava) and 10 km (Danube) 24

2.5. Trends 24

3. RESULTS AND DISCUSSION **25**

3.1 General and comparative results 25

3.2 Little Tern (*Sternula albifrons*) 33

3.3 Common Tern (*Sterna hirundo*) 35

3.4 Little Ringed Plover (*Charadrius dubius*) 37

3.5 Common Sandpiper (*Actitis hypoleucos*) 41

3.6 Common Kingfisher (*Alcedo atthis*) 45

3.7 Sand Martin (*Riparia riparia*) 48

3.8 European Bee-Eater (*Merops apiaster*) 51

3.9 Data analysis per river segments 5 km (Mura, Drava) and 10 km (Danube) 54

3.10 Threats 57

4. SUMMARY, CONCLUSIONS AND ACTION RECOMMENDATIONS **62**

4.1 Current status of riverbed breeding birds in TBR Mura-Drava-Danube in 2021–2022 62

4.2 Importance and natural potential of the studied area 65

4.3 River segments and stretches for protection and restoration actions in TBR MDD 66

4.4 General conclusions, data gaps and uncertainties & need for actions and future research 68

5. REFERENCES 71

6. ANNEXES / APPENDIX 77

Annex 6.1 – Božič (2022) 77

Annex 6.2 - Grlica (2022) 77

Annex 6.3 - Radišič (2022) 77

Appendix 6.4: Datasets stored in the digital layer (.shp files) 77

Appendix 6.5: Terms of Reference (ToR) 78

Appendix 6.7: Tables with breeding sites & breeding pairs numbers per species in 550 km riverbed of Mura, Drava and Danube in TBR MDD 83

Figures

Figure 1: Map of the 5-country Biosphere Reserve Mura-Drava-Danube according to UNESCO designation in September 2021 (WWF Austria) 10
Figure 2: The Mura, Drava and Danube riverbed between Ceršak (SLO) and Bačka Palanka (RS), where the census of selected breeding bird species was conducted in the 2021 and 2022 seasons. Different colours represent the sections, where different bird experts conducted the field bird census. Light green line – Božič 2022, blue line – Grlica 2022, dark green line – Radišić 2022, grey line – no bird census. 16
Figure 3: Detailed field survey overview on river bird census conducted in season 2021 in the TBR MDD. 17
Figure 4: The width of the riverbed and type of the habitat as also type of the sediments differ in the three rivers in the TBR MDD – Mura River (left above; photo: Luka Božič), Drava River (right above; photo: Darko Grlica) and Danube River (left and right below; photo: Darko Grlica, Dimitrije Radišič). 17
Figure 5: Target species of the 550 km Mura-Drava-Danube riverbed surveys in 2021 and 2022 (from top left to bottom right) – Little Ringed Plover *Charadrius dubius* (photo: T. Basle), Common Sandpiper *Actitis hypoleucos* (photo: J. Novak), Common Kingfisher *Alcedo atthis* (photo: L. Božič), Sand Martin *Riparia riparia* (photo: A. Ploj), Bee-eater *Merops apiaster* (photo: A. Ploj), Common Tern *Sterna hirundo* (photo: A. Ploj) and Little Tern *Sternula albifrons* (photo: A. Povedano, https://en.wikipedia.org/wiki/Little_tern) 19
Figure 6: Overview of the eight River sections types (RTS) and river kilometre (rkm) together with the visualization and assessment segments of 5 km for Mura and Drava and 10 km for Danube (according to Schwarz (2022). 23
Figure 7: Distribution of seven selected indicator species of breeding birds (Little Ringed Plover Charadrius dubius, Common Sandpiper Actitis hypoleucos, Common Tern Sterna hirundo, Little Tern Sternula albifrons, European Bee-Eater Merops apiaster, Common Kingfisher Alcedo atthis, Sand Martin Riparia riparia) registered in the Mura, Drava and Danube riverbed between Ceršak (SLO) and Bačka Palanka (RS), based on registrations of presumably nesting individuals during the 2022 censuses. 27
Figure 8: Linear density of breeding pairs per segment for two groups of river bird breeders - bar breeding birds and bank breeding birds **in 2021** (= total number of breeding pairs per 5 km (Mura, Drava) or 10 km (Danube) long segment of the riverbed). 28
Figure 9: Linear density of breeding pairs per segment for two groups of river bird breeders - bar breeding birds and bank breeding birds **in 2022** (= total number of breeding pairs per 5 km (Mura, Drava) or 10 km (Danube) long segment of the riverbed). A larger circle means a larger number of breeding pairs and a greater importance of this area for birds that nest on gravel/sand bars (green circle) or steep river banks (blue circle). 28
Figure 10: Percentage of breeding pairs of seven target species in the Mura, Drava and Danube riverbed in TBR MDD between Ceršak (SLO) and Bačka Palanka (RS). Data are based on registrations of nesting individuals during the 2022 censuses – LRP: n = 91, CS: n = 65; CT: n = 8; LT: n = 1; EBE: n = 192; CK: 216; SM: n = 6449) 31
Figure 11: Percentage of breeding pairs of seven target species in the eight river sections of the Mura, Drava and Danube riverbed in TBR MDD between Ceršak (SLO) and Bačka Palanka (RS). LRP: n = 91, CS: n = 65; CT: n = 8; LT: n = 1; EBE: n = 192; CK: 216; SM: n = 6449) 31
Figure 12: Linear density (pairs per 10 km) of the seven target bird species for eight river segments (Bar-breeders: Little Ringed Plover Charadrius dubius, Common Sandpiper Actitis hypoleucos, Common Tern Sterna hirundo, Little Tern Sternula albifrons & bank-breeders: European Bee-Eater Merops apiaster, Common Kingfisher Alcedo atthis, Sand Martin Riparia riparia) registered in the Mura, Drava and Danube riverbed between Ceršak (SLO) and Bačka Palanka (RS), based on registrations of presumably nesting individuals during the 2022 censuses. **The values of the "y" axis are displayed on a logarithmic scale.** 32
Figure 13: Distribution of the Little Tern (*Sternula albifrons*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022. The breeding attempt on the Danube in 2021 was unsuccessful due to high water levels within a few days after the observations. 34

Figure 14: Distribution of the Common Tern (*Sterna hirundo*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022. The light violet point is the location of Šoderica lake.....36
Figure 15: Distribution of the Little Ringed Plover (*Charadrius dubius*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022.....38
Figure 16: Linear density of Little Ringed Plover (Charadrius dubius) breeding pairs in 2021 and 2022 per 5 km (Mura, Drava) and 10 km (Danube) long riverbed segments in the TBR MDD.....38
Figure 17: Distribution of Common Sandpiper (*Actitis hypoleucos*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022.....42
Figure 18: Linear density of Common Sandpiper (Actitis hypoleucos) breeding pairs in 2021 and 2022 per 5 km (Mura, Drava) and 10 km (Danube) long riverbed segments in the TBR MDD.....43
Figure 19: Distribution of the Common Kingfisher (*Alcedo atthis*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022.....45
Figure 20: Linear density of the Common Kingfisher (Alcedo atthis) breeding pairs in 2021 and 2022 per 5 km (Mura, Drava) and 10 km (Danube) long riverbed segments in the TBR MDD.....46
Figure 21: Distribution of Sand Martin (*Riparia riparia*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022.....49
Figure 22: Linear density of Sand Martin (Riparia riparia) breeding pairs in 2021 and 2022 per 5 km (Mura, Drava) and 10 km (Danube) long riverbed segments in the TBR MDD.....50
Figure 23: Distribution of European Bee-Eater (*Merops apiaster*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022.....52
Figure 24: Linear density of European Bee-Eater (Merops apiaster) breeding pairs in 2021 and 2022 per 5 km (Mura, Drava) and 10 km (Danube) long riverbed segments in the TBR MDD.....52
Figure 25: Traces of anthropogenic activities, encountered on gravel bars during surveys in the Mura riverbed between Ceršak (SLO) and Dekanovec (HR). Photo: Luka Božič, DOPPS Birdlife Slovenia.....58
Figure 26: Rip-rap on the river bank of the Drava River and invasive species Paulownia tomentosa in Croatia in 2021. Photo: Darko Grlica.....59
Figure 27: Machinery for sediment gravel extraction on the Drava River in Croatia in 2021. Photo: Darko Grlica.....59

Tables

Table 1: Information on field surveys of the Mura, Drava and Danube riverbed and other localities in the territory of the Mura-Drava-Danube TBR in the 2021 and 2022 seasons. 20
Table 2: Division of the Mura, Drava and Danube into river section types as proposed by Schwarz (2022). 23
Table 3: Number of breeding data (census units) on seven target breeding bird species and four other species of nature conservation importance collected during field surveys of the Mura, Drava, Danube riverbed and other locations (gravel pits, river side arms) in the territory of the TBR Mura-Drava-Danube TBR in 2021 and 2022 26
Table 4: Estimation of the breeding pairs numbers for target river bird species in survey sections on the Mura, Drava and Danube River in 2021 and 2022 (after: (1) - Božič 2022: * mean value of data from 2021 and data from 2022, (2) - Grlica 2022, (3) - Radišić 2022). 30
Table 5: Estimation of the breeding pair numbers for target river bird species in survey sections on the Mura, Drava and Danube River in 2021 and 2022 (after: Božič 2022: * mean value of data from 2021 and data from 2022, (2) - Grlica 2022, (3) - Radišić 2022)..... 30
Table 6: Little Tern (Sternula albifrons) breeding pair number and linear densities in the surveyed sections on the Mura, Drava and Danube Rivers in the TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). Density = breeding pairs per km of the riverbed 34
Table 7: Common Tern (Sterna hirundo) breeding pairs number and linear density in surveys section on the Mura, Drava and Danube Rivers in the TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). Density = breeding pairs per km of the riverbed 36
Table 8: Little Ringed Plover (Charadrius dubius) breeding pairs number and linear density in the surveyed section on the Mura, Drava and Danube Rivers in TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). Density = breeding pairs per km of the riverbed 39
Table 9: Common Sandpiper (Actitis hypoleucos) breeding pairs number and linear density in surveys section on the Mura, Drava and Danube Rivers in TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). Density = breeding pairs per km of the riverbed 43
Table 10: Common Kingfisher (Alcedo atthis) breeding pairs number and linear density in the surveyed section on the Mura, Drava and Danube Rivers in TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). Density = breeding pairs per km of the riverbed 47
Table 11: Sand Martin (Riparia riparia) breeding pairs number and linear density in surveys section on the Mura, Drava and Danube Rivers in TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). “Density” = breeding pairs per km of the riverbed; “c” - colony 50
Table 12: European Bee-Eater (Merops apiaster) breeding pairs number and linear density in surveys section on the Mura, Drava and Danube Rivers in the TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). “Density” = breeding pairs per km of the riverbed; “c” - colony..... 53
Table 13: The river segments of the Mura and Drava (5 km) and the Danube (10 km) river corridor with the highest breeding densities for each target bird species. Peak values of 2–4 segments are in red text. 54

SUMMARY

Bird experts from Slovenia, Croatia and Serbia implemented the first-ever joint nearly complete 5-country river breeding bird mapping for the transboundary river corridor Mura-Drava-Danube (MDD). This report summarizes and combines the findings and results of three separate final reports by bird experts.

In 2021 and 2022, river bird surveys of selected breeding bird species were conducted in the MDD riverbed between Ceršak (SLO-AT) and Bačka Palanka (HR-RS) in a total length of 550 km. The survey covered almost entirely the main river channels of the TBR MDD, except the sections of Drava River between accumulation reservoirs for power plants (Ormož, Varaždin, Dubrava) and 77 km of Danube River between Fajsz (HU) and Batina/Bezdan (rkm 1510-rkm 1433). The field survey methods used mostly complied with common minimum standards for riverbed bird census in the TBR MDD area. Target species of the surveys were Little Ringed Plover *Charadrius dubius* (LRP), Common Sandpiper *Actitis hypoleucos* (CS), Common Tern *Sterna hirundo* (CTER), Little Tern *Sternula albifrons* (LTER), Common Kingfisher *Alcedo atthis* (KIN), Sand Martin *Riparia riparia* (SMA) and the European Bee-eater *Merops apiaster* (BEE). More than 2300 data were collected, digitized and interpreted according to special criteria. Additionally, 1882 existing data for target bird species in the TBR MDD area in Slovenia for the period 2000-2020 were purchased in project lifelineMDD. This survey was conducted to assess the status quo of indicator river birds within the TBR MDD in 2021–2022 to learn from the distribution pattern and the breeding status of the target species and based on this to draw conclusions about the status of dynamic river habitats in the MDD corridor. Breeding distribution maps were prepared for all target species, and population and trend estimates were made where this was possible.

In period 2021-2022, LRP (Little Ringed Plover) population size on the 550 km of Mura, Drava and Danube riverbed was estimated at 100–106 pairs with a linear breeding density of 0,18–0,19 pairs/km in period 2021–2022, and for individual rivers as follows: for the Mura was estimated at 50-74 pairs (0,35-0,52 pairs/km), for the Drava at 21-41 pairs (0,18-0,33 pairs/km) and for the Danube at 6-13 pairs (0,06-0,08 pairs/km), in period 2021–2022. LRP was very densely distributed only along the lower half of the Mura River and upper part of the Drava River upstream of Barcs (HU)/Terezino Polje (HR). The highest densities are reached from Mursko Središče to Legrad (rkm 070 to rkm 049), where linear density reached a record 1.9–2.1 (in 2021) and 1.3–1.4 pairs/km (in 2022), therefore conservation of LRP population in this stretch is extremely important for the whole TBR MDD. Results from Mura riverbed indicate, that the breeding of the LRP depends exclusively on the availability of suitable gravel bars; 43.6 % of all gravel bars mapped in the Mura riverbed were occupied by LRP in at least one of the study years. LRP population trend in the 2008–2022 period was estimated as uncertain. Variations in numbers detected over time can probably be explained availability of suitable gravel bars.

CTER (Common Tern) and LTER (Little Tern) population size in the 550 km of MDD riverbed could be estimated at only a few pairs. During the nesting season in 2022, only one pair of LTER was nesting on the Drava at the Heresznye (187 rkm) and 8 pairs of CTER were nesting in two colonies at Repaš (rkm 205) and Heresznye (187 rkm). LTER and also CTER can be considered among the most endangered river bird species in TBR MDD, therefore, targeted measures have to be taken urgently. Very likely, the Drava River is important for the population of terns, nesting on gravel pits very near the river (e.g., Šoderica), especially for feeding during the breeding season. For CTER decreasing and for LTER most probably decreasing trend was found on Drava in the MDD population in the period 2008–2022.

CS (Common Sandpiper) population size on the 550 km of Mura, Drava and Danube riverbed was estimated at 61–77 pairs with a linear breeding density of 0,11–0,14 pairs/km in period 2021–2022, and for individual rivers as follows: for the Mura was estimated at 51-69 pairs (0,36-0,49 pairs/km), for the Drava at 8-10 pairs (0,03-0,04 pairs/km) and for the Danube at 0 pairs (0 pairs/km), in period 2021–2022. CS was the most frequently recorded species but a large part of the observations were without indication of breeding. Distribution pattern of breeding Common Sandpipers from 2021 and 2022 followed the distribution pattern of the Little Ringed Plover, with the several kilometre long gaps between data on Drava and exception that no single breeding pair of Common Sandpiper were recorded on the Danube. In 2021 and 2022 more than 80 % of the TBR MDD breeding pairs of the CS were nesting on the Mura riverbed. The highest breeding densities of the CS in this survey were found on the Mura River in the river stretch from Mursko Središče to Dekanovec with linear densities from 0.9–1.1 in 2021 and 0.8–1.4 pairs/km in 2022, respectively. CS overall population trend in the 2008–2022 period was estimated as uncertain (for Mura and Drava), although on the Mura in Slovenia a moderate increase was estimated for the period 2008–2022. In survey in Slovenia, most of the pairs (81 % in 2021 and 89 % in 2022) selected gravel bars for breeding, while others nested in side arms, river banks and artificial structures with shingle surface or woody debris. 42.6 % of all gravel bars were occupied by CS in at least one of the study years. The isolated breeding locations of LRP and CS on the upper heavily regulated Mura are result of recent river restoration projects (Gosdorf, Sicheldorf, Hrastje-Mota). The gravel bar surface area determines the occupancy probability of both species and has significant effect on the number of LRP and CS pairs nesting on it. Some of the key nesting locations were affected by anthropogenic activities, such as gravel excavation, off-road driving and prolonged recreational use.

KIN (Common Kingfisher) population size on the 550 km of Mura, Drava and Danube riverbed was estimated at 194–219 pairs with a linear breeding density of 0,35–0,040 pairs/km in period 2021–2022, and for individual rivers as follows: for the Mura was estimated at 43-57 pairs (0,34-0,37 pairs/km), for the Drava at 81-101 pairs (0,30-0,37 pairs/km) and for the Danube at 59-72 pairs (0,45-0,52 pairs/km), in period 2021–2022.

SMA (Sand Martin) population size on the 550 km of Mura, Drava and Danube riverbed was estimated at 6477–9676 pairs (in 61–64 colonies) with a linear breeding density of 11,8–17,6 pairs/km in period 2021–2022, and for individual rivers as follows: for the

Mura was estimated at 663-876 pairs in 19–21 colonies (density 5,8–5,0 pairs/km), for the Drava at 4591-7979 pairs in 8–13 colonies (density 29,2-16,8 pairs/km) and for the Danube at 871-1183 pairs (6,5-8,8 pairs/km), in the period 2021–2022.

BEE (European Bee-Eater) population size on the 550 km of Mura, Drava and Danube riverbed was estimated at 192–467 pairs with a linear breeding density of 0,35–0,85 pairs/km in period 2021–2022, and for individual rivers as follows: for the Mura was estimated at 5-14 pairs (0,04-0,10 pairs/km), for the Drava at 141-309 pairs (0,52-1,13 pairs/km) and for the Danube at 46-144 pairs (0,34-1,07 pairs/km), in the period 2021–2022.

The results for all seven indicator bird species show the high natural value of the Mura River upstream of the Drava confluence all the way to Mursko Središče and Drava River between the Mura-Drava confluence and downstream to Terezino Polje/Barcs.

The surveys in 2021 and 2022 confirmed the national and international importance of the Mura, Drava and Danube River area between Ceršak (SLO) and Bačka Palanka (HR) for selected river bird species.

According to the analysis of bird breeding data per segments (5km/10 km) the most important river segments with highest density and/or river breeding bird biodiversity of the rivers Mura, Drava and Danube were identified. Based on that analysis we would recommend stretches in TBR MDD where protection and restoration should be concretized:

i) the prioritized river segments/stretches for protection and conservation actions:

- on Mura River between Križovec (HR) and Domašinec (HR)/Murasemenye (HU) (rkm 045-065) and upstream of the Mura-Drava confluence at Legrad (rkm 000-005);
- on Drava River segments between Ferdinandovac (HR)/ Vizvar/Heresznye(HU) and Križnica (HR) (rkm 175-190), between Legrad and Hlebine (rkm 215-235), between Repaš and Čambina (rkm 200-210) and, short stretches downstream of Dubrava hydropower reservoir/lake (rkm 240-250) and in the area of Trnovec (rkm 290-295);
- one segment on the Danube River in between Aljmaš and Borovo, upstream of Vukovar (rkm 1340-1380).

ii) prioritised river segments/stretches for river restoration actions:

- long stretches of upper Mura between Ceršak and Gornja Radgona (rkm 110-145);
- Drava from Barcs to Gornje Predrijevo upstream of Noskovci (rkm 120-160) and short stretches of Danube in the area of Šarengrad-Bačka Palanka (rkm1295-1305) and
- also, the area of Batina/Bezdan (rkm 1420-1430) hold only few characteristic bird species of pristine riverine habitats.

1. INTRODUCTION

1.1. General Introduction

The present report is the result of a study conducted within the DTP3-308-2.3 lifeline MDD project, financed by the European Union´s Interreg Danube Transnational Programme. The area analysed and targeted by the present study (hereinafter called "target area") comprises river sections in the 5-country Biosphere Reserve Mura-Drava-Danube (TBR MDD, Figure 1), shared between Austria, Slovenia, Hungary, Croatia, and Serbia. 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 700 kilometres long "green belt", connecting almost 1.000,000 hectares of highly valuable natural and cultural landscapes, including a chain of 13 individual protected areas and 3.000 km^2 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 was realized: Hungary and Croatia (in 2012), Serbia (in 2017), Slovenia (in 2018) and Austria (2019) achieved UNESCO designation. The penta-lateral designation was submitted in 2020 and the designation was finally achieved in September 2021.

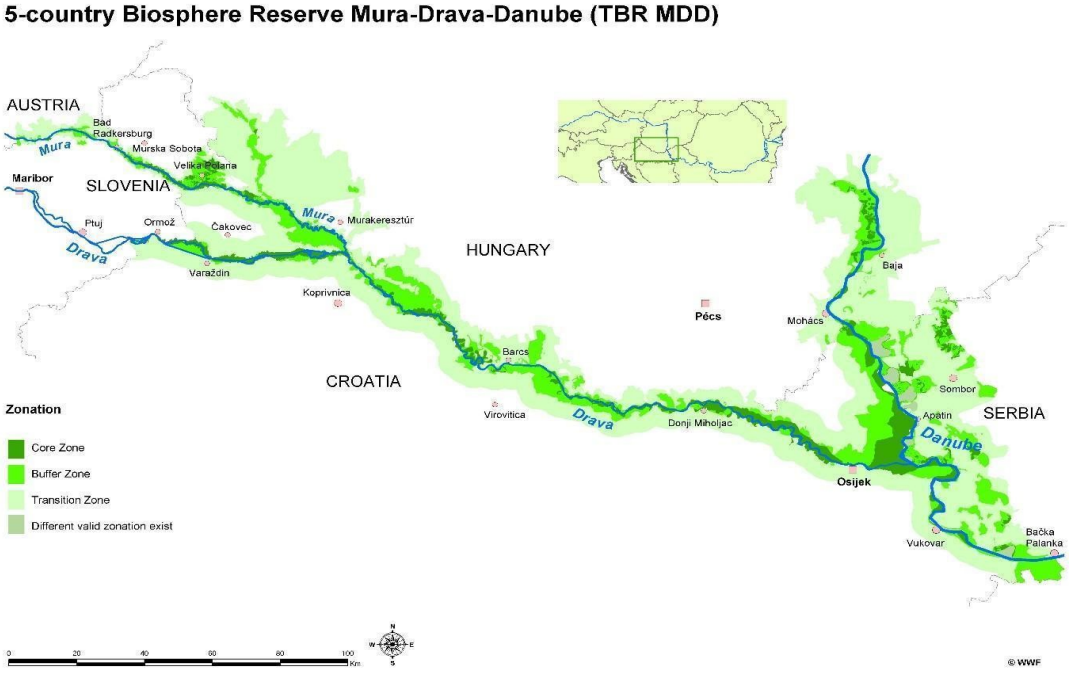

Figure 1: Map of the 5-country Biosphere Reserve Mura-Drava-Danube according to UNESCO designation in September 2021 (WWF Austria)

The project´s work package for *Establishing the scientific knowledge base* (Work Package T1) has been proposed as its aim to establish, as a first, scientific knowledge base regarding vertical, lateral and longitudinal connectivity within the Mura-Drava-Danube bio-corridor. All study results and the overlaid GIS data collected, therefore, build the basis for a synthesis report on biotic indicators and abiotic framework conditions. This builds the basis for long-term conservation and restoration goals within the 5-country Biosphere Reserve Mura-Drava-Danube (TBR MDD) as well as for the formulation of a TBR MDD River Restoration Strategy, elaborated in the framework of the same project (Output O.T2.4). The facts and results presented in this project are the first-ever such scientific assessment, which was done between July 2020 and December 2022, harmonized on the 5-country scale, setting the ground for the future decision making on 5-country level on river management and restoration. Whereas such activities and knowledge in each of the countries involved in the TBR MDD partly exist, it was the first-time that methods and area were harmonized for monitoring and studies of the biotic elements and the abiotic framework conditions for the Mura-Drava-Danube River corridor.

Information on the current status of the seven breeding river birds (bio-indicators) in the TBR MDD is a major contribution to the above-mentioned knowledge base and for the use of these mappings as an input to the synthesis report in project Activity T1.3. For this purpose, the Institute of the Republic of Slovenia for Nature Conservation (IRSNC), Regional Unit Maribor, coordinated the “River birds breeding report” within the lifelineMDD project.

The overall aim of this study was to analyse the status quo of the number and distribution of breeding sites for selected seven river bird species (Little Tern, Common Tern, Little-ringed Plover, Common Sandpiper, Sand Martin, Common Kingfisher, European Bee-Eater), as well as the number of breeding pairs per breeding site. Another aim of the report was also to draw conclusions on issues/threats to river birds and how to counteract those through protection and restoration measures and future restoration strategies.

The river birds breeding report is the result of the mapping of river birds breeding sites performed by IRSNC, WWF Adria, and INCVP (Institute of Nature Conservation of Vojvodina Province, Serbia) with the help of external bird experts from Slovenia (DOPPS Birdlife Slovenia), Croatia (Natural History Society Drava) and Serbia the (University of Novi Sad, Faculty of Science, Department for Biology and Ecology) in the breeding seasons in 2021 and 2022. This report compiles results from three national final reports into one joint report. Final reports of countries are provided as annexes/appendixes to this report.

Selected results from former/earlier bird mappings and monitoring activities in the TBR MDD were integrated into separate final reports and in this joint report if possible/available, even though these do not cover the whole TBR MDD and not all target river birds for each section and year. The previous ones were mainly included for the

Mura River in Slovenia, where existing data for target bird species in the TBR MDD area between 2000 and 2020 were purchased as part of the lifelineMDD project.

1.2. State of knowledge and study aims

The river breeding bird study has had the aim to contribute to the establishment of the knowledge base regarding longitudinal and lateral connectivity within the MDD bio-corridor. River breeding birds as bio-indicators indicate the ecological functionality of the existing habitats and dynamic processes related to connectivity. River birds breed on gravel bars and steep banks created by longitudinal sediment flow and lateral dynamics.

Breeding birds, which depend on habitats created in highly dynamic riverine ecosystems, such as steep banks, and gravel and sand banks, are endangered on the European level, mainly due to habitat loss. In the lifelineMDD bird study seven river breeding birds were chosen as indicator species and monitored jointly throughout the TBR MDD for the first time based on a harmonized counting method over two breeding seasons: 2021 and 2022. Four of the species are gravel/sand bar breeders: Little Tern *Sternula albifrons*, Common Tern *Sterna hirundo*, Common Sandpiper *Actithis hypoleucos*, Little Ringed Plover *Charadrius dubius* and three are steep bank breeders: Common Kingfisher *Alcedo atthis*, Sand Martin *Riparia riparia*, European Bee-Eater *Merops apiaster*. These target indicator species have complex ecology or special ecological needs; therefore, they indicate the conditions of their habitats well. The species themselves, their distribution (presence or absence) and the number of their breeding pairs give us a good insight into the conditions of the rivers Mura, Drava, and Danube.

River birds are partly monitored by some countries and also in varying frequencies. Data on breeding numbers are available for single countries, but not for the transboundary river corridor MDD. Also, the existing mapping/monitoring methods in each country are different. In Croatia there are existing long-term data for all seven target species from regular surveys along the Mura, Drava, and Danube rivers in Croatia, including the border stretches with Hungary (Mura, Drava) and Serbia (Danube). Data on the Drava has been collected from 2004 onwards, for the rivers Mura and Danube from 2008 onwards (Gattermayr *et al.* 2019). In Slovenia, for the Mura River, including the border stretches with Austria and Croatia, there in an existing national monitoring for the Common Kingfisher conducted every two years, where also data on other target river bird species are recorded (if possible). DOPPS Birdlife Slovenia as the most important expert institution in the field of ornithology in Slovenia also has other additional raw data on river birds for the area of the Mura River and the Mura River Biosphere Reserve in their database. According to Radišić (2022) in Serbia continuous monitoring of river birds does not exist. Thus, data from 2021 and 2022 could not be compared with previous data. A survey conducted in 2021 and 2022 is an important step toward establishing a proper river bird monitoring in Serbia (Radišić 2022). However, there are existing important river bird data collected on the Danube in Serbia for the Joint Danube Survey 3 (JDS3) in 2011 and 2013 (Schmidt *et al*. 2015, Liška *et al*. (eds.) 2015). Additional data on river

birds in TBR MDD are existing, recorded in the past by Tibor Mikuška, BirdLife Austria and the Hungarian National Park Duna-Drava Directorate (Gattermayr *et al.* 2019). Exchange of data between the countries, joint result interpretation in the whole TBR MDD and continuous cooperation between bird experts from different countries are missing.

So far there was no available data on breeding numbers and the river bird's distribution maps from the joint transboundary field survey in the TBR MDD. However, in the scope of the "Drava Life" project LIFE14 NAT/HR/000115, an **"Action plan for riverbirds in the planned five-country Biosphere Reserve "Mura-Drava-Danube"** (hereinafter "Action plan") has been developed for the TBR MDD (Gattermayr *at al.* 2019). In this "Action plan", a comprehensive data collection for seven target river breeding birds from the TBR MDD area and an overview of the current status for four characteristic gravel/sand bank breeders and three characteristic steep bank breeders was made. In the "Action plan" for the first time, the distribution of the seven indicator bird species and their breeding numbers have been worked out for the large TBR region (including also the Slovenian Drava from Maribor to Središče ob Dravi that is not part of TBR MDD) in cooperation with local ornithologists and based on the existing data. In the "Action plan" also the main threats for these river bird species have been identified and according to those, 10 objectives and, finally, 43 preservation actions have been worked out in workshops with experts and stakeholders, which are to reverse these negative trends (Gattermayr *at al.* 2019).

Nevertheless, the authors of this joint river breeding bird study or/and separate final reports for the three countries (provided as an annex to this study) have attempted to integrate existing knowledge on target river breeding birds as well as possible selected publications and reports for this study. For the Mura River in Slovenia in the scope of the project lifelineMDD the purchase of existing data for target river birds for TBR MDD area was conducted (Božič 2021a). Detailed literature analysis was not undertaken within this project.

In 2021, when the project lifelineMDD was still in progress, the 5-country Biosphere reserve Mura-Drava-Danube was declared. This was the right time to start with the first joint mapping/monitoring of the target river birds that breed in the riverbed of Mura-Drava-Danube throughout the whole TBR MDD. Project partners of the lifelineMDD project (IRSNC, INCVP, WWF Adria) and bird experts from Slovenia, Croatia and Serbia implemented the first-ever joint (nearly) complete 5-country field river breeding bird census (mapping) for the transboundary river corridor MDD, in 2021 and 2022. River bird surveys in a dimension of 550 km riverbed (not the whole app. 680 km riverbed in TBR MDD) were carried out and the methods were standardized as much as possible (defined ToR for the TBR MDD: 1-2 rounds per year, by boat, end of April-July, assessing the number of birds and breeding pairs).

In the "Action plan" 10 objectives have been developed for every threat and sub-threat and actions required for achieving these objectives were defined. Some of these actions were implemented as part of the lifelineMDD "bird study" and are listed below in brackets in the list of aims of this study.

Overall, the aims of this study can be summarized as following:

- First-ever joint 5-country field river breeding bird mapping/census or monitoring for the transboundary river corridor MDD conducted with standardized methodology and unique digital layer/database form used in the whole TBR MDD *(Action 2 in »Action plan«),*
- Assess the status quo of indicator river birds within the TBR MDD in 2021 and 2022, this means: number and distribution of breeding sites for all seven indicator river bird species: Little Tern, Common Tern, Little-ringed Plover, Common Sandpiper, Sand Martin, Common Kingfisher, European Bee-Eater on 550 km of the TBR MDD,
- Determine the number of breeding pairs per breeding site (see annexes),
- Assess the population sizes of target bird species on 550 km of the Mura, Drava and Danube riverbed according to mapping in season 2021 and 2022,
- Try to assess the short-term population trend according to available existing data on target river bird species from previous years,
- Analyse the linear density of breeding sites/pairs per 5 km and 10 km river segments for target indicator species and define segments important for preservation and segments with high potential for restoration *(first step in Action 7, Action 17, Action 19 and Action 20 in the »Action plan«),*
- Use information from above points as a baseline and a tool for the long-term impact assessment of future restoration projects,
- Addressed the potential threats to the target river birds identified in the field in 2021 and 2022,
- Draw conclusions on threats/issues for river birds and how to counteract those through protection and restoration measures and future restoration strategies,
- Identification of knowledge gaps that should be addressed in future surveys.

2. METHODOLOGY

In this study, due to the long section of birds mapping of the 550 km of river Mura, Drava and Danube rivers, three groups of bird experts from Slovenia (DOPPS Birdlife Slovenia), Croatia (Natural History Society Drava) and Serbia (University of Novi Sad) were involved. All in all, at least 6 experts and 6 assistants were involved in the field riverbed survey in 2021 and/or 2022. In order to avoid discrepancies in field surveys between different bird experts and different rivers in the TBR MDD, we first standardized the method and prepared the Terms of Reference (ToR).

2.1. Terms of Reference

Working group for birds of the lifelineMDD project, aided by bird experts, have developed a unified methodology with the common minimum standards (ToR) to be used in this first

joint mapping/census of river breeding birds in 5-country Biosphere Reserve Mura–Drava–Danube.

When preparing the ToR, we reviewed protocols and census methods already used in the existing river bird monitoring in TBR MDD countries, reviewed the existing literature (Božič & Denac 2017, Schmidt *et al.* 2015, Grlica 2018a, Grlica 2020, Mikuska & Grlica 2013, Mikuška et al. 2015, Gattemayr *et al.* 2019) and in several meetings also took into account the experiences of bird experts (Luka Božič, Darko Grlica, Dimitrije Radišić, Matthias Gattermayr, Jelena Kralj).

Due to the large study area and permanent changes in water level, a simplified, flexible and efficient methodology was developed in the ToR. These ToR must also be taken into account in future river bird census/mapping/monitoring in the TBR MDD. The most important standards of the ToR are presented below, but for more details and the whole ToR see annexes.

1. Monitoring requirements: 1 monitoring round per year (total 2 monitoring rounds in 2021 and 2022) within the wider monitoring time frame (end of April– July); In case of unfavourable weather or water levels, the visit must be optimised to make sure birds can already nest, or repeated later, under favourable conditions; monitoring done at least 10 days after high water levels (if possible, based on weather conditions and water levels); monitoring done by vessels (electro boat or similar vessel that will not disturb the birds)
2. Monitoring time frame: 2021 (end of April – July, 2022 (end of April– July)
3. Monitored area:
    - River Mura (SI-AT, IRSNC): from Šentilj/Spielfeld to Dekanovec (a tributary of the Big Krka)
    - River Mura (HR-HU): from Dekanovec to Mura-Drava confluence (Legrad) (0-49rkm)
    - River Drava (HR-HU): from Lovrečan - Ormož- Svibovec to Varaždin, and downstream of Donja Dubrava to the Drava-Danube confluence
      + gravel pit Šoderica
    - River Danube (HR): from Batina to Ilok, right river bank
    - River Danube (RS): from Bezdan (Batina)Ilok to Bačka Palanka (Ilok), left river bank
4. Monitored seven bird species: Little Tern (*Sternula albifrons*), Common Tern (*Sterna hirundo*), Little-ringed Plover (*Charadrius dubius*), Common Sandpiper (*Actitis hypoleucos*), Sand Martin (*Riparia riparia*), Common Kingfisher (*Alcedo atthis*), European Bee-Eater (*Merops apiaster*).
   Additional species, characteristic for riverine systems, can also be recorded (e.g. White-tailed eagle (*Haliaeetus albicilla*), Black stork (*Ciconia nigra*), etc.)
5. Data collected in the field must be digitized and prepared in shapefile format with a unique attribute table (see Annexes), for the purpose of simplifying aggregation of data in digital layers from all different countries.

2.2. Study area

The study area covers 550 km of Mura, Drava and Danube rivers in TBR (hereinafter: "550 km MDD"; see Figure 2). This does not represent the whole TBR MDD, the missing parts are the stretches of the Drava River between river kilometre (rkm) 314–300 and rkm 289–256 where the river is adjusted to three hydroelectric reservoirs (Ormož, Varaždin, Donja Dubrava) for power plants and also the section of the Danube River between Fajsz (HU) and Batina/Bezdan (rkm 1510–1433) was not included in the field survey. The survey was mainly limited to the main stream of the Mura, Drava, Danube, including gravel bars, river islands, river banks with riparian vegetation, and other structures in the riverbed and only few side arms (in Slovenia).

In Serbia there were included also some selected main river backwaters (in 2021: Vukovarska ada, Hagla, Ada Kritoš, Donji Prut, Staklara, Mišvald; in 2022: Šarengradska ada, Hagla. Donji Prut, Staklara, Mišvald) and some selected gravel pits in Slovenia and Croatia (Križovec, Šoderica). Additionally, in 2022 in the frame of another project in Slovenia, the bird mapping of the Common Kingfisher was extended to a big part of the larger side arms of the Mura River in Slovenia (see Božič 2022).

Figure 2: The Mura, Drava and Danube riverbed between Ceršak (SLO) and Bačka Palanka (RS), where the census of selected breeding bird species was conducted in the 2021 and 2022 seasons. Different colours represent the sections, where different bird experts conducted the field bird census. Light green line – Božič 2022, blue line – Grlica 2022, dark green line – Radišić 2022, grey line – no bird census.

The field survey of the 550 km Mura, Drava and Danube riverbed was only possible due the cooperation of bird experts from Slovenia, Croatia and Serbia. The course of all three rivers was split into sections, for each of which a national bird expert implemented the field survey (Figure 3).

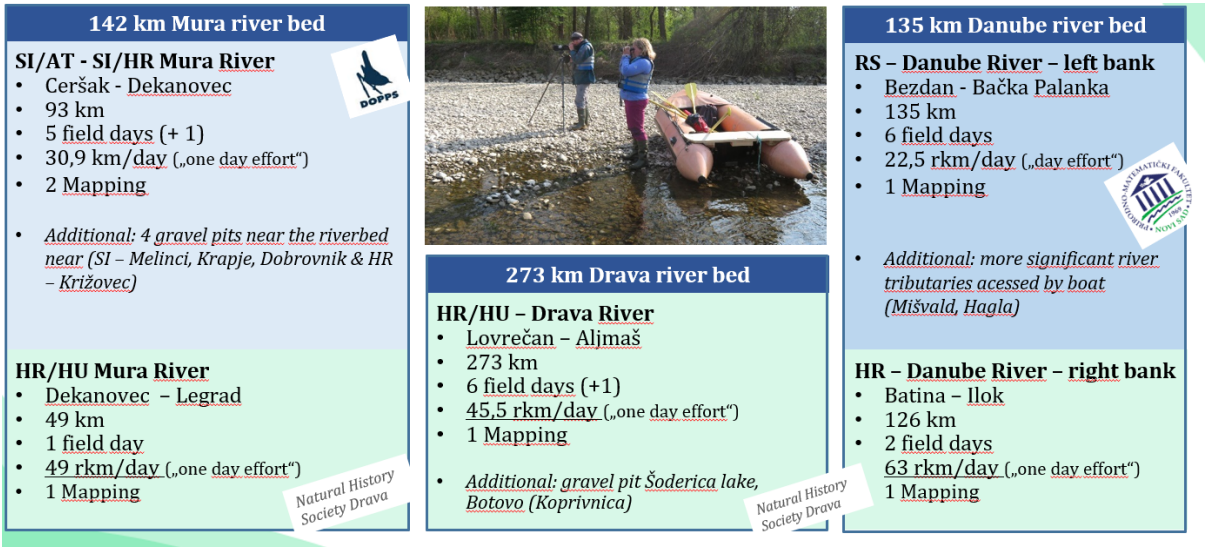

Figure 3: Detailed field survey overview on river bird census conducted in season 2021 in the TBR MDD.

Figure 4: The width of the riverbed and type of the habitat as also type of the sediments differ in the three rivers in the TBR MDD – Mura River (left above; photo: Luka Božič), Drava River (right above; photo: Darko Grlica) and Danube River (left and right below; photo: Darko Grlica, Dimitrije Radišič).

The Mura, Drava and Danube differ in terms of dimensions (the width of the riverbed) and type of sediments on bars and banks, that is illustrated in Figure 4. In Slovenia near Ceršak (rkm 143), where the TBR MDD begins, the width of the riverbed is slightly less than 70 m, the width of the Drava riverbed near Barcs (rkm 153) is around 220 m, and

the width of the Danube River, on the most eastern border of the TBR MDD near Bačka Palanka (rkm 1295) is almost 400 m. This fact must also be taken into account when planning the project studies (finances) and also analysing and interpreting the results, particularly when observing the target river bird species in the field and then assessing the number of breeding pairs.

2.3. Field survey methods

The main goal of the survey was to monitor seven bird species which are indicators of river dynamics. According to the requirements of the ToR, seven river birds were the target species as presented in the Figure 5.

Figure 5: Target species of the 550 km Mura-Drava-Danube riverbed surveys in 2021 and 2022 (from top left to bottom right) – Little Ringed Plover *Charadrius dubius* (photo: T. Basle), Common Sandpiper *Actitis hypoleucos* (photo: J. Novak), Common Kingfisher *Alcedo atthis* (photo: L. Božič), Sand Martin *Riparia riparia* (photo: A. Ploj), Bee-eater *Merops apiaster* (photo: A. Ploj), Common Tern *Sterna hirundo* (photo: A. Ploj) and Little Tern *Sternula albifrons* (photo: A. Povedano, https://en.wikipedia.org/wiki/Little_tern).

Due to its nature conservation importance, on the Mura in Slovenia Common Merganser *Mergus merganser* was also systematically included in the census of the riverbed breeding birds (Božič 2022). Bird experts also recorded random observations of Black Stork *Ciconia nigra*, White-tailed Eagle *Haliaeetus albicilla*, White-throated Dipper *Cinclus cinclus*, Wood Sandpiper *Tringa glareola,* Yellow-legged Gull *Larus michahellis, Black-headed Gull Chroicocephalus ridibundus,* Common Merganser *Mergus merganser,* Pygmy cormorant *Microcarbo pygmaeus,* Black kite *Milvus migrans,* Black-crowned night heron *Nycticorax nycticorax…* Both breeding and nonbreeding individuals of all target and additional bird species were recorded. Non-target bird data were not analyzed for this joint report but are included in the digital layer (attribute table) of the data.

The field survey methods were mostly complied with common minimum standards (ToR) for the riverbed bird census in the TBR MDD area, developed by the working group for birds of the lifelineMDD project, aided by bird experts. The only provision from the ToR that was not entirely taken into account is the implementation of the census at least 10 days after the cessation of high-flow events. The latter was not always possible, especially in 2021, due to the prolonged duration of large discharges, leading to high-water levels almost during the entire breeding season and administrative reasons related to crossing the border (Slovenian-Croatian) during the Covid-19 pandemic. However, fieldwork was conducted during the period when species that nest on sand islets had the highest probability to start breeding. This fact was considered in the analysis.

In general, bird censuses for a survey in one year were conducted once in the breeding season, by small boat or vessels. There are two deviations from that; the bird surveys in Slovenia in 2021 and 2022, the censuses were carried out twice per breeding season. Also, in Serbia a second bird census in 2022 was conducted. Therefore, the data on breeding pairs for the Mura in Slovenia including bordering stretches with Austria and Croatia are more detailed. This fact was considered in the analysis and when displaying breeding densities on maps

Detailed descriptions of the methodological implementation of bird censuses in each country can be found in separate final bird expert reports and Annexes (Božič (2022), Grlica (2022), Radišić (2022)).

In the 550 km MDD corridor in 2021 and 2022 altogether **42 days of field survey on** riverbed was conducted, **20 in the year 2021 and 22 in the year 2022**. Additionally, in the other project - national monitoring of birds in Slovenia, 50 days of inventories in the

field was done in 2022 beside the riverbed, where gravel pits and smaller side arms were checked (for details see Božič 2022). In Slovenia the census in the field was done twice per season, the same is valid for the Danube in Serbia in 2022. All censuses in MDD in Croatia were done only once due to the very long total (448 km) length of the river course Mura, Drava and Danube in Croatia, which had to be surveyed and the project funds were limited for this activity.

The schedule of bird censuses on the Mura, Drava and Danube River in the TBR MDD area is shown in Table 1.

Table 1: Information on field surveys of the Mura, Drava and Danube riverbed and other localities in the territory of the Mura-Drava-Danube TBR in the 2021 and 2022 seasons.

Legend: 1 - DOPPS Birdlife Slovenia, Luka Božič, SI, 2 - Natural History Society Drava, Ivan Darko Grlica, HR, 3 - University of Novi Sad, Faculty of Science, Department for Biology and Ecology, Dimitrije Radišić, RS

ID	**Date**	**Year**	**River**	**Country**	**Riverbed surveys MDD sections, rkm**	**External expert** (institution, responsible person), **country**
1	25.04.2021	2021	Mura	Slovenia	143-80	1 - DOPPS Birdlife Slovenia
2	29.04.2021	2021	Mura	Slovenia	80-49	1 - DOPPS Birdlife Slovenia
3	4.06.2021	2021	Mura	Slovenia	143-95	1 - DOPPS Birdlife Slovenia
4	10.06.2021	2021	Mura	Slovenia	95-70	1 - DOPPS Birdlife Slovenia
5	9.06.2021	2021	Mura	Slovenia	70-49	1 - DOPPS Birdlife Slovenia
6	25.04.2022	2022	Mura	Slovenia	143-95	1 - DOPPS Birdlife Slovenia
7	26.04.2022	2022	Mura	Slovenia	95-70	1 - DOPPS Birdlife Slovenia
8	28.04.2022	2022	Mura	Slovenia	70-49	1 - DOPPS Birdlife Slovenia
9	6.06.2022	2022	Mura	Slovenia	143-95	1 - DOPPS Birdlife Slovenia
10	7.06.2022	2022	Mura	Slovenia	95-70	1 - DOPPS Birdlife Slovenia
11	12.06.2022	2022	Mura	Slovenia	70-49	1 - DOPPS Birdlife Slovenia
12	30.06.2021	2021	Mura	Croatia	49-0	2 - Natural History Society Drava
13	12.06.2022	2022	Mura	Croatia	49-0	2 - Natural History Society Drava
14	8.06.2021	2021	Drava	Croatia	161-96	2 - Natural History Society Drava
15	9.06.2021	2021	Drava	Croatia	96-39	2 - Natural History Society Drava
16	11.06.2021	2021	Drava	Croatia	39-0	2 - Natural History Society Drava
17	1.07.2021	2021	Drava	Croatia	256-201	2 - Natural History Society Drava
18	2.07.2021	2021	Drava	Croatia	201-161	2 - Natural History Society Drava
19	3.07.2021	2021	Drava	Croatia	320-314 and 300-389	2 - Natural History Society Drava
20	30.05.2022	2022	Drava	Croatia	161-124	2 - Natural History Society Drava
21	31.05.2022	2022	Drava	Croatia	124-39	2 - Natural History Society Drava
22	1.06.2022	2022	Drava	Croatia	39-0	2 - Natural History Society Drava
23	11.06.2022	2022	Drava	Croatia	256-183	2 - Natural History Society Drava
24	16.06.2022	2022	Drava	Croatia	183-161	2 - Natural History Society Drava
25	19.06.2022	2022	Drava	Croatia	320-314 and 300-389	2 - Natural History Society Drava

ID	Date	Year	River	Country	Riverbed surveys MDD sections, rkm	External expert (institution, responsible person), country
26	14.06.2021	2021	Danube	Croatia	1425-1353	2 - Natural History Society Drava
27	15.06.2021	2021	Danube	Croatia	1353-1299	2 - Natural History Society Drava
28	4.06.2022	2022	Danube	Croatia	1425-1331	2 - Natural History Society Drava
29	5.06.2022	2022	Danube	Croatia	1331-1299	2 - Natural History Society Drava
30	8.07.2021	2021	Danube	Serbia	1298. - 1308.	3- 3- University of Novi Sad
31	13.07.2021	2021	Danube	Serbia	1408. - 1433.	3- University of Novi Sad
32	14.07.2021	2021	Danube	Serbia	1375. - 1408.	3- University of Novi Sad
33	15.07.2021	2021	Danube	Serbia	1355. -1375.	3- University of Novi Sad
34	21.07.2021	2021	Danube	Serbia	1328. - 1355.	3- University of Novi Sad
35	22.07.2021	2021	Danube	Serbia	1308. - 1328.	3- University of Novi Sad
36	23.05.2022	2022	Danube	Serbia	1308. - 1356.	3- University of Novi Sad
37	24.05.2022	2022	Danube	Serbia	1298. - 1308.	3- University of Novi Sad
38	25.05.2022	2022	Danube	Serbia	1433. - 1382.	3- University of Novi Sad
39	3.06.2022	2022	Danube	Serbia	1356. - 1382.	3- University of Novi Sad
40	12.07.2022	2022	Danube	Serbia	1308 - 1363	3- University of Novi Sad
41	12.07.2022	2022	Danube	Serbia	1408 – 1433	3- University of Novi Sad
42	14.07.2022	2022	Danube	Serbia	1363 – 1408	3- University of Novi Sad

Birds were observed from a slowly moving boat. Gravel bars surface was systematically checked by binoculars and/or spotting scope. Very large gravel bars and sand islets were often surveyed on foot on the bar/island edge if possible, following the principle of not disturbing the birds. Exact locations of observed individuals and their suitable habitats were recorded with GPS devices. Details of the habitat were noted and often also photographed.

For every record, bird experts counted the observed individuals and estimated the number of breeding pairs (bp). The minimum required information for each registration recorded (species, number of individuals) includes (1) species, (2) number of individuals (occupied nest holes in colonial burrowing birds) and (3) behaviour, in particular any form suggesting breeding (i.e. warning calls or territorial, display, distraction behaviour etc.). For each observation, we chose one of 16 breeding codes which describe the strongest evidence of breeding on location.

2.4. Data analysis and interpretation of results

The data collected were digitized and prepared in shapefile format with a unique attribute table as determined in ToR. The content and form of the attribute table was determined at a meeting of bird experts and project partners and are uniform for all countries involved in the census of riverbed breeding bird species (Slovenia, Croatia, Serbia). The attribute table contains the following fields in the specified order: **ID, English species**

name, Scientific species name, GPS point (in our case sequential number of the registration on orthophoto)**, Date, N_WGS84 (PHI), E_WGS84 (LAMBDA)**, River KM; Location – nearest settlement, **Number of individuals, Number of pairs, Breeding code**, Water conditions, Note, Photo, **Legit & det. / Expert name, Country, River**. Fields in bold are required.

The interpretation of the collected data (estimation of the population size) followed the criteria for a breeding pair/occupied territory, based on bird experts previous experience and recommendations from abroad (Andretzke *et al.* 2005, Božič & Denac 2010, 2017).

Detailed descriptions for the interpretation of recorded data on individuals or breeding pairs for each country can be found in separate final bird expert reports in the Annexes (Božič (2022), Grlica (2022), Radišić (2022)).

Each data was assigned a breeding code according to European Bird Census Council (EBCC; Keller *et al.* 2020, Slovenian version according to Mihelič *et al.* 2019); those actually used in this study are marked in bold:

0 Species observed in the breeding season outside possible nesting habitats
1 Species observed in the breeding season in possible nesting habitats
2 Singing male(s) present (or breeding calls heard) in breeding season
3 Pair observed in suitable nesting habitat in breeding season
4 Permanent territory presumed through registration of territorial behaviour (song, etc.) on at least two different days a week or more apart at the same place
5 Courtship and display
6 Visiting probable nest site
7 Agitated behaviour or anxiety calls from adults
8 Brood patch on adult examined in the hand
9 Nest building or excavating nest-hole
10 Distraction-display or injury-feigning
11 Used nest or eggshells found (occupied or laid within period of survey)
12 Recently fledged young (nidicolous species) or downy young (nidifugous species)
13 Adults entering or leaving nest-site in circumstances indicating occupied nest (including high nests or nest holes the contents of which cannot be seen) or adult seen incubating
14 Adult carrying faecal sac or food for young
15 Nest containing eggs
16 Nest with young seen or heard (Božič 2022)

Digital layer (.shp) with a unique attribute table from all three bird experts were then joined. For graphical presentation of the breeding occurrence of target species and

creation of other maps ArcMap 10.8.1. was used. For graphical presentation of numerical data in diagrams MS excel was used.

2.4.1 Data analysis per river sections

Analysis per river sections was used for visualisation and to get a quick insight into the most important river section of three rivers Mura, Drava, and Danube for seven target breeding river birds in TBR MDD. Analysing and combining data of breeding pairs of target river bird in eight river sections also allows us to cross over and compare these results (in the project´s synthesis report) with results of other project studies, for example the river training structures study.

Table 2: Division of the Mura, Drava and Danube into river section types as proposed by Schwarz (2022).

River	Section		Rkm from	Rkm to
Mura	MUR1	Spielfeld – Croatian border	143	85
	MUR2	Croatian border – Hungarian border	85	45
	MUR3	Hungarian border – Drava confluence	45	0
Drava	DRA1	Ormož – Mura confluence	310	235
	DRA2	Mura confluence – Heresznye	235	185
	DRA3	Heresznye – Danube confluence	185	0
Danube	DAN1	Fajsz – Drava confluence	1510	1382
	DAN2	Drava confluence – Bačka Palanka	1382	1295

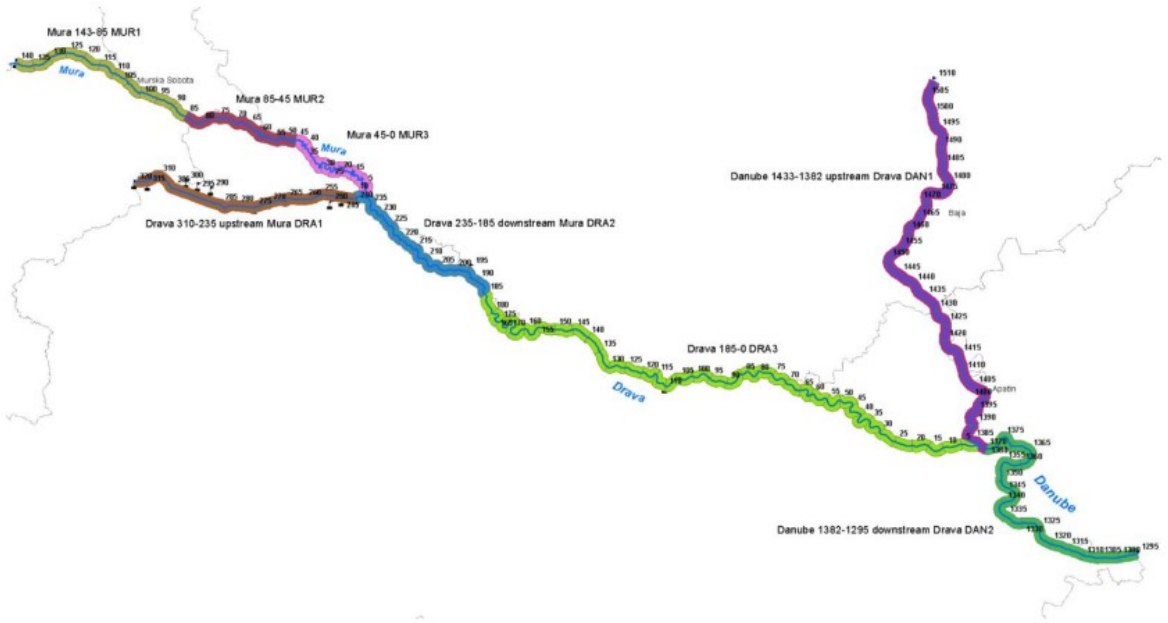

Figure 6: Overview of the eight River sections types (RTS) and river kilometre (rkm) together with the visualization and assessment segments of 5 km for Mura and Drava and 10 km for Danube (according to Schwarz (2022).

Due to the large survey area and heterogeneity, for the purposes of data visualization and interpretation the more several hundred-kilometre long MDD surveyed area is divided into eight survey sections, established for the lifelineMDD project report River Training Structures and Historical Mapping within the Mura-Drava-Danube TBR (Schwarz 2022). River section types (RST) were defined as suggested by Schwarz (2022). The definition of overall RST for the three rivers is an important step to characterize the importance of these river sections for breeding of target river birds and to assess all other results accordingly throughout all work packages and in particular the scientific studies. The eight River section types are defined for the three rivers as described (Schwarz 2022) in table 2 and figure 6 above (in downstream direction).

2.4.2 Data analysis per river segments 5 km (Mura, Drava) and 10 km (Danube)

We also analysed bird breeding data on a more detailed scale. To allow a more detailed visualization and assessment of target river breeding birds but also for the final synthesis (overlay) with the other scientific studies the digital layer with assessment segments, with a standard size of 10 rkm for the Danube and 5 rkm for the Mura and the Drava was prepared (Figure 6). River assessment segments were defined as suggested by Schwarz (2022) in the report *River Training Structures and Historical Mapping within the Mura-Drava-Danube TBR*.

The riverbed of the Mura, Drava and Danube from the whole TBR MDD was "cut" into 114 segments, but in the bird study only 98 segments of 550 km surveyed riverbed of three rivers were included. Segments on upper Drava between hydropower plants (Drava I: DRA255-290 and DRA300-310) and the Hungarian section of the Danube (Danube I; rkm 1440-1510) were not included in the bird survey (Figure 6).

Data on breeding pairs per river segment represent the linear breeding density. Analysis of breeding pairs per river segment was used to graphically display and calculate the linear breeding density of the target bird species. Density for equal length segments allows us to directly compare individual river segments with each other, and in this way, we obtained information about the most important river segments for nesting birds. In this way, we were also able to determine the stretches of the three rivers in the TBR MDD that must be protected and those that should be a priority for restoration projects (Chapter 4.2).

2.5. Trends

Trends were estimated, where possible, by external experts separately for each river. For Mura, Drava and Danube in Croatia this was done by Darko Grlica (Grlica 2022), for Mura in Slovenia this was done by DOPPS Birdlife International (Luka Božič; Božič 2022). Trends for Serbia could not be assessed, since according to Radišić (2022) continuous

monitoring of river birds in Serbia does not exist. Thus, data from 2021 could not be compared with previous data (Radišić 2022).

According to the report by Božič (2022), population trends for Mura in Slovenia were calculated using rtrim-package (Bogaart *et al*. 2018), which is a specially developed program for analysing ecological data with missing values, specifically time-series of counts using Poisson regression (Pannekoek & van Strien 2005). Rtrim-package was used in R (R Core Team 2013). The multiplicative overall slope (trend) represents the mean change over a period of time and was determined over the whole time period (2008–2022) for which the model was fitted. Plots of the overall slope, its 95% confidence band, the total population per time and their 95% confidence intervals were created. Based on values and confidence intervals (slope ± SE), trends are classified into one of the following categories: strong increase/decrease, moderate increase/decrease, and uncertain. As our dataset contained numerous zero counts, a linear trend model with changepoints at all years with positive count data available, was used in the analysis (Pannekoek et al. 2005).

According to the report by Grlica (2022), for the estimation of the population trend for target river birds on Mura, Drava and Danube (right bank) in Croatia an MS excel option with fitting a trendline was used. A trendline is an additional line that indicates the slope (or trend) in a particular data series and is also known as a line of best fit. Trendline was used for regressions analysis and in this survey a linear regression line was used. The slope of the line shows the trend; if the line is increasing then the trend is "increasing", if the line is decreasing then the trend is "decreasing". A greater slope of the line indicates a greater trend of population growth or decline. If the data are widely scattered above and below the regression lines, the trend prediction is poorly reliable.

Based on the trends determined for each individual river by bird experts, we tried to determine the overall trend for each target bird species across the TBR MDD area.

3. RESULTS AND DISCUSSION

3.1 General and comparative results

Breeding birds, which depend on habitats created in highly dynamic riverine ecosystems, such as steep banks, gravel and sand bars are endangered on the European level, mainly due to habitat loss. In the lifelineMDD bird study seven river breeding birds were chosen as indicator species and surveyed throughout the TBR MDD for the first time based on a harmonised counting method, over two breeding seasons: 2021 and 2022. Four of the species are gravel/sand **bar breeders:** Little Tern *Sternula albifrons,* Common Tern *Sterna hirundo*, Common Sandpiper *Actitis hypoleucos*, Little Ringed Plover *Charadrius dubius* and three are steep **bank breeders:** Kingfisher *Alcedo atthis,* Sand Martin *Riparia riparia*, European Bee-Eater *Merops apiaster*. These target indicator species have a complex ecology or special ecological needs; therefore, they indicate the conditions of their habitats well. The species themselves, their distribution (presence or absence),

number of their breeding sites and numbers of breeding pairs give us a good insight into the conditions of the rivers Mura, Drava and Danube.

During field surveys of the 550 km Mura, Drava, Danube riverbed more than 2.300 data (census units) on seven target breeding bird species and at least four other species of nature conservation importance were collected during field surveys were collected in the 2021 and 2022 season, respectively. Details are given in table 3. Additionally, 1882 existing data for target bird species in the TBR MDD area in Slovenia for period 2000-2020 were purchased in project lifelineMDD.

Table 3: Number of breeding data (census units) on seven target breeding bird species and four other species of nature conservation importance collected during field surveys of the Mura, Drava, Danube riverbed and other locations (gravel pits, river side arms) in the territory of the TBR Mura-Drava-Danube TBR in 2021 and 2022

	Nr. data 2021	Nr. data 2022	Source (report)
SLO-Mura	321	371+20 [a]	Božič 2022
HR-Mura	107	78	Grlica 2022
HR-Drava	330+12 [b]	384+2 [b]	Grlica 2022
HR-Daube	162	183	Grlica 2022
RS-Danube	181	161	Radišić 2022
Total	**1.113**	**1.199**	**2.312**

[a] – additional data for Kingfisher on side arms of the Mura in Slovenia; [b] – additional data for target bird species on Šoderica lake in Croatia.

Datasets are stored in the following .shp files, complement to this study: lifelineMDD_birds_2021, lifelineMDD_birds_2022, lifelineMDD_birds_2022_additional.

A prolonged period of high-water levels in 2021 adversely affected the nesting birds on the Drava and Danube. For this reason, we used data from 2022 to illustrate the spatial distribution of breeding pairs of all seven target species within TBR MDD, since these data are more representative. Figure 7 shows the distribution of seven characteristic river bird species in the 550 km of the TBR MDD.

Spatial data with the number of breeding pairs for each breeding site recorded in seasons 2021 and 2022 are separately attached to this report on the digital layer (.shp) and are included in the annexes.

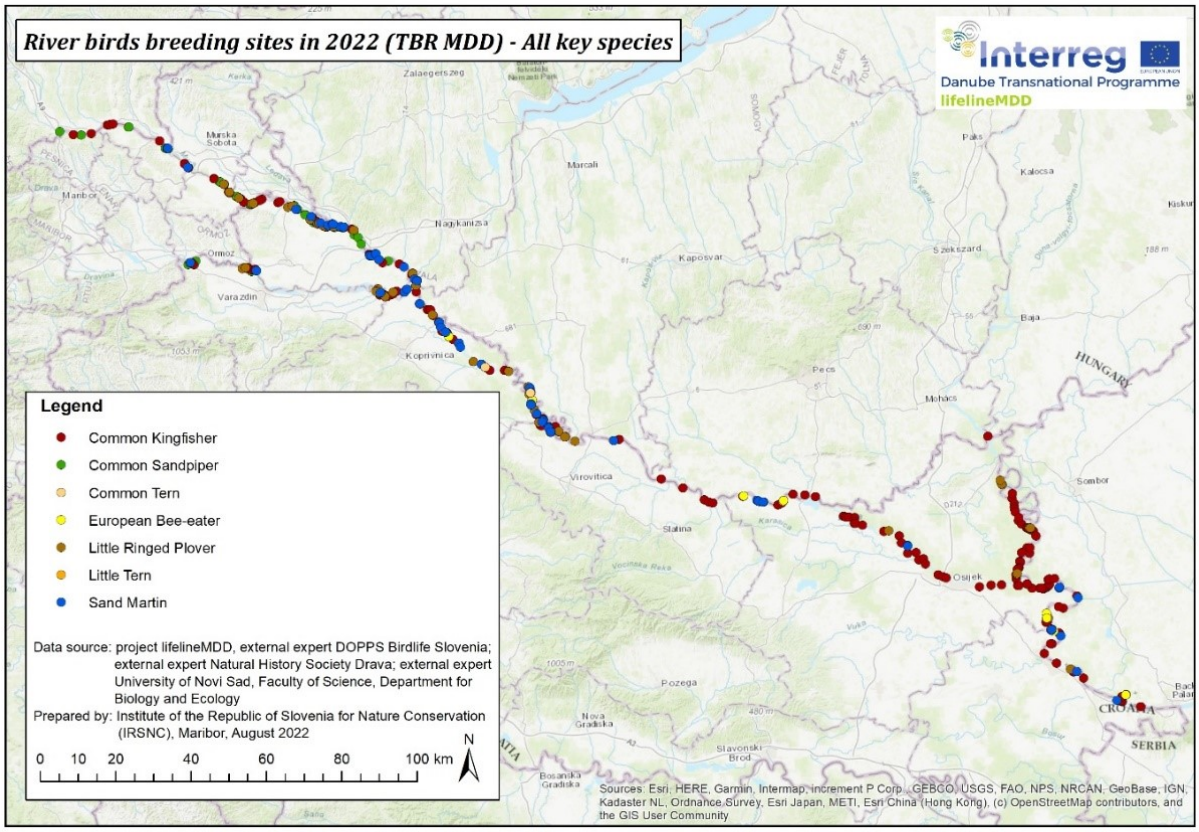

Figure 7: Distribution of seven selected indicator species of breeding birds (Little Ringed Plover *Charadrius dubius*, Common Sandpiper *Actitis hypoleucos*, Common Tern *Sterna hirundo*, Little Tern *Sternula albifrons*, European Bee-Eater *Merops apiaster*, Common Kingfisher *Alcedo atthis*, Sand Martin *Riparia riparia*) registered in the Mura, Drava and Danube riverbed between Ceršak (SLO) and Bačka Palanka (RS), based on registrations of presumably nesting individuals during the 2022 censuses.

It has been observed that there are high breeding pair densities in some sections of the Mura, Drava, and Danube riverbeds for selected two groups of birds indicative of river dynamics / that indicate river dynamics (bar- and bank breeders), suggesting certain parts of the river are rich in gravel or sediment bars and islands, while other host meander bends with steep banks.

Figure 8 and Figure 9 show that the linear densities of birds nesting on gravel/sand bars **(bar breeders)** are the highest in the lower part of the Croatian-Hungarian Mura River and partly on the Slovenian-Croatian Mura.

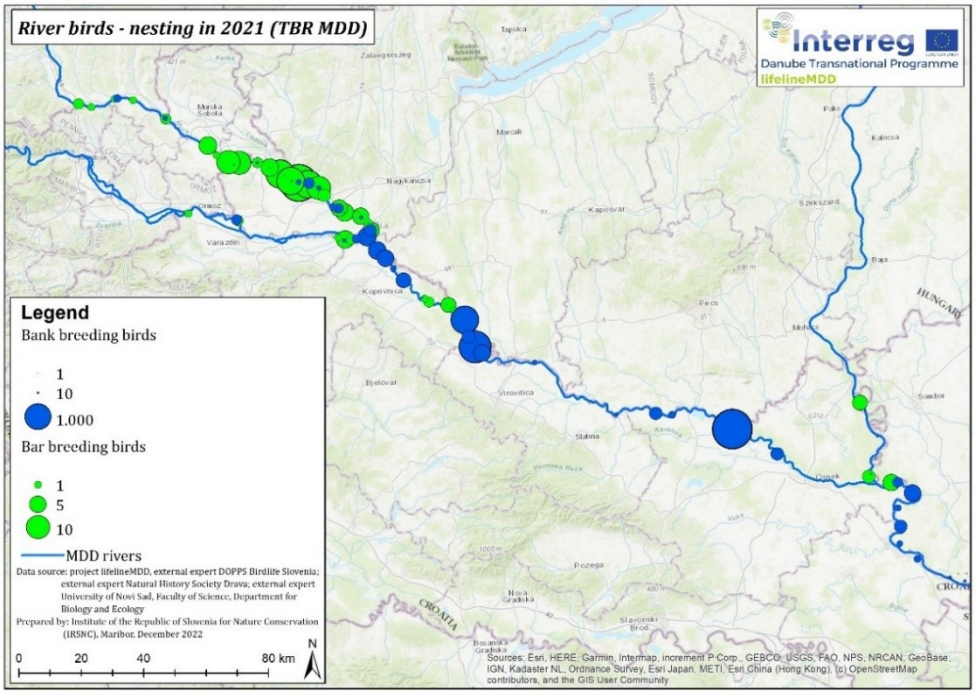

Figure 8: Linear density of breeding pairs per segment for two groups of river bird breeders - bar breeding birds and bank breeding birds **in 2021** (= total number of breeding pairs per 5 km (Mura, Drava) or 10 km (Danube) long segment of the riverbed). A larger circle means a larger number of breeding pairs and a greater importance of this area for birds that nest on gravel/sand bars (green circle) or steep river banks (blue circle).

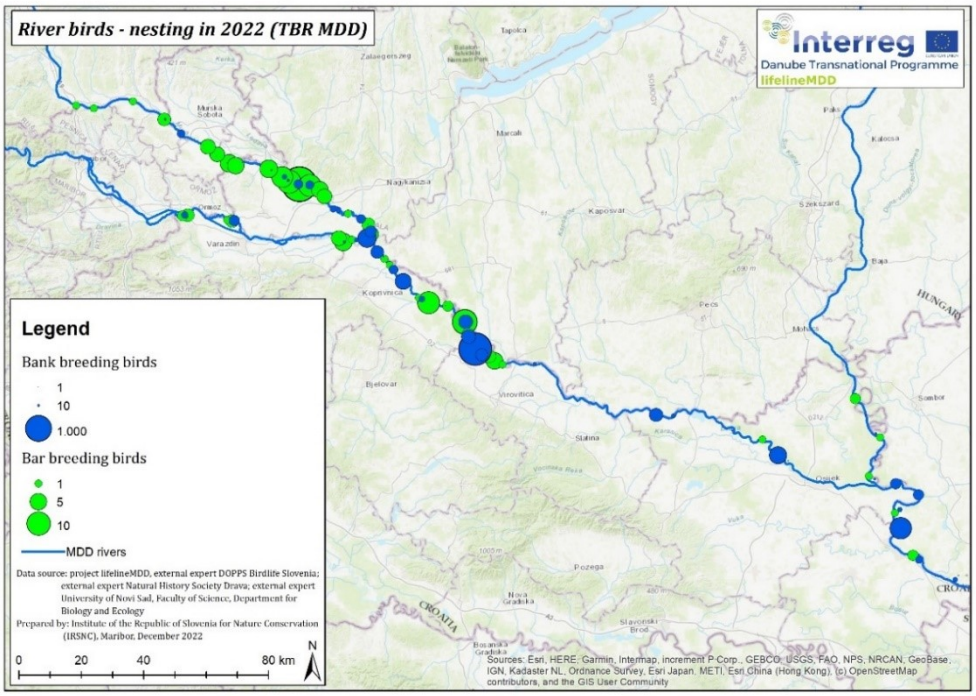

Figure 9: Linear density of breeding pairs per segment for two groups of river bird breeders - bar breeding birds and bank breeding birds **in 2022** (= total number of breeding pairs per 5 km (Mura, Drava) or 10 km (Danube) long segment of the riverbed). A larger circle means a larger number of breeding pairs and a greater importance of this area for birds that nest on gravel/sand bars (green circle) or steep river banks (blue circle).

The results also show that bar breeders almost do not breed in the Drava section between Barcs(HU)/Terezino Polje(HR) and the confluence of the Drava and the Danube. This may mean that there is a lack of gravel bars and islands in this stretch or there is at least a lack of gravel, or there may also be disturbances (high water level or human disturbance) that prevent nesting on the existing bars. The Danube River between Zlatna Greda and Vukovar has low densities of bar breeding birds, meaning there are existing suitable habitat (bars), but maybe conditions during the censuses in 2021 and 2022 were not optimal for nesting (high water level for a long time in the season in 2021 was recorded). Bar breeders are present in low densities at few points also on the heavily regulated upper part of the Mura River between Spielfeld/Ceršak and Bad Radkersburg/Gornja Radgona. As a closer look reveals, these are the sites where river restoration projects have already been implemented (Gosdorf, Donnersdorf, Sicheldorf/Mele).

Linear densities of birds nesting in steep river banks **(bank breeders)** are the highest on the Drava stretch from the confluence with the Mura and downstream to Pitomača/Križnica(HR) or Barcs(HU) and on the Danube River between Erdut and Borovo (Vukovar). This indicates that in this river stretch the banks are free of riverbed fixation measures allowing for strong lateral erosion. The latter resulted in long and high steep river walls in the area, which are optimal nesting banks for colonial breeding birds (Sand Martins, Bee-Eaters). The omparison of bird indicator linear density maps from 2021 and 2022 (Figure 8, Figure 9) also shows, that in 2022 a big colony of bank breeders on a segment near Gat (HR) on is missing. The exact cause is unknown, but it should be noted that the Sand Martins can be characterized by large fluctuations in breeding pair numbers between individual years.

Population size estimation according to survey in 2021 and 2022

Gravel bars and islands on 550 km of Mura, Drava, Danube riverbed between Ceršak (SLO-AT) and Bačka Palanka (HR-RS) supported in 2021 and 2022 the existance of ca. 130–223 bar breeders and ca. 6442–10038 bank breeders (Table 4, Table 5). The estimated number of breeding pairs for Little Ringed Plover is between 74 and 132, for Common Sandpiper it is between 56 and 82, for Common Tern between 0 and 8, for Little Tern between 0 and 1, for Common Kingfisher between 178 and 234, for European Bee-eater between 192 and 467 and for Sand Martins between 6072 and 10038. The highest number of breeding pairs for the Little Ringed Plover and for the Common Sandpiper was in the Mura River stretch from Veržej (SI) to the Mura-Drava confluence in Croatia for both years. The only section with breeding Common Terns was on the Drava River with 8 breeding pairs in 2022. The only breeding Little Tern was found on the Drava River in 2022. The highest number of breeding pairs for the Common Kingfisher, European Bee-Eater and Sand Martin was on the Drava River for both years.

Table 4: Estimation of the breeding pairs numbers for target river bird species in survey sections on the Mura, Drava and Danube River in 2021 and 2022 (after: (1) - Božič 2022: * mean value of data from 2021 and data from 2022, (2) - Grlica 2022, (3) - Radišić 2022).

	Little Ringed Plover	Common Sandpiper	Com. Tern	Little Tern	Common Kingfisher	European Bee-eater	Sand Martin
Mura AT-SLO-HR (1)	40-56*	35-38*	0	0	27-32*	0	145-195*
Mura HR-HU (2)	10-18	16-31	0	0	16-25	5-14	518-681
Drava (2)	21-41	8-10	0-8	1	81-101	141-309	4591-7979
Danube-HR bank (2)	0-2	0	0	0	34-45	35-130	598-770
Danube-RS bank (3)	6-11	0	0	(1)**	25-27	11-14	273-413
Sum 550 km MDD* **	**100-106**	**61-77**	**0-8**	**0-1**	**194-219**	**192-467**	**6477-9676**

***In 2021 an unsuccessful attempt of nesting Little Tern was observed on the Danube near Steklara.*

**** The range of the estimate of the total bird population in TBR MDD is not a direct sum of the ranges shown above (separated for min and max), but is the total sum of the number of breeding pairs on each river in 2021 and the sum of the number of breeding pairs of birds on each river in 2022. Based on these two obtained numbers, a range for the entire TBR MDD is then assessed, which is shown in the last line of the table 5 and Table 6.*

Table 5: Estimation of the breeding pair numbers for target river bird species in survey sections on the Mura, Drava and Danube River in 2021 and 2022 (after: Božič 2022: * mean value of data from 2021 and data from 2022, (2) - Grlica 2022, (3) - Radišić 2022).

	Little Ringed Plover	Common Sandpiper	Common Tern	Little Tern	Comm. Kingfisher	European Bee-eater	Sand-martin
Mura (1), (2)	50-74*	51-69*	0	0	43-57*	5-14*	663-876*
Drava (2)	21-41	8-10	0-8	1	81-101	141-309	4591-7979
Danube (2), (3) both bank (HR, RS)	6-13	0	0	0	59-72	46-144	871-1183
Sum 550 km MDD* **	**100-106**	**61-77**	**0-8**	**0-1**	**194-219**	**192-467**	**6477-9676**

Most of the breeding population of the Little Ringed Plover and Common Sandpiper in TBR MDD in 2022 can be found on the Mura River (Figure 10), 46% of the population for the Little Ringed Plover and 85% for the Common Sandpiper. From Figure 10 it is evident that the Common Tern and the Little Tern only nest on the Drava River. Most of the populations of the Common Kingfisher, European Bee-Eater and Sand Martin can be found on the Drava River: 73% of the population of the Common Kingfisher, 47% of the European Bee-Eater population and 71% of the Sand Martin population.

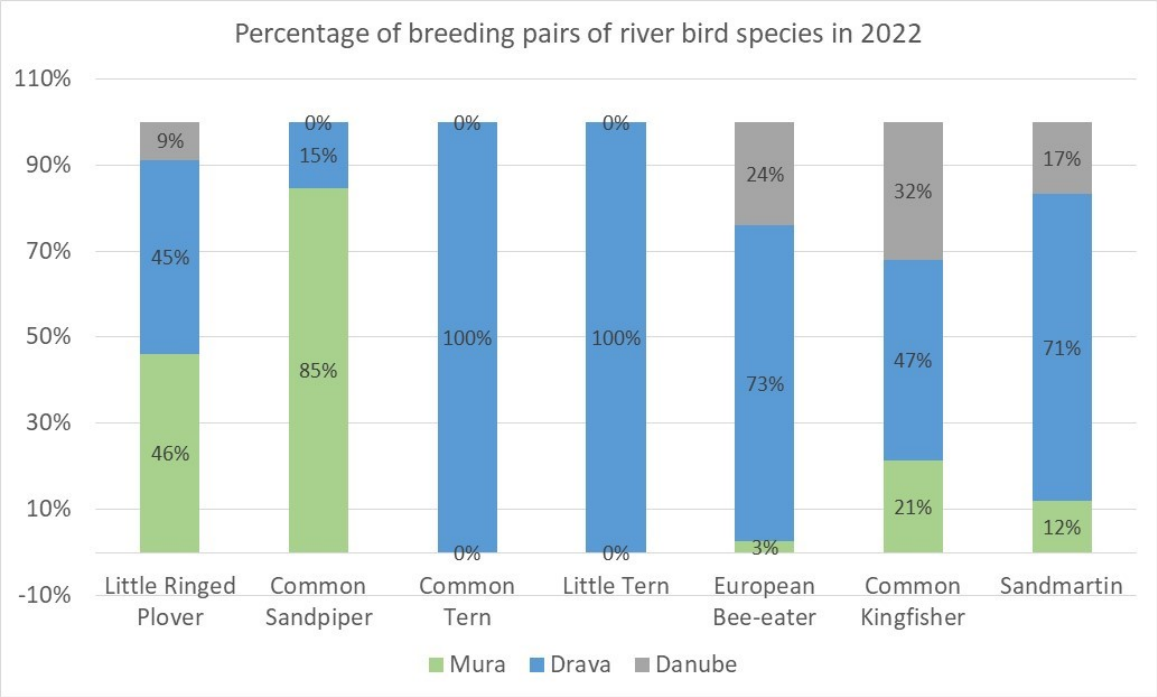

Figure 10: Percentage of breeding pairs of seven target species in the Mura, Drava and Danube riverbed in TBR MDD between Ceršak (SLO) and Bačka Palanka (RS). *Data are based on registrations of nesting individuals during the 2022 censuses – LRP: n = 91, CS: n = 65; CT: n = 8; LT: n = 1; EBE: n = 192; CK: 216; SM: n = 6449)*

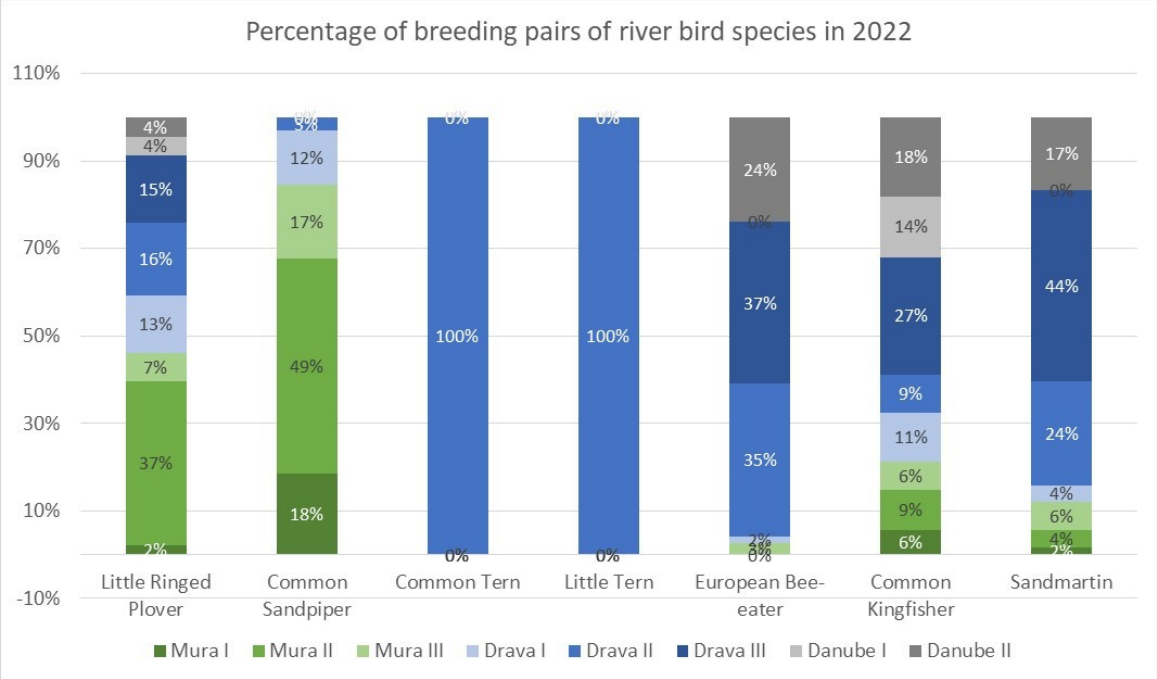

Figure 11: Percentage of breeding pairs of seven target species in the eight river sections of the Mura, Drava and Danube riverbed in TBR MDD between Ceršak (SLO) and Bačka Palanka (RS). *LRP: n = 91, CS: n = 65; CT: n = 8; LT: n = 1; EBE: n = 192; CK: 216; SM: n = 6449)*

Results of analysis of breeding pairs per river sections (sections - Figure 6, results - Figure 11 and Figure 12,) indicate that the lower parts of the Mura (Mura II, Mura III) and the upper parts of the Drava (Drava I, Drava II) are most important for bar-breeding birds in the TBR MDD, whereas the Drava (Drava II, Drava III) and Danube (Danube II) are more important for bank-breeding birds. Common Kingfisher was the most evenly distributed species along the study area; Little and Common Terns were the rarest nesting bird species, recorded only in Drava II section.

From Figure 12 it is evident that the Little Ringed Plovers highest linear density is at the section Mura II, where it reaches 8,5 pairs/10 km, at other sections this number is significantly lower. It is similar for the Common Sandpiper, which's linear density is as well the highest at the section Mura II, 8 pairs/10 km. Such high densities of breeding pairs only occur in river sections with numerous extensive and sparsely vegetated gravel bars, most of which are occupied by more than 1-2 pairs of either or both species. The Common and Little Tern were only found at the section Drava II, where their linear density is 1,6 pairs/ 10 km for the Common Tern and 0,2 pairs/10 km for the Little Tern. At the section Drava III the Sand Martins and European Bee-eaters reached the highest linear density with 306 pairs/10 km for Sand Martins and 13,4 pairs/10 km for European Bee-eaters. The Common Kingfisher´s highest density is at the section Danube I, with 6,98 pairs/10 km. Values of linear breeding densities on shorter river stretches, i.e., on 5 km/10 km segments are even significantly higher at some locations (Table 13).

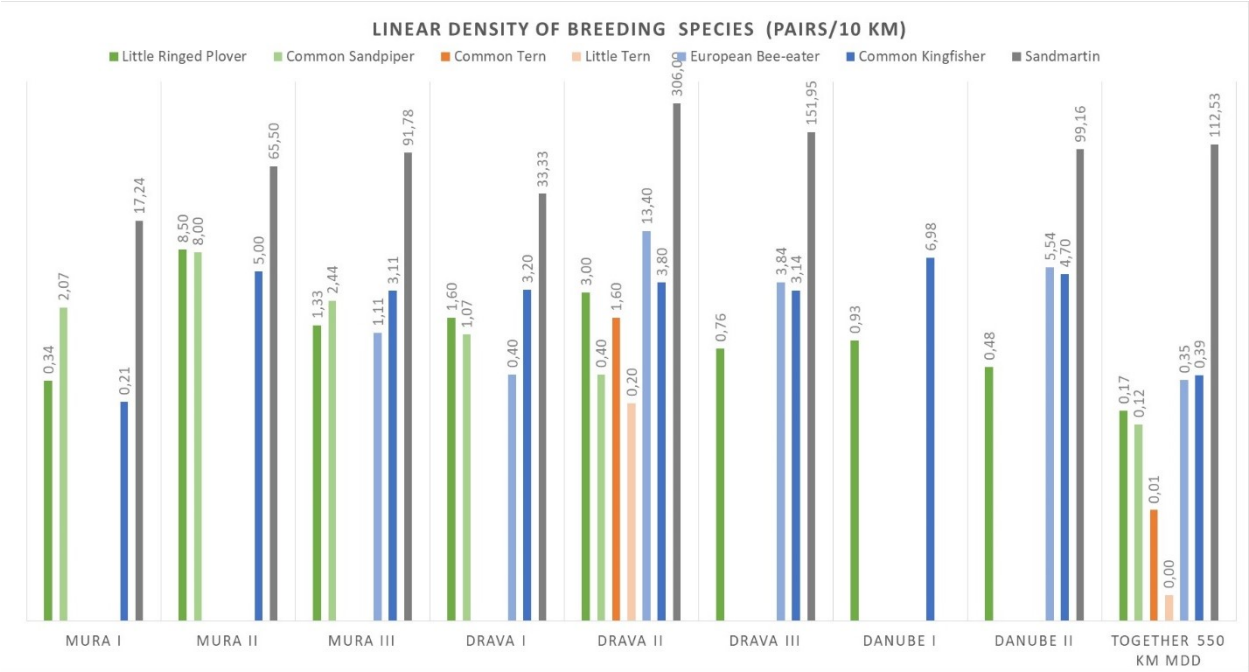

Figure 12: Linear density (pairs per 10 km) of the seven target bird species for eight river segments (Bar-breeders: Little Ringed Plover *Charadrius dubius*, Common Sandpiper *Actitis hypoleucos,* Common Tern *Sterna hirundo*, Little Tern *Sternula albifrons* & bank-breeders: European Bee-Eater *Merops apiaster*, Common Kingfisher *Alcedo atthis*, Sand Martin *Riparia riparia*) registered in the Mura, Drava and Danube riverbed between Ceršak (SLO) and Bačka Palanka (RS), based on registrations of presumably nesting individuals during the 2022 censuses. **The values of the "y" axis are displayed on a logarithmic scale.**

Information on the observed bird's occurrence and linear breeding densities along the Mura, Drava and Danube rivers provides valuable clues about the state of the riverine habitats and processes on separate parts of the river course. In addition, results show that restoration projects are essential for connectivity, as in the heavily regulated upper reaches of the Mura River, indicator bird species were only recorded in the areas of the lifelineMDD pilot restoration site at Hrastje-Mota or other previous restoration sites on the Austrian riverbank (Gosdorf, Sicheldorf).

Finally, the results above prove the high ecological values of different stretches for different target breeding species on all three rivers and strengthen the importance and connectivity of and within the TBR MDD.

3.2 Little Tern (*Sternula albifrons*)

Distribution in the TBR MDD, breeding pairs & linear density in 2021, 2022 and trend assessment 2008–2022

The Little Tern was recorded very rarely in the TBR MDD river bird survey in 2021 and 2022, which was expected. The only breeding pair of this species was recorded in the TBR MDD on the Drava River in 2022, on the gravel island near Heresznye (HU).

According to the report from the Serbian ornithologist Radišić (2022), an unsuccessful breeding attempt was probably observed on the Danube in 2021, on a sandy river islet near Staklara (near Aljmaš). The water level was high for a long time in the season 2021, even during the bird census, thus individuals were not nesting. Breeding of the Little Tern on river islets on the surveyed section of the Danube River has not been recorded during the last decades (Puzović et al. 2015).

Due to the long period of high water and submerged gravel islands on the Drava in 2021 (between June 11th and July 1st) only individuals were observed, , which did not show any nesting ground related behaviour: two individuals on the old course of the Drava from Veliki Bukovec to Donja Dubrava (rkm 256 to rkm 242) and two more individuals on the Drava downstream from the power plant Dubrava (section rkm 190–183). It is not known whether the Little Tern attempted to nest later. For the Little Tern, it is not unusual for the nesting to fail in the unfavourable years. (Grlica 2022).

In 2022, at several other locations in the TBR MDD individual non-nesting birds were observed. All these detailed data for individual non-nesting birds can be found in the digital layer of the annexes.

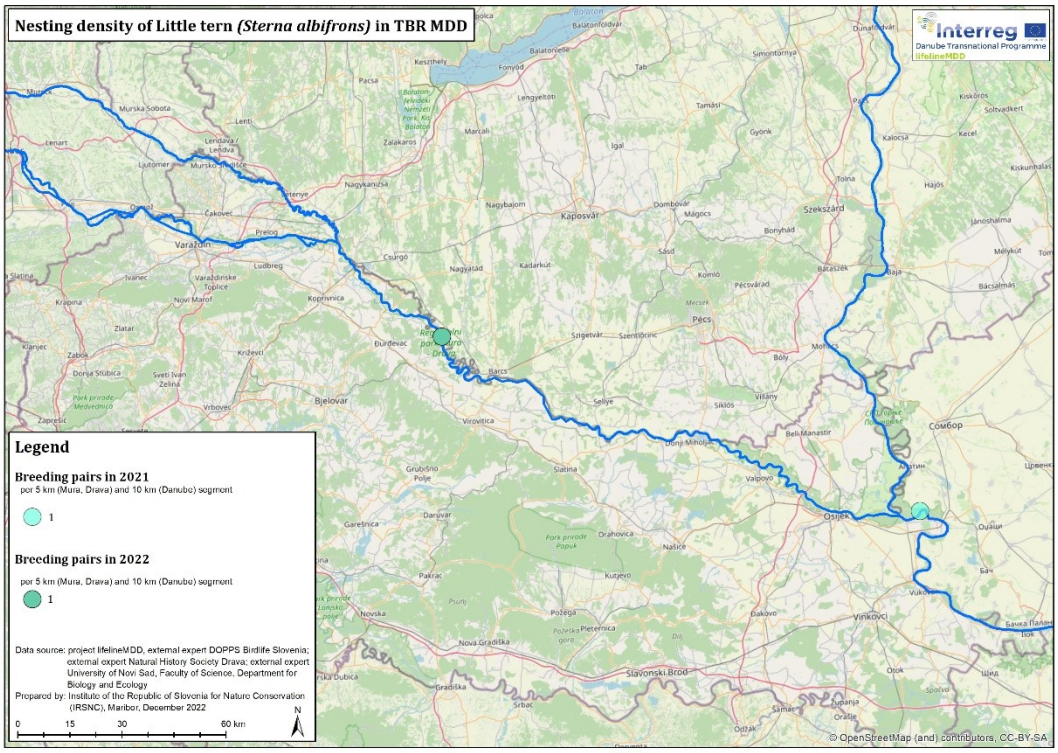

Figure 13: Distribution of the Little Tern (*Sternula albifrons*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022. The breeding attempt on the Danube in 2021 was unsuccessful due to high water levels within a few days after the observations.

Table 6: Little Tern (*Sternula albifrons*) breeding pair number and linear densities in the surveyed sections on the Mura, Drava and Danube Rivers in the TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). Density = breeding pairs per km of the riverbed

	Length (km)	Pairs 2021	Pairs 2022	Density 2021	Density 2022	Population trend 2008-2022
Mura-A/SLO/HR(1)	93	0	0	0,00	0,00	not breeding (1)-TRIM
Mura-HR/HU(2)	49	0	0	0,00	0,00	not breeding
Drava(2)	273	0	1	0,00	0,00	decreasing (uncertain) (2)-Excel-linear r.
Danube-HR(2)	135	0	0	0,00	0,00	not breeding
Danube-SRB(3)	135	0*	0	0,00	0,00	unknown
	Length (km)	**Pairs 2021**	**Pairs 2022**	**Density 2021**	**Density 2022**	**Population trend 2008-2022**
Mura	142	0	0	0,00	0,00	not breeding
Drava	273	0	1	0,00	0,00	decreasing (uncertain)
Danube	135	0	0	0,00	0,00	unknown
MDD together in TBR	**550**	**0**	**1**	**0,00**	**0,00**	**decreasing (uncertain)**

**In 2021 an unsuccessful attempt of nesting was observed on the Danube near Staklara.*

The river bird survey in the TBR MDD in 2022 confirms previous findings, that the only breeding area for the Little Tern is the 50 km section of the Drava in Croatia partly

bordering Hungary downstream of the Drava-Mura confluence (Gattermayr *et al.* 2019). The Drava River there still offers appropriate gravel and sand bars and feeding grounds. However, existing literature (Mohl 2001) and the latest report from Grlica (2022) (table 6) shows a very probable decreasing trend for Little Tern on the Drava in the period 2008–2022.

According to the last river bird census, it remains unclear whether Gattermayr's (2019) statement that four to five pairs on average are breeding regularly on Drava (mostly in the company of the Common Tern) is still valid. Therefore, it is **necessary to continue monitoring of the situation in the field every year** and already now start restoring river dynamics on Drava, to in time prevent the extinction of the Little Tern population in TBR MDD. Little Tern can be considered among the most endangered target species in TBR MDD. Therefore, it is also necessary to completely limit/prohibit human disturbance on gravel banks/islands hosting the last breeding sites.

3.3 Common Tern (*Sterna hirundo*)

Distribution

During field surveys on the Mura, Drava, and Danube in both study years breeding pairs of the Common Tern were recorded, as expected only in 2022 and only on the Drava River. Two small colonies with a total of 8 pairs were recorded: 5 pairs nested in the colony at 205 rkm (Repaš) and 3 pairs in the colony at 187 rkm (Heresznye). In 2021, due to the high-water level over a long period in the season, only 37 feeding and non-nesting individuals of the Common Tern were recorded on the Drava in the section between 320 rkm and 104 rkm. Most of these individuals (23) were recorded in the section between 242–104 rkm (Donja Dubrava and Podravska Moslovina) and these individuals did not show nesting ground behaviour. It is not known whether the Common Tern tried to nest later this year, but it is not unusual for the Common Tern to miss nesting in unfavourable years (Grlica 2022). Recorded individuals in 2021 could also be feeding birds from the colony on Šoderica Lake, right next to the Drava.

On the Danube River in TBR MDD in 2021 and 2022 no breeding of Common Tern was observed, which is not surprising since the breeding of the Common Tern on river islets on the Danube River has not been recorded during the last decades (Puzović et al. 2015). Non-breeding individuals of this species were observed in 2021 near Bačka Palanka (Radišić 2022) and one feeding bird was recorded downstream from Batina in 2022 (Grlica 2022).

On the Mura River, there was no observation of individuals of Common Tern in 2021–2022.

Recorded individual of non-nesting birds and breeding pairs of Common Tern are included in the digital layer of the annexes.

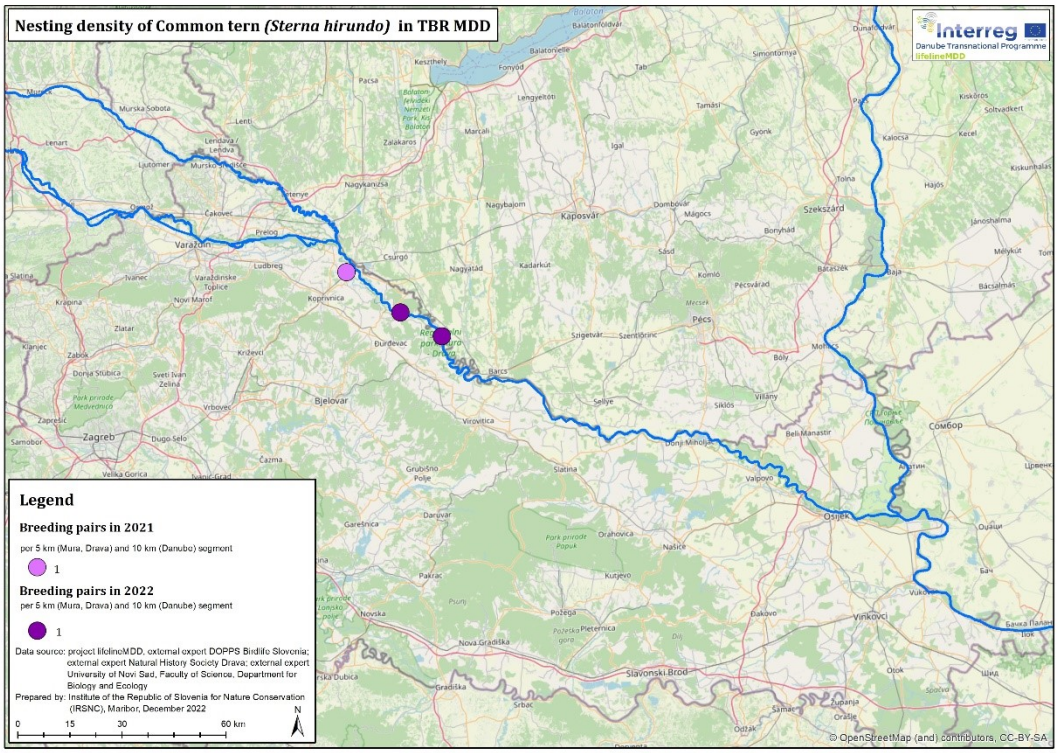

Figure 14: Distribution of the Common Tern (*Sterna hirundo*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022. The light violet point is the location of Šoderica lake.

Breeding pairs and linear density in 2021, 2022 & trend assessment 2008–2022

Table 7: Common Tern (*Sterna hirundo*) breeding pairs number and linear density in surveys section on the Mura, Drava and Danube Rivers in the TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). Density = breeding pairs per km of the riverbed

	Length (km)	Pairs 2021	Pairs 2022	Density 2021	Density 2022	Population trend 2008-2022
Mura-A/SLO/HR(1)	93	0	0	0,00	0,00	not breeding (1)
Mura-HR/HU(2)	49	0	0	0,00	0,00	not breeding (2)
Drava(2)	273	0*	8*	0,00	0,00	decreasing (2)-Excel-linear regression
Danube-HR(2)	135	0	0	0,00	0,00	not breeding?
Danube-SRB(3)	135	0	0	0,00	0,00	not breeding?
	Length (km)	**Pairs 2021**	**Pairs 2022**	**Density 2021**	**Density 2022**	**Population trend 2008-2022**
Mura	142	0	0	0,00	0,00	not breeding
Drava	273	0	1	0,00	0,00	decreasing
Danube	135	0	0	0,00	0,00	not breeding?
MDD together in TBR	**550**	**0***	**8***	**0,00**	**0,00**	**decreasing**

**In 2021 a colony of 40 pairs of Common Tern was recorded on Šoderica Lake, right next to the Drava and can represent the Drava population of Common Terns.*

In both years of the bird survey on the MDD riverbed only 8 breeding pairs of Common Tern were recorded. We shouldn't forget that also gravel pits near the Drava River can represent a part of safe breeding sites for the Drava population of Common Terns. After Grlica (2022) this is very likely for 40 nesting pairs of Common Terns recorded in 2021 on Šoderica Lake, right next to the Drava near Botovo/Koprivnica (HR) (rkm 225–230). Despite the fact that gravel pits near the Drava River can represent safe breeding sites with no hydropeaking short-term fluctuation influence, natural river stretches of the Drava are very important for terns feeding during the breeding season. In a recent study, Tome *et al*. (2019) showed that Common Tern from the Drava River in Slovenia and the Sava River in Croatia most often feed within a radius of 2–5 km from nesting sites, but can also feed on water bodies 20–60 km far away.

Based on the study results (table 7) it is not surprising that the overall trend of the Common Tern on Drava in TBR MDD in the period 2008–2022 was estimated as decreasing (Grlica 2022). The breeding pairs of the census in the last decade indicate (Grlica 2022) that Common Tern and Little Tern can be considered among the most endangered river bird species in the TBR MDD. Therefore, targeted measures have to be taken for these two endangered bird species.

3.4 Little Ringed Plover (*Charadrius dubius*)

Distribution

In 2021 and 2022, the Little Ringed Plover was very densely distributed only along the lower half of the Mura River and upper part of the Drava River upstream of Barcs (HU)/Terezino Polje (HR); on Drava also upstream from the Mura confluence, all the way to the reservoir lake Dolnja Dubrava. In both years this species was distributed on the Danube River, between Batina and Vukovar (Vučedol) but not so widely. While on the previously mentioned Mura and Drava stretches the distribution of Little Ringed Plover was more or less continuous, on the Danube River up to several kilometres long gaps between data existed (Figure 15, Figure 16). With the exception of a single location on the upper Mura (Gosdorf) and lower half of Drava (Valpovo-Nard), these two stretches of the rivers were practical without the breeding of Little Ringed Plover in 2021 and 2022.

Despite the population recorded in the TBR MDD from 2021 to 2022 decreased, the distribution of the species differs between 2021 and 2022 and was more widely distributed in 2022, probably due to more favourable water level conditions of the Drava and Danube Rivers (Figure 15).

Data of breeding pairs and individuals of the Little Ringed Plover are included in the digital layer of the annexes.

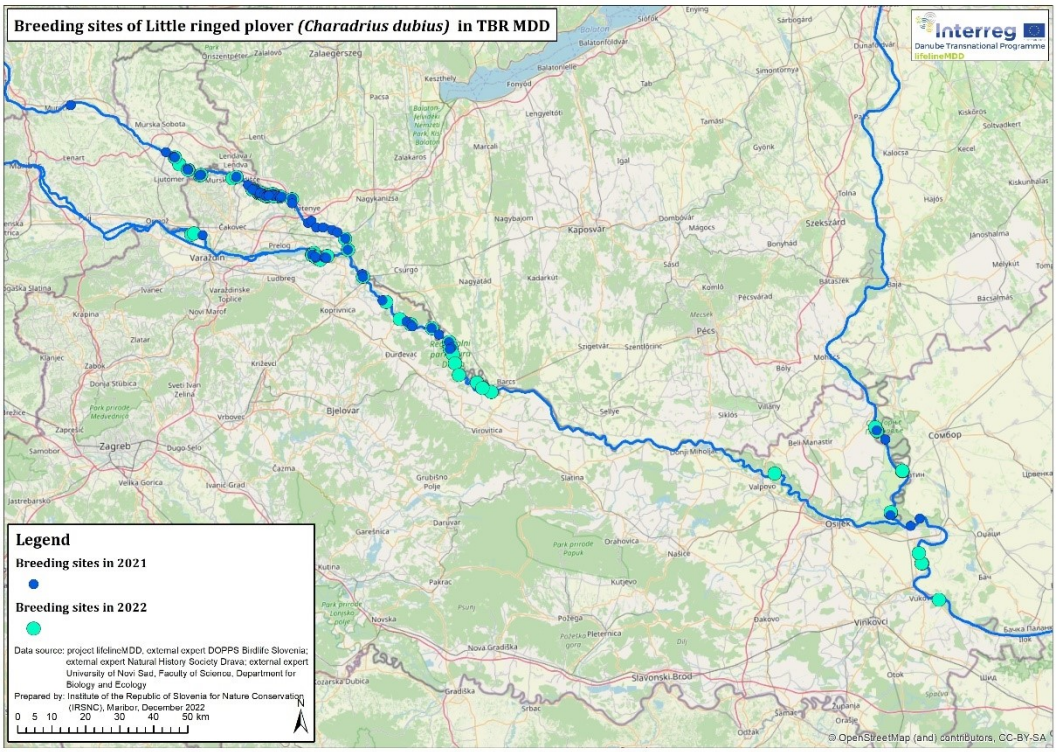

Figure 15: Distribution of the Little Ringed Plover (*Charadrius dubius*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022.

Breeding pairs and linear density in 2021, 2022 & trend assessment 2008–2022

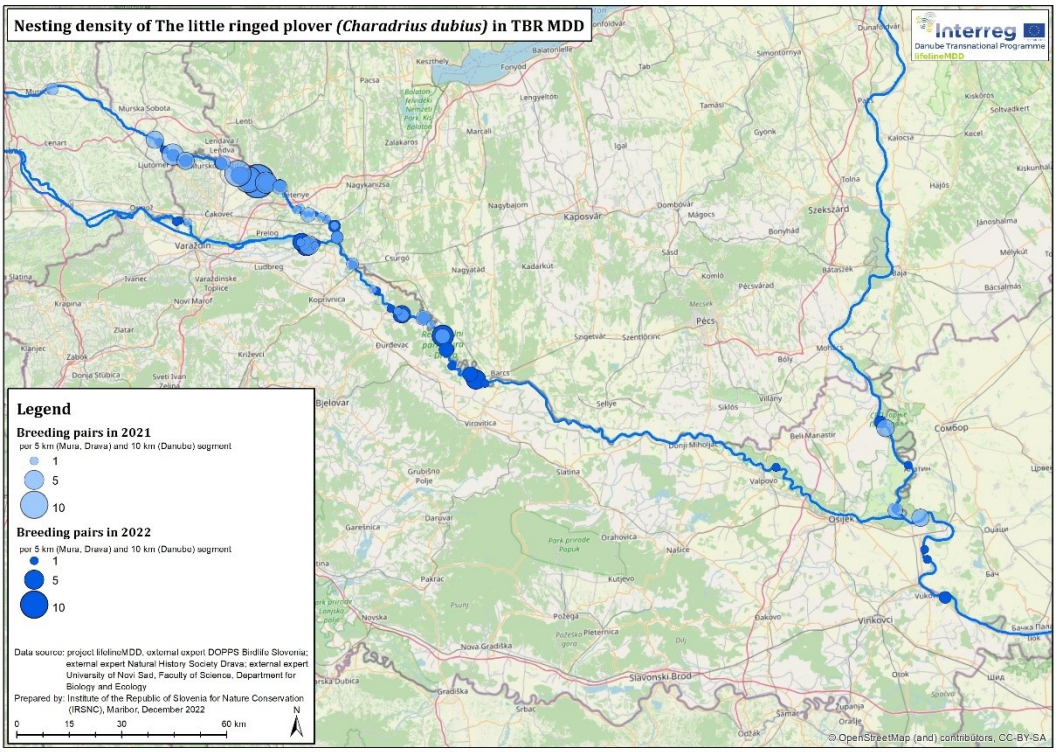

Figure 16: Linear density of Little Ringed Plover (*Charadrius dubius)* breeding pairs in 2021 and 2022 per 5 km (Mura, Drava) and 10 km (Danube) long riverbed segments in the TBR MDD.

A larger circle means a larger number of breeding pairs and greater importance of this area for this species.

Table 8: Little Ringed Plover (*Charadrius dubius)* breeding pairs number and linear density in the surveyed section on the Mura, Drava and Danube Rivers in TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). Density = breeding pairs per km of the riverbed

	Lenght (km)	Pairs 2021	Pairs 2022	Density 2021	Density 2022	Population trend 2008-2022
Mura-A/SLO/HR(1)	93	56	40	0,60	0,43	uncertain (1)-TRIM
Mura-HR/HU(2)	49	18	10	0,37	0,20	increasing (uncertain) (2)-Excel-linear r.
Drava(2)	273	21	41	0,08	0,15	increasing (uncertain) (2)-Excel-linear r.
Danube-HR(2)	135	0	2	0,00	0,01	unknown
Danube-SRB(3)	135	11	7	0,08	0,04	unknown
	Lenght (km)	**Pairs 2021**	**Pairs 2022**	**Density 2021**	**Density 2022**	**Population trend 2008-2022**
Mura	142	74	50	0,52	0,35	uncertain
Drava	273/	21/	41/	0,08/	0,15/	increasing (uncertain)
Dr. to Barcs	118	21	40	0,18	0,33	
Danube	135	11	9	0,08	0,06	unknown
MDD together in TBR	**550**	**106**	**100**	**0,19**	**0,18**	**uncertain**

Breeding pairs of Little Ringed Plover were estimated forthe Mura, Drava and Danube riverbed and for the whole TBR MDD; linear breeding densities were calculated and summarized in Table 8.

A comparison of Little Ringed Plover breeding pairs and linear densities between rivers shows that these species most often breed on the Mura, where they also reached the highest densities (Table 8). Little Ringed Plover breeding pairs in the Mura riverbed were estimated at 74 pairs with a linear breeding density of 0.5 pairs/km in 2021, and at 50 pairs with a density of 0.35 pairs/km in 2022. Božič (2022) wrote that the estimate for 2021 is the highest Little Ringed Plover population size recorded in the Mura riverbed since the first comprehensive census in 2008 (DOPPS *unpubl.*) and also, that in both study years on 98 km of the Mura crossing Slovenia, over two-thirds of all LRP pairs were recorded in the section from Mursko Središče to Legrad (rkm 070 to rkm 049), where the linear density reached a record 1.9–2.1 (in 2021) and 1.3–1.4 pairs/km (in 2022). Also, Grlica (2022) reports that the highest density of Little Ringed Plover was found in the stretch of Mura from rkm 49 to rkm 40 rkm in 2021, where 8 pairs nested, that is, almost half of the population of these birds on Croatian Hungarian bordering Mura. Schmidt *et al*. (2015) report extraordinarily high densities of nearly 2.8 territories per 10-kilometres for the Drava River.

Breeding pairs and densities from the Drava River are significantly lower than on the Mura (Table 8), but if we take into account that the Little Ringed Plover breeds only on the upper 118 km of the Drava, upstream of Barcs, the linear density for 2022, when the water level was not high, is just a little lower than the density from the Mura River (Figure 15, 16, Table 8).

On the Danube in 2022 Little Ringed Plover was recorded on seven river islands, with a total population estimation of 9 or 10 breeding pairs (Radišić 2022, Grlica 2022). The population of Little Ringed Plover in 2021 was estimated at 11 pairs (Radišić 2022). Almost all breeding sites were near Bački Monoštor, Apatin, Aljmaš and Erdut and Borovo, between 1345 and 1418 river kilometres, and two pairs were detected near Vučedol (Vukovar), at 1328 rkm (Grlica 2022).

We can conclude that for the nesting of the Little Ringed Plover the most important stretches in the TBR MDD are the lower part of the Mura downstream from Veržej and no less important is the entire part of the upper part of the Drava upstream of Barcs. On the Mura, at some shorter stretches Little Ringed Plover densities reached record high densities, especially in the section from Mursko Središče (65 rkm) to Murarátka (HU)/Hodošan (HR) (45 rkm), therefore the conservation of the Little Ringed Plover population in this stretch is extremely important for the whole TBR MDD.

Based on experts' assessments, we also tried to analyze the population trend of Little Ringed Plover in the TBR MDD between the years 2008 and 2022 (Table 8). Population trends were assessed separately by two different experts for Mura (Božič 2022, Grlica 2022) and Drava River (Grlica 2022), where a sufficiently long series of data from several consecutive years existed. Continuous monitoring of river birds in Serbia does not exist. Thus, data from 2021 could not be compared with previous data (Radišić 2022) and the population trend could not be assessed.

According to Božič (2022), the apparently moderate long-term population increase of Little Ringed Plover on the Mura River on the territory of Slovenia and bordering countries was sporadically interrupted by individual years with a substantially lower number of breeding pairs. The overall trend of Little Ringed Plover after the method TRIM in the period 2008–2022 was therefore estimated as uncertain (Table 8). According to Grlica (2022) a simpler (and probably less reliable) method of assessing the trend with a linear regression line in an excel sheet indicates a small population growth of Little Ringed Plover in Croatian-Hungarian Mura. The same was the population trend assessment for Little Ringed Plover on the Drava River in the period 2008-2022. Due the variations of Little Ringed Plover breeding pairs between individual years, both on the Mura and the Drava were very large, as a precaution, we assessed the trend as uncertain (Table 8).

Božič (2022) explained that variations in numbers detected over time can probably be explained by changes in surface area and proportions of the main habitats in the riverbed, especially the availability of suitable gravel bars. Gravel bars are the result of erosion and sedimentation processes and are very dynamic systems characterized by a high proportion of deposits without or sparse vegetation cover. Their succession is, among others, related to the duration and frequency of flooding which tends to vary between years (Gilvear *et al.* 2008). Consequently, a reduction in shingle area due to encroachment of woody vegetation results in a decline of breeding pairs, while the reverse triggered a population recovery (see Božič & Denac 2017).

Habitat

In Slovenia all Little Ringed Plover census units (n=120), without a single exception, were registered on shingle deposits; 119 on gravel bars (either mid-channel bars or point bars) and only one on shingle area exposed at low water level in the riverbed, not suitable for nesting. The breeding of the species in the Mura riverbed depends exclusively on the availability of suitable gravel bars (Božič 2022). The same applies also to the Drava and the Danube Rivers. Radišić (2022) reports that breeding sites of Little Ringed Plover were sandy river islets without vegetation, or sparsely vegetated by pioneer plants or very young willow bushes, while older trees were rarely present on small patches of islets. On two sites, potential breeding territories were found on sandy shores of larger, well-forested river islands, sometimes connected to the river shore.

Out of 94 gravel bars mapped in the Mura riverbed in Slovenia and the Austrian or Croatian border, 41 (43.6 % of all) were occupied by Little Ringed Plover breeding pairs. Most gravel bars occupied 1–2 pairs nested, while more were recorded at only a few most suitable sites on lower Mura. (Božič 2022)

As a result of recent restoration projects on the Austrian side, isolated breeding sites on upper Mura have been created along sections where no suitable habitat could be found due to anthropogenic interventions in the past, particularly channelization of the riverbed with rock riprap. (Božič 2022)

3.5 Common Sandpiper (*Actitis hypoleucos*)

Distribution

At first glance, the distribution pattern of breeding Common Sandpipers from 2021 and 2022 followed the distribution pattern of the Little Ringed Plover, with the exception that no single breeding pair of Common Sandpiper were recorded on the Danube (Figure 17). But a closer look reveals that this species was somewhat more widely distributed on the Mura River than Little Ringed Plover in this study. The range along the lower half of the Mura was very similar to the Little Ringed Plover, but with shorter gaps, leading to a fairly continuous distribution between Veržej and Drava confluence in Legrad fairly continuous. On the upper Mura, breeding pairs were recorded at 4–5 sites, separated 4–12 km from the nearest neighbouring nesting location (Božič 2022). However, this species was also completely absent from the upper part of the inner Mura, later means the Mura between Radenci and Razkrižje.

A closer look also reveals that this species was not so widespread on the Drava River in this study as the Little Ringed Plover. On Drava, downstream the Mura confluence only a few breeding sites of Common Sandpiper with up to several kilometres long gaps between data existed, with the lowest recorded nesting pair located on the 187th rkm (Heresznye, HU). There were three locations (Grlica 2022), separated by a few kilometres, on the old course of the Drava between the power plant reservoirs where breeding Common Sandpipers congregated (Figure 17). Distribution on the Drava in 2021 and 2022 can be assessed as narrow compared to previous years. This is also mentioned by Grlica (2022)

with the number of pairs that nested during the 2021 nesting season below expectations and reported by Gattermayr *et al*. (2019) that at the Drava upstream of the town of Barcs (HU) high breeding densities of Common Sandpiper can be found.

Regardless of the text above, on all three rivers the Common Sandpiper was the most frequently recorded species (see a digital layer in annexes), but a large part of the observations without indication of breeding (no expressed nesting behaviour and/or outside suitable nesting habitat). Species individuals were distributed quite uniformly throughout the Danube and Drava riverbed, which indicates migration and dispersal movements (Grlica 2022, Radišić 2022). Solitary individuals and occasionally small groups were observed on the Danube on river islets near Bezdan and Apatin. However, it is estimated that Common Sandpiper was not breeding on a surveyed part of the Danube in 2021 and 2022 (Radišić 2022).

Data of breeding pairs and individuals of Common Sandpiper are included in the digital layer of the annexes.

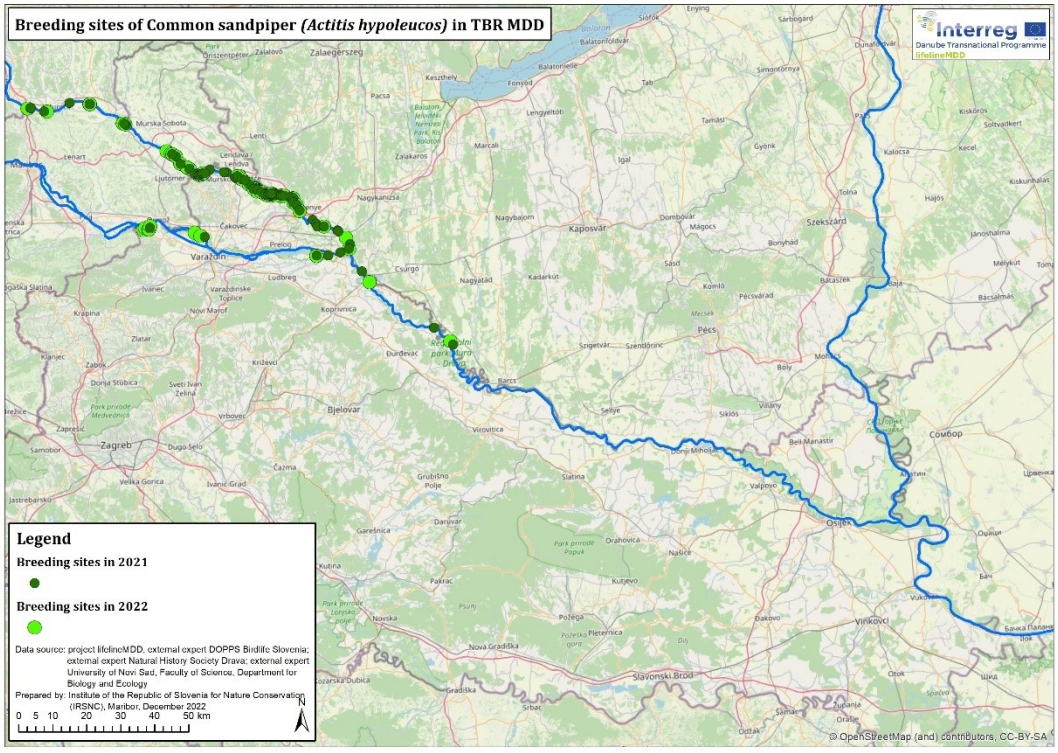

Figure 17: Distribution of Common Sandpiper (*Actitis hypoleucos*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022.

Breeding pairs and linear density in 2021, 2022 & trend assessment 2008–2022

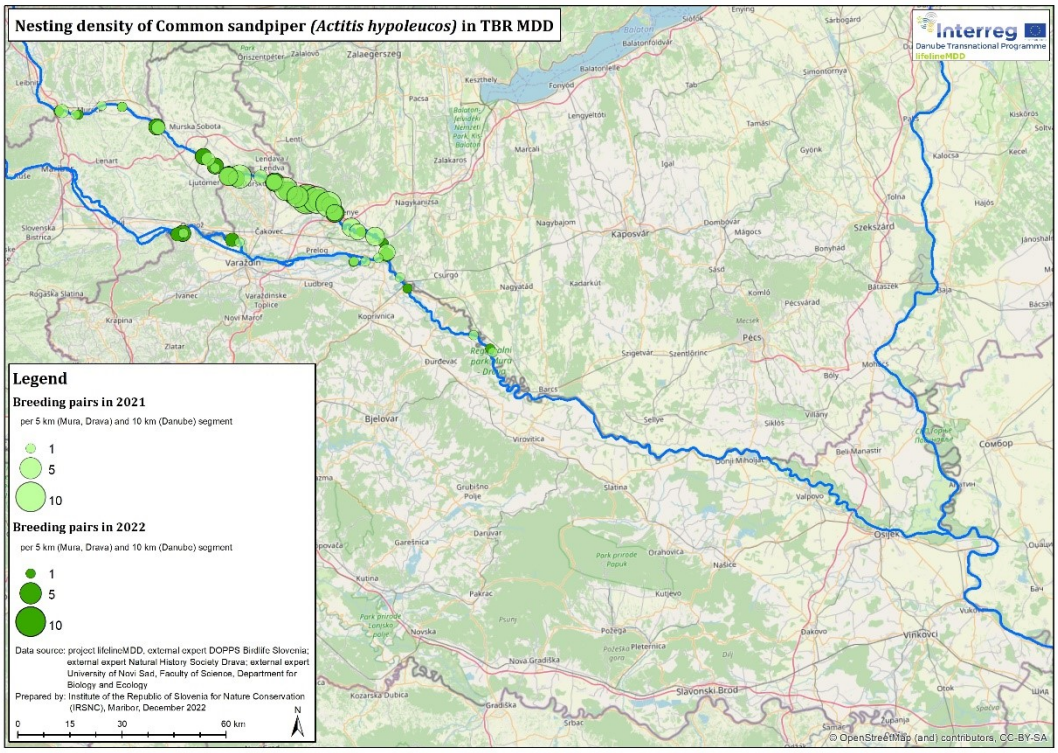

Figure 18: Linear density of Common Sandpiper (*Actitis hypoleucos*) breeding pairs in 2021 and 2022 per 5 km (Mura, Drava) and 10 km (Danube) long riverbed segments in the TBR MDD.

A larger circle means a larger number of breeding pairs and a greater importance of this area for this species.

Table 9: Common Sandpiper (*Actitis hypoleucos*) breeding pairs number and linear density in surveys section on the Mura, Drava and Danube Rivers in TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). Density = breeding pairs per km of the riverbed

	Length (km)	Pairs 2021	Pairs 2022	Density 2021	Density 2022	Population trend 2008-2022
Mura-A/SLO/HR(1)	93	38	35	0,41	0,38	moderate increase (1)-TRIM
Mura-HR/HU(2)	49	31	16	0,63	0,33	uncertain (2)-Excel-linear regression
Drava(2)	273	8	10	0,03	0,04	uncertain (2)- Excel-linear regression
Danube-HR(2)	135	0	0	0,00	0,00	unknown
Danube-SRB(3)	135	0	0	0,00	0,00	unknown
	Lenght (km)	**Pairs 2021**	**Pairs 2022**	**Density 2021**	**Density 2022**	**Population trend 2008-2022**
Mura	142	69	51	0,49	0,36	moderate increase (uncertain)
Drava	273	8	10	0,03	0,04	uncertain
Danube	135	0	0	0,00	0,00	unknown
MDD together in TBR	**550**	**77**	**61**	**0,14**	**0,11**	**uncertain**

Breeding pairs of the Common Sandpiper population in the Mura, Drava and Danube riverbed and together in the TBR MDD were estimated and linear breeding density was calculated and is provided in Table 9.

In 2021 and 2022 more than 80 % of the TBR MDD breeding pairs of the Common Sandpiper were nesting in the Mura riverbed. The highest breeding densities of the Common Sandpiper in this survey were found on the Mura River in 2021 and 2022 and were 0,36–0,49 pairs per kilometre of the river (Table 9, Figure 18) and have also exceeded these values on the stretch between Veržej (SI) and Drava confluence, where densities are especially high. Božič (2022) reports that in the Mura River stretch from Mursko Središče to Dekanovec the linear density reached 0.9–1.1 in 2021 and 0.8–1.4 pairs/km in 2022, respectively. Also, the population size estimates for both study years are the highest recorded in the Mura riverbed since the first comprehensive census in 2008 (DOPPS *unpubl.*). From the previous surveys, only figures for 2016 are similar, while those obtained earlier are substantially lower (Božič 2022).

On the Mura River also isolated nesting of Common Sandpiper in at least three locations on the upper Mura occurred in areas where river restoration projects were carried out recently on the Austrian side of the riverbed (Figure 18).

Based on the aforementioned data, it is not surprising that the overall trend of the Common Sandpiper in Slovenia and the Austrian and Croatian bordering Mura section in the 2008–2022 period was estimated with TRIM as a moderate increase (Božič 2022). According to Grlica (2022) a series of data for the Mura downstream of Dekanovec in the period 2008–2022 with a linear regression line in the excel sheet indicates a trend with small population increase, but the opposite for the Drava - a linear regression line indicates a small population decline there. Since the high data fluctuations over the years, out of the precautionary principle, it is safer to assess the trend as uncertain for both Mura and Drava (Table 9).

Habitat

Bird experts from Slovenia also briefly analyzed habitats for this species in their research area. Božič (2022) found out that most of the Common Sandpiper pairs (81 % in 2021 and 89 % in 2022) in the study area selected gravel bars for breeding (either mid-channel bars or point bars). Furthermore, a small proportion of pairs nested in other types of riverine habitats such as side arms, river banks and artificial structures with shingle surfaces or woody debris. However, also for this species, its breeding in the Mura riverbed can be considered as highly dependent on the availability of suitable gravel bars.

Out of 94 gravel bars mapped in the Mura riverbed, 40 (42.6 % of all) were occupied by Common Sandpiper breeding pairs in at least one of the study years. On most occupied gravel bars one pair nested, while two pairs on a single gravel bar were recorded at only four (2021) and five (2022) most suitable sites (Božič 2022).

Božič (2022) showed in his study, that a clear link between the availability of suitable gravel bars and a number of breeding pairs on separate survey sections can be established, demonstrating the dependence of the two indicator species – Little Ringed Plover and Common Sandpiper - of the riverine ecosystem on this type of habitat. An important feature of gravel bars, related to the occurrence of indicator species. is their surface area. It was demonstrated that both species mostly select larger gravel bars for breeding. Gravel bar size is not only important in terms of occupancy probability but also has a significant effect on the number of Little Ringed Plover and Common Sandpiper pairs nesting on it. The larger the surface area of the gravel bar, the more pairs can use it as a nesting site (Božič 2022).

3.6 Common Kingfisher (*Alcedo atthis*)

Distribution

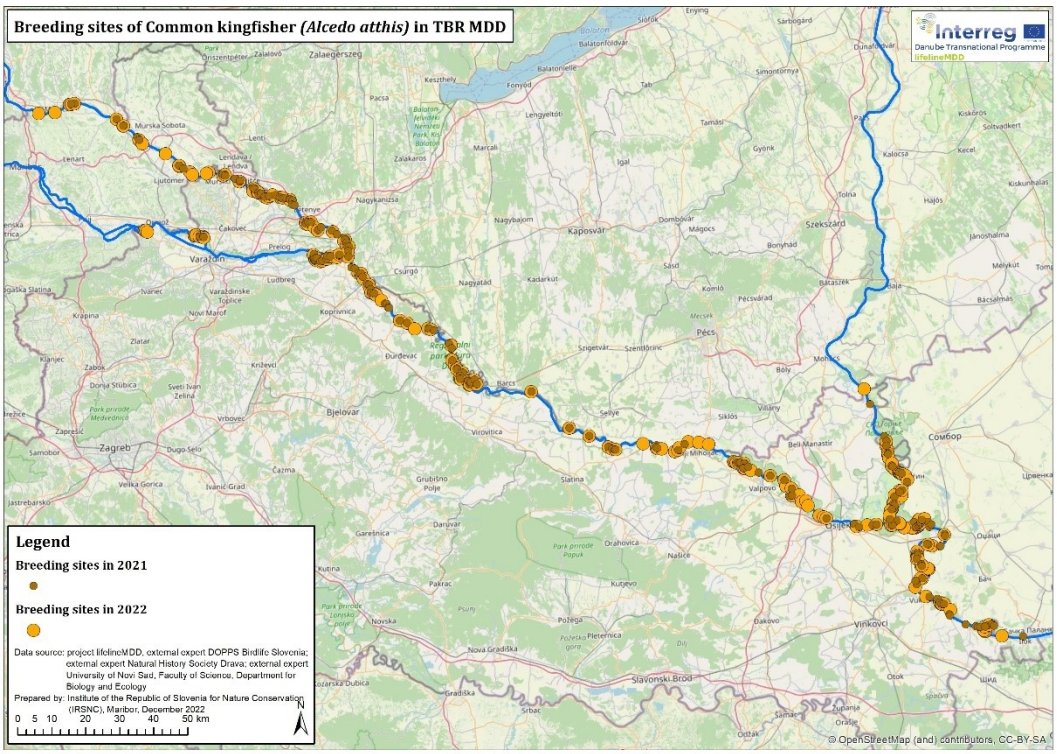

Figure 19: Distribution of the Common Kingfisher (*Alcedo atthis*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022.

The Common Kingfisher (*Alcedo atthis*) is a charismatic solitary nesting species that lives in steep sandy banks. In the survey, it was the only species of seven target river bird species that was more or less, at least in low densities, evenly distributed along the main river courses of the entire TBR MDD study area (Figure 19). It was missing only at the large power plant reservoirs in Croatia and Slovenia, on the 30 km Drava stretch

downstream of Barcs (HU) and in ca. 7 km long distribution gap at upper bordering Mura (upstream of Gornja Radgona).

The distribution of the Common Kingfisher in the river sidearms is not shown in Figure 20, because the side arms were not examined systematically and completely. Only selected river backwaters on the Danube in both years and on Mura River in Slovenia in 2022 also all potential side arms were examined (Božič 2022, Radišić 2022).

Breeding pairs and linear density in 2021, 2022 & trend assessment 2008–2022

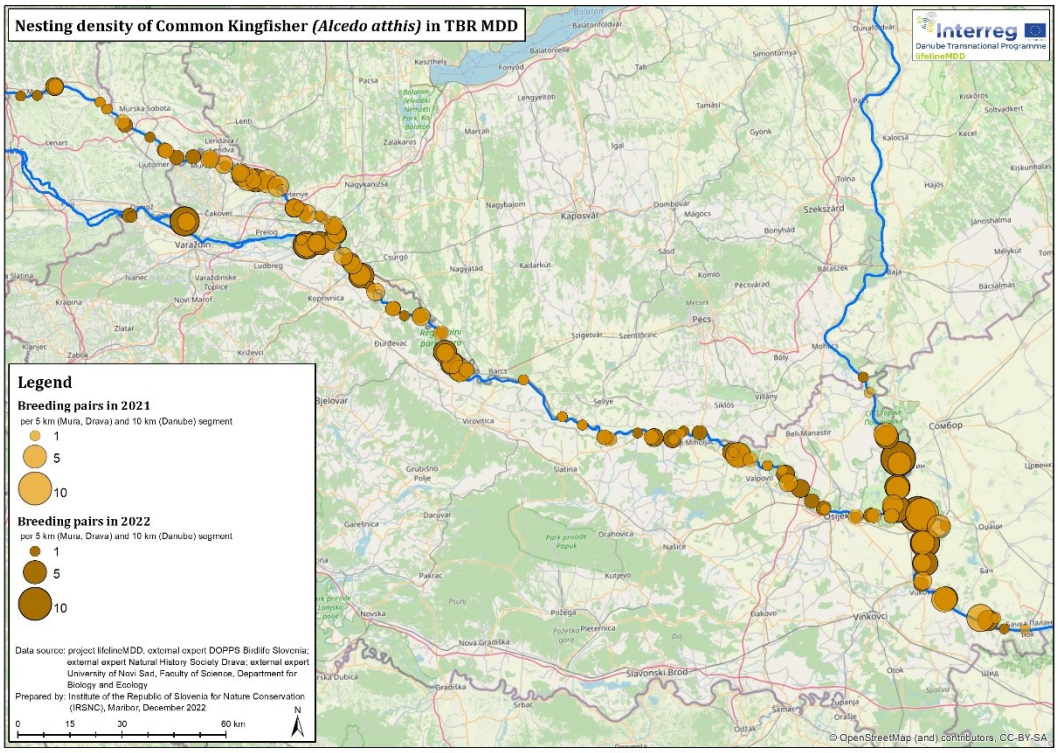

Figure 20: Linear density of the Common Kingfisher (*Alcedo atthis*) breeding pairs in 2021 and 2022 per 5 km (Mura, Drava) and 10 km (Danube) long riverbed segments in the TBR MDD.

A larger circle means a larger number of breeding pairs and a greater importance of this area for this species.

Breeding pairs of Common Kingfisher were estimated forthe Mura, Drava and Danube riverbed and for the whole TBR MDD; linear breeding densities were calculated and summarized in Table 10.

Table 10: Common Kingfisher (*Alcedo atthis*) breeding pairs number and linear density in the surveyed section on the Mura, Drava and Danube Rivers in TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). Density = breeding pairs per km of the riverbed

	Lenght (km)	Pairs 2021	Pairs 2022	Density 2021	Density 2022	Population trend 2008-2022
Mura-A/SLO/HR(1)	93	27	32	0,29	0,34	moderate increase (1)-TRIM
Mura-HR/HU(2)	49	25	16	0,51	0,33	increasing (uncertain) (2)-Excel-linear r.
Drava(2)	273	81	101	0,30	0,37	increasing (uncertain) (2)-Excel-linear r.
Danube-HR(2)	135	34	45	0,25	0,33	increasing (uncertain) (2)-Excel-linear r.
Danube-SRB(3)	135	27	25	0,20	0,19	unknown
	Lenght (km)	**Pairs 2021**	**Pairs 2022**	**Density 2021**	**Density 2022**	**Population trend 2008-2022**
Mura	142	52	48	0,37	0,34	moderate increase
Drava	273	81	101	0,30	0,37	increasing (uncertain)
Danube	135	61	70	0,45	0,52	unknown
MDD together in TBR	**550**	**194**	**219**	**0,35**	**0,40**	**increasing (uncertain)**

The total population size of the Common Kingfisher in the Mura, Drava and Danube riverbedwas estimated at 194 pairs with a linear breeding density of 0.35 pairs/km in 2021, and at 219 pairs with a density of 0.4 pairs/km in 2022. The largest proportion of pairs (over 40 % of the MDD riverbed breeding population) was recorded on the Drava riverbed, but the highest linear nesting densities were calculated for the whole stretch of the Danube and reached 0.45–0.52 pairs/km (Table 10). These results deviate from the results reported by Gattermayr *et al.* (2019), who reported very low nesting densities at the Danube. There can be two reasons for such high nesting densities in 2021 and 2022: the kingfisher census was more accurate, as it was carried out on both the left (Serbian) and right (Croatian) banks of the Danube in the same year. The higher number was also certainly influenced by the partial river bird census in some larger backwaters and sidearms on the Serbian side of the Danube (Mišvald, Hagla, Šarengradska ada, Donji Prut).

It should be emphasized that, unlike the previous two target species, the Table 10, given above, does not constitute estimates of the total number of breeding pairs in the area of the Mura, Drava and Danube River studied in TBR MDD as the Kingfisher distribution is not entirely limited to the main river channel. Grlica (2022) also emphasizes this when he writes in his report, that the actual number of Kingfishers can be up to 50% higher because not all river branches are monitored, and nests are often much hidden, so they are easy to overlook. These are also confirmed results of the study in the target area in Slovenia by Božič (2022), where an additional survey of different localities outside the main river channel in 2022 resulted in 18 registrations of 19 individuals, all of them along the side arms (10 locations). By including these additional pairs, the total 2022 population of the Mura River area studied increases by one third, from 28–36 pairs to 37–49 pairs, and the overall linear breeding density rises to 0.4–0.5 pairs/km of the river (Božič 2022).

Kingfishers have often been recorded nesting on the edges of colonies of Bee-eaters and Sand Martins (Grlica 2022).

The assessment of the Common Kingfisher population trend (Table 10) in the Slovenian, Austrian and Croatian bordering Mura section was in the 2008–2022 period estimated with TRIM as moderate increase (Božič 2022). According to Grlica (2022) a series of data for Mura downstream of Dekanovec and for the Drava River in period 2008–2022 indicates the trend with a small population increase. But since the high data fluctuations over the years are recorded, also due to harsh winter conditions that can decrease the numbers of Kingfisher (as in 2012), out of the precautionary principle, it is better to assess the overall trend in the TBR MDD as uncertain (Table 10).

Habitat

In general, the Kingfisher inhabits flowing or still water bodies, rich in fish of suitable size and with overhanging bank vegetation that provides hunting perches. For nesting, it requires vertical walls, located over or near water, comprised of fine-grained, usually sandy material, in which it excavates a 50–90 cm long nesting tunnel. (Božič 2022)

In the Slovenian part of the bird study on Mura River (Božič 2022) also some nesting habitat characteristics were collected and recorded in the field. Firstly, estimates of Kingfisher nest-site parameters were assessed at 22 locations. The median height of the nest hole and the nesting wall above the water level of the river was 1.1 m (range 0.5–3.0 m) and 1.5 m (range 1.0–8.0 m). Characteristics of nesting sites in that study confirm the preference of Kingfisher for nesting close to the bank top (Isotti & Consiglio 1998, Hartwig 2005, Straka & Grim 2007).

Secondly, Božič (2022) also observed that, on lower Mura, the majority of Kingfisher nest holes were excavated in long stretches of natural river banks (often several hundred metres), while on the inner Mura most were found in rather short areas of the river bank with an exposed steep surface of suitable alluvial soil (a few tens of meteres at most). On the upper and inner (only Slovenian Mura), nest-sites in long stretches of natural river banks existed only in areas where recent river restoration projects, focused on removal of dysfunctional/ unnecessary rock ripraps were carried out.

Although few nest holes were found there, results of the 2022 census indicate the importance of river side channels for the Kingfisher, especially in sections where the main river channel was largely regulated by rock ripraps and consequently no natural banks exist (e.g. inner (only Slovenian) Mura). In contrast to the sections with long stretches of natural river banks, side channels are presumably the main nest-site type of the species in such sections (Božič 2022). Lack of suitable nest sites is presumably a limiting factor for the Kingfisher population on large parts of the upper and inner Mura, as reported for several rivers with altered flow regime elsewhere (Čech 2006, Schmidt & Zuna-Kratky 2009).

3.7 Sand Martin (*Riparia riparia*)

Distribution

The Sand Martin breeds in colonies in steep banks of rivers, streams and gravel pits. According to Figure 21 Sand Martin colonies are widespread in the TBR MDD, but the distribution is more evenly and condensed on the section of the Mura riverbed downstream from Mursko Središče (distances among colonies were more than 2 km apart (Božič 2022)), past the confluence with the Drava River and all the way to Barcs on the Drava River. Individual and big colonies on the Drava River with distances of several 10 km gaps between each other are also between Dolnji Miholjac and Osijek and on steep banks of the old Drava course between power plant reservoirs (lakes) upstream of the Drava confluence with the Mura. Some important breeding colonies were also found at the Danube River between Erdut and Mohovo (Šarengrad).

In 2021 and 2022, three smaller individual colonies were found also on the heavily regulated upper and inner Mura River. Such locations are found exclusively in sections where recent river restoration projects, focused on removal of dysfunctional/unnecessary rock ripraps were carried out. Thus, the preservation of the Sand Martin on large part of the Mura riverbed is dependent entirely on implementation of conservation measures. (Božič 2022) At the location of project lifelineMDD pilot restoration site on inner Mura at Hrastje-Mota (Slovenia) after the implemented measure 93 pairs of Sand Martins nested in 2022.

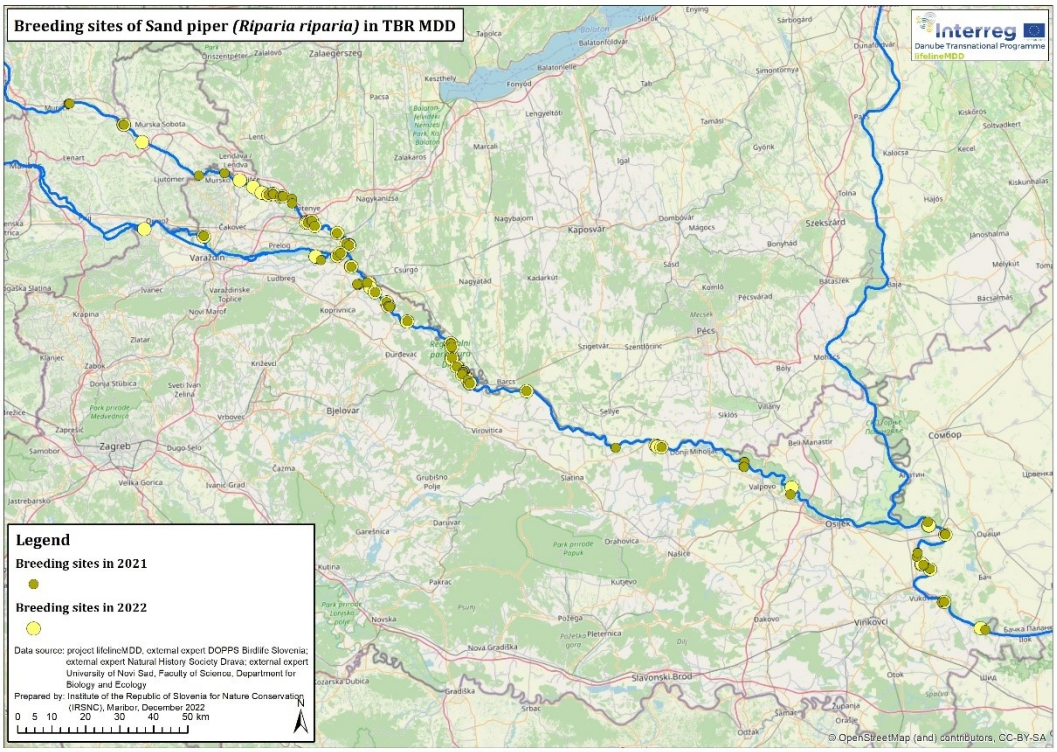

Figure 21: Distribution of Sand Martin (*Riparia riparia*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022.

Breeding pairs and linear density in 2021, 2022 & trend assessment 2008–2022

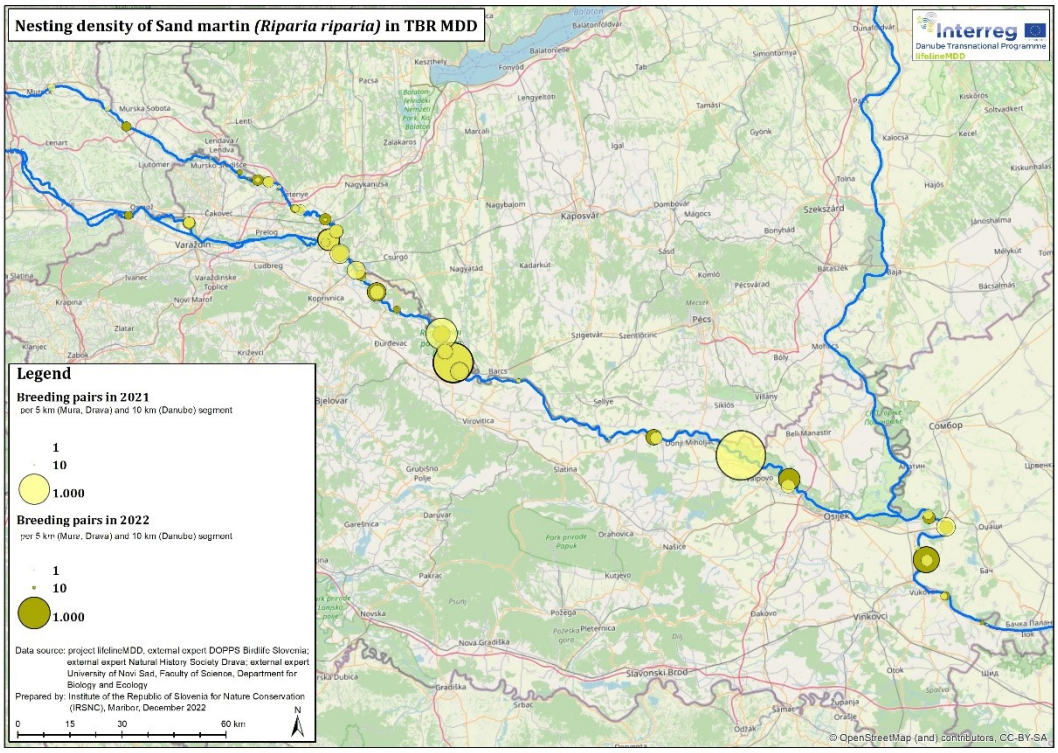

Figure 22: Linear density of Sand Martin (*Riparia riparia*) breeding pairs in 2021 and 2022 per 5 km (Mura, Drava) and 10 km (Danube) long riverbed segments in the TBR MDD.

A larger circle means a larger number of breeding pairs and a greater importance of this area for this species.

Table 11: Sand Martin (*Riparia riparia*) breeding pairs number and linear density in surveys section on the Mura, Drava and Danube Rivers in TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). "Density" = breeding pairs per km of the riverbed; "c" - colony

	Lenght (km)	Pairs 2021	Pairs 2022	Density 2021	Density 2022	Population trend 2008-2022
Mura-A/SLO/HR(1)	93	145 (7 c)	195 (7 c)	1,56	1,99	uncertain (1)-TRIM
Mura-HR/HU(2)	49	681 (12 c)	518 (14 c)	13,90	10,57	increasing (uncertain) (2)-Excel-linear r.
Drava(2)	273	7979 (32 c)	4591 (32 c)	29,23	16,82	decreasing (2)-Excel-linear regression
Danube-HR(2)	135	598 (9 c)	770 (5 c)	4,43	5,70	uncertain (2)-Excel-linear regression
Danube-SRB(3)	135	273 (4 c)	413 (3 c)	2,02	3,06	unknown
	Lenght (km)	**Pairs 2021**	**Pairs 2022**	**Density 2021**	**Density 2022**	**Population trend 2008-2022**
Mura	142	826	703	5,82	4,95	uncertain
Drava	273	7979	4591	29,23	16,82	decreasing
Danube	135	871	1183	6,45	8,76	unknown
MDD together in TBR	**550**	**9676**	**6477**	**17,59**	**11,78**	**decreasing**

Breeding pairs of Sand Martin were estimated forthe Mura, Drava and Danube riverbed and for the whole TBR MDD linear breeding densities were calculated and summarized in Table 11.

The total breeding population of Sand Martins in the area of 550 km Mura, Drava and Danube riverbed together was estimated at 9676 pairs (64 colonies) with a linear breeding density of 17.6 pairs/km in 2021, and at 6477 (61 colonies) pairs with a density of 11.8 pairs/km in 2021 and 2022. The highest nesting densities of Sand Martins in the TBR MDD were recorded on the Drava from the Mura-Drava confluence and downstream to Križnica (235 rkm to 170 rkm). High nesting densities were also recorded on the lower Drava upstream and downstream of Valpovo in 2021 and 2022. It is evident from Figure 22 and from the report by Grlica (2022) that in 2022 two big colonies of Sand Martin were missing, that were present in 2021 near Gat (HR) on segment rkm 65-50. The exact reason is not known but it is well known that the location of colonies as well as the number of breeding pairs vary strongly from year to year (Gattermayr *et al*. 2019, Grlica 2022) and is also evident in Figure 22.

Relatively high densities were found at two locations on the Danube River, first upstream of Borovo (> 400 breeding pairs in 2022) and second downstream of Erdut/Bogojevo (ca. 200 breeding pairs in both years).

The assessment of the Sand Martin population trend (table 11) in the Mura riverbed is characterized by unpredictable and highly fluctuating numbers, making the ascertainment of population trend difficult. The multiplicative overall trend of Sand Martin in the 2008–2022 period was estimated with the TRIM as uncertain (Božič 2022). Due to the fluctuation in colony size on the Danube riverbed over the observation period, also here the population trend is difficult to estimate.

3.8 European Bee-Eater (*Merops apiaster*)

Distribution

There are fewer Bee-Eater breeding sites in the TBR compared to Sand Martin breeding sites. The distribution of the European Bee-Eater within the study area in the TBR MDD is very wide but not continuous along the river courses (Figure 23). In 2021 and 2022, most of the breeding sites were found along the Drava River in Croatia, at the river stretch between the Mura-Drava confluence and Donji Miholjac.there are existing localized breeding sites with known localities also allong Danube, but also one breeding site on Mura.

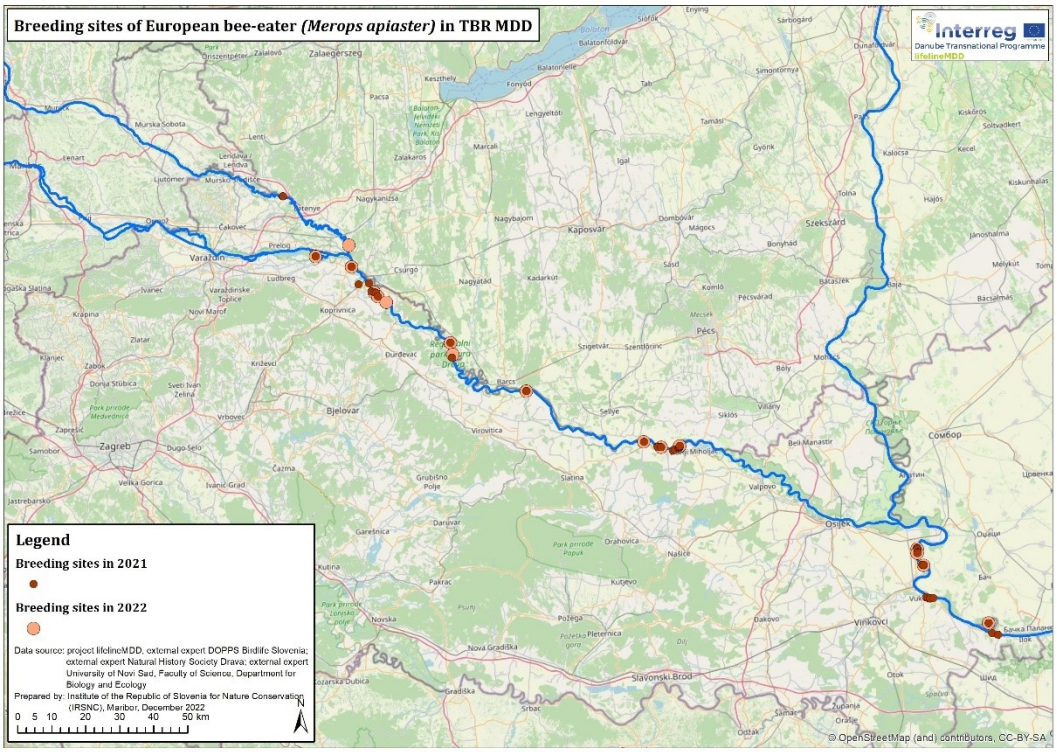

Figure 23: Distribution of European Bee-Eater (*Merops apiaster*) breeding pairs in the TBR MDD survey area of the Mura, Drava and Danube Rivers in 2021 and 2022.

Breeding pairs and linear density in 2021, 2022 & trend assessment 2008–2022

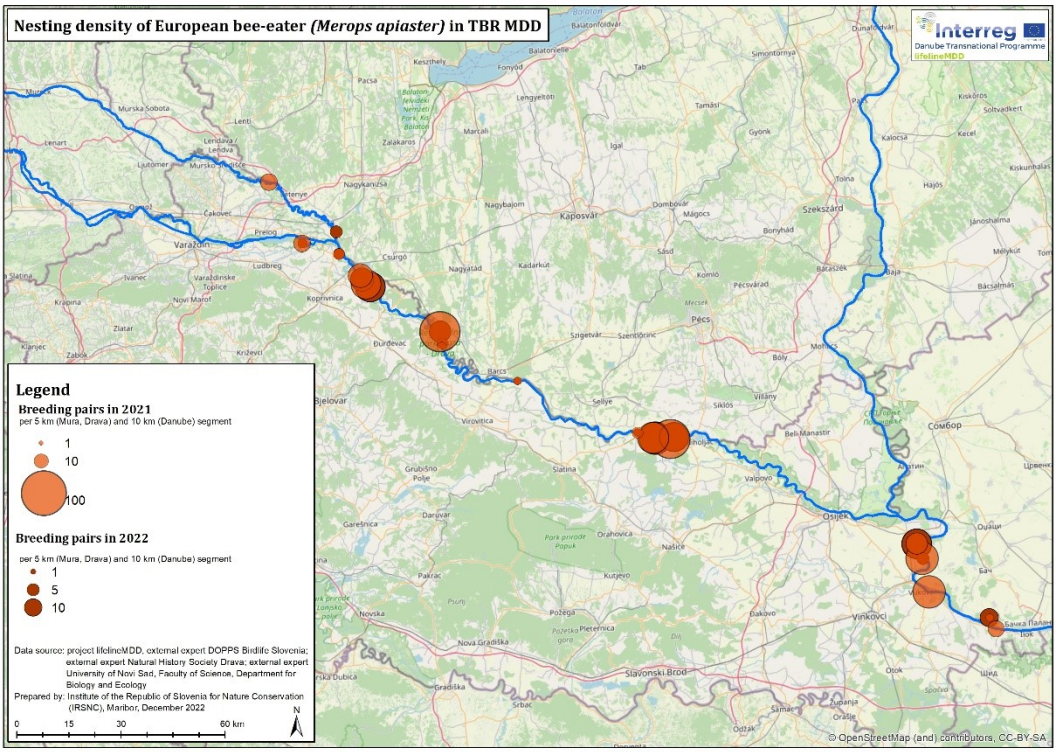

Figure 24: Linear density of European Bee-Eater (*Merops apiaster*) breeding pairs in 2021 and 2022 per 5 km (Mura, Drava) and 10 km (Danube) long riverbed segments in the TBR MDD.

A larger circle means a larger number of breeding pairs and a greater importance of this area for *this species.*

Table 12: European Bee-Eater (*Merops apiaster*) breeding pairs number and linear density in surveys section on the Mura, Drava and Danube Rivers in the TBR MDD in 2021 and 2022 (Data provided by: (1) - Božič 2022, (2) - Grlica 2022, (3) - Radišić 2022). "Density" = breeding pairs per km of the riverbed; "c" - colony

	Lenght (km)	**Pairs 2021**	**Pairs 2022**	**Density 2021**	**Density 2022**	**Population trend 2008-2022**
Mura-A/SLO/HR(1)	93	0	0	0,00	0,00	unknown
Mura-HR/HU(2)	49	14 (2 c)	5 (1 c)	0,29	0,10	unknown
Drava(2)	273	309 (22 c)	141 (12 c)	1,13	0,52	increasing (uncertain) (2)-Excel-linear r.
Danube-HR(2)	135	130 (14 c)	35 (3 c)	0,96	0,26	increasing (uncertain) (2)-Excel-linear r.
Danube-SRB(3)	135	14 (4 c)	11 (3 c)	0,10	0,08	unknown
	Lenght (km)	**Pairs 2021**	**Pairs 2022**	**Density 2021**	**Density 2022**	**Population trend 2008-2022**
Mura	142	14	5	0,10	0,04	unknown
Drava	273	309	141	1,13	0,52	increasing (uncertain)
Danube	135	144	46	1,07	0,34	unknown
MDD together in TBR	**550**	**467**	**192**	**0,85**	**0,35**	**unknown/uncertain**

Breeding pairs of the European Bee-Eater population in the Mura, Drava and Danube riverbed and the total number for the TBR MDD were estimated and linear breeding density calculated (Table 12). The breeding density depends on quality and size of steep banks and cliffs and reaches from single breeding pair to large colonies. All recorded colonies were quite small, only four colonies had between 30-85 breeding pairs (see Annexes).

European Bee-Eater population size in the Mura, Drava and Danube riverbed together was estimated at 467 pairs in 42 colonies with a linear breeding density of 0.85 pairs/km in 2021, and at 192 pairs in 19 colonies with a density of 0.35 pairs/km in 2022. The largest proportion of pairs (65% or 73% of the MDD riverbed breeding population) and the highest breeding densities were recorded on the Drava riverbed (Table 12), with breeding locations near Libanovec, Hlebine, Heresznye, Žlebina, and Donji Miholjac. High breeding densities were recorded also on the Danube River between Dalj and Borovo (Vukovar).

Also, for the European Bee-Eater population a trend in the TBR MDD still couldn't be assessed with certainty due to fluctuations in the number of breeding pairs between years and in some cases also due to the lack of data series, therefore the overall trend is uncertain. The linear regression line (Table 12) for the series of breeding data in the period between 2008-2022 on the Drava and on the Croatian bank of the Danube indicates an increase in the population of European Bee-Eater, but this estimate is rather unreliable (uncertain).

3.9 Data analysis per river segments 5 km (Mura, Drava) and 10 km (Danube)

According to the simple analysis of bird breeding data also the most important river segments with highest density and/or river breeding bird biodiversity (number of different species) of rivers Mura, Drava and Danube were identified (Table 13, Table 14).

Table 13: The river segments of the Mura and Drava (5 km) and the Danube (10 km) river corridor with the highest breeding densities for each target bird species. Peak values of 2–4 segments are in red text.

Little Ringed Plover	
River segment	Density (pairs/km)
MUR060-065	0,8
MUR055-060	1,2
MUR050-055	2,8
MUR045-050	0,8
DRA250-255	0,8
DRA245-250	1
DRA200-205	0,8
DRA185-190	1,2
DRA160-165	1

European Bee-eater	
River segment	Density (pairs/km)
MUR000-005	1
DRA220-225	3,6
DRA215-220	6
DRA185-190	3
DRA090-095	7
DRA085-090	5,6
DAN1350-1360	3
DAN1310-1320	1,1

Sandmartin	
River segment	Density (pairs/km)
MUR100-105	18,6
MUR050-055	23,2
MUR045-050	21
MUR030-035	13,6
MUR010-015	26
MUR000-005	37
DRA320-315	14
DRA290-295	30
DRA235-240	100
DRA230-235	50
DRA220-225	21
DRA215-220	70
DRA205-210	10
DRA185-190	55
DRA180-185	56
DRA175-180	320
DRA170-175	43,8
DRA090-095	48,4
DRA035-040	90
DAN1370-1380	15
DAN1360-1370	17
DAN1340-1350	66,3

Common Sandpiper	
River segment	Density (pairs/km)
MUR080-085	0,8
MUR065-070	0,8
MUR060-065	0,8
MUR055-060	0,8
MUR050-055	1,6
MUR045-050	1
MUR035-040	0,8

Common Kingfisher	
River segment	Density (pairs/km)
MUR055-060	0,8
MUR050-055	1
MUR000-005	0,8
DRA290-295	1,6
DRA245-250	1,4
DRA240-245	1
DRA220-225	1,2
DRA180-185	1
DRA175-180	1
DRA170-175	0,8
DRA060-065	1
DAN1400-1410	1,1
DAN1370-1380	1,2
DAN1350-1360	0,8

Common Tern	
River segment	(pairs/km)
DRA200-205	1
DRA185-190	0,6

Little Tern	
River segment	(pairs/km)
DRA185-190	0,2

Linear breeding density can be calculated for selected and arbitrarily long sections of the river. If the selected section is several dozen kilometres long and the distribution of breeding pairs is very uneven, breeding density calculations are not the most representative. Therefore, we tried to show linear breeding densities for individual species also for shorter sections, i.e., river segments 5 km long (Mura, Drava) and 10 km long (Danube). In comparison with the calculated breeding density for eight river sections (Schwarz 2022, see Figure 12) values of linear breeding densities on this shorter river stretches (5 km/10 km segments) is even significantly higher at some locations (Table

13). The highest breeding density per 5 km/10 km segment for each target species is written in red text.

The extensive Table 14 below is easy to use as it works on the principle of a traffic light. The green-coloured river segments represent the parts of the river course MDD that are numerically (breeding pairs) or by biodiversity most important (based on censuses in the 2022 season). River segments in red colour represent parts of the river course MDD where no nesting river birds have been recorded or only single pair occured, and only 0-2 different river bird species are present (based on censuses in the 2022 season).

Table 14: Assessment of the importance of the river section importance in terms of the number of species and the number of breeding pairs of river bird species per river segments, 5 km at Mura and Drava Rivers and 10 km at Danube River (according to Figure 6, Schwarz (2022)).

Legend: *River segment - river assessment segments (5km – Mura, Drava & 10 km Danube); DAN – Danube; DRA – Drava; MUR – Mura; BP – breeding pair; All species BP 2022 – breeding pairs of all river bird species in year 2022; Species & NO Sand Martins BP 2022 - breeding pairs of river bird species without Sand Martins in year 2022; No. of species – total number out of seven target river bird species (biodiversity)*
Intense green colour *– the best or good river segments – light green colour*
Red colour *–degraded river segments*

River segment	All species BP 2022	Species & NO Sand Martins BP 2022	No. of species
DAN1300-1310	1	1	1
DAN1310-1320	35	15	3
DAN1320-1330	87	7	3
DAN1330-1340	2	2	1
DAN1340-1350	675	12	4
DAN1350-1360	39	39	3
DAN1360-1370	171	1	2
DAN1370-1380	162	12	2
DAN1380-1390	8	8	2
DAN1390-1400	6	6	1
DAN1400-1410	12	12	2
DAN1410-1420	7	7	2
DAN1430-1440	1	1	1
DRA000-005	2	2	1
DRA005-010	2	2	1
DRA010-015	1	1	1
DRA020-025	2	2	1
DRA025-030	2	2	1
DRA030-035	3	3	1
DRA035-040	451	1	2
DRA040-045	3	3	1
DRA045-050	1	1	1
DRA050-055	1	1	1
DRA055-060	1	1	1

River segment	All species BP 2022	Species & NO Sand Martins BP 2022	No. of species
DRA060-065	5	5	1
DRA065-070	3	3	1
DRA075-080	2	2	1
DRA080-085	1	1	1
DRA085-090	31	31	2
DRA090-095	280	38	3
DRA095-100	3	3	2
DRA100-105	0	0	0
DRA105-110	1	1	1
DRA110-115	2	2	1
DRA120-125	1	1	1
DRA125-130	1	1	1
DRA130-135	0	0	0
DRA135-140	0	0	0
DRA140-145	1	1	1
DRA145-150	22	2	2
DRA150-155	0	0	0
DRA155-160	1	1	1
DRA160-165	5	5	1
DRA165-170	5	5	2
DRA170-175	223	4	2
DRA175-180	1606	6	3
DRA180-185	292	12	4
DRA185-190	302	27	7
DRA195-200	4	4	2
DRA200-205	10	10	3
DRA205-210	53	3	3
DRA215-220	382	32	4
DRA220-225	130	25	4
DRA225-230	4	4	2
DRA230-235	255	5	3
DRA235-240	502	2	2
DRA240-245	31	6	3
DRA245-250	21	16	5
DRA250-255	5	5	2
DRA290-295	161	11	4
DRA295-300	1	1	1
DRA310-315	4	4	2
DRA320-315	74	4	3
MUR000-005	198	13	5
MUR005-010	5	5	3
MUR010-015	130	0	1
MUR015-020	1	1	1
MUR020-025	2	2	2

River segment	All species BP 2022	Species & NO Sand Martins BP 2022	No. of species
MUR025-030	32	2	2
MUR030-035	71	3	2
MUR035-040	4	4	1
MUR040-045	6	6	3
MUR045-050	116	11	4
MUR050-055	143	27	4
MUR055-060	22	14	4
MUR060-065	40	10	4
MUR065-070	10	7	4
MUR070-075	2	2	1
MUR075-080	7	7	3
MUR080-085	8	8	3
MUR085-090	6	6	3
MUR090-095	5	5	3
MUR100-105	95	2	2
MUR105-110	11	4	3
MUR110-115	1	1	1
MUR120-125	1	1	1
MUR125-130	3	3	1
MUR130-135	1	1	1
MUR135-140	2	2	2
MUR140-145	1	1	1

3.10 Threats

Species associated with dynamic river habitats, such as indicator birds nesting on gravel bars/islands or on steep river banks are highly threatened due to different impacts. While the bird experts conducted the bird census, they also tried to record the threats to river breeding birds observed in the field. Although this was not the primary task of the bird study and recording of threats was not very systematic, the following threats were observed in the field:

1. Recreational use and leisure activities

The most often observed threat was human disturbance of birds during the breeding season (e.g., quad-driving/off-road driving, boating, fishing, swimming, hiking/cycling/holiday houses, gold panning with motorized devices etc.).

For the Mura River Božič (2022) reports, that during the bird survey, threats were also identified which mostly included all kinds of anthropogenic activities in the riverbed that clearly took place during or shortly before the breeding season: gravel excavation, off-road driving and prolonged recreational use (i.e. picnic, fireplace, boat stop; Figure 25).

Some of the key nesting locations of the Little Ringed Plover and the Common Sandpiper in different survey sections were affected, including a large gravel bar on lower Mura severely degradedthrough combination of all three types of activities. Two pairs of Common Sandpiper nested there in 2021, but none was recorded in 2022. The species is known to be sensitive to human-related disturbances, caused by various forms of land use along river corridors (off-road driving, boating, camping, fishing, etc.), which are often listed among most important threats to local populations in some parts of Central Europe (Yalden 1992, Bezzel *et al.* 1995, Lengyel 1998, Schödl 2003, Bauer *et al.* 2005).

Figure 25: Traces of anthropogenic activities, encountered on gravel bars during surveys in the Mura riverbed between Ceršak (SLO) and Dekanovec (HR). Photo: Luka Božič, DOPPS Birdlife Slovenia

Moreover, for Drava and Danube the Croatian bird expert Grlica (2022) wrote, that the existing bars and remaining bars that appear at lower water levels are occupied by fishermen, bathers and picnickers. Many years of systematic disturbance of these birds resulted in the disappearance of indicator bird species from that area.

Nevertheless Božič (2022) concludes that at the current level the situation is not yet alarming, but all kinds of anthropogenic activities in the riverbed should be regulated appropriately in the future and measures to limit these threats should be taken. As other studies previously showed, human disturbance directly affects foraging and breeding behaviour of wading birds (Denac *et al.* 2017, Schmid *et al.* 2018). Therefore, also awareness raising work with the public needs to be done by providing information and

setting up panels as done in a species promotion concept at the alpine Rhine (Schmid *et al.* 2018).

2. River regulation with river training structures (embankments, groins, traverses, rip-rap)

In the field survey in 2021 and 2022, new river bank fortifications were recorded in Croatia, on the Drava and Mura rivers (Grlica 2022).

Channelling of the river by revetments and other river management constructions were identified also on the Danube (Grlica 2022).

Figure 26: Rip-rap on the river bank of the Drava River and invasive species *Paulownia tomentosa* in Croatia in 2021. Photo: Darko Grlica.

The encouraging news for TBR MDD is that in Slovenia on the Mura River in 2022, within the framework of the lifelineMDD project and particularly "Natura Mura" cohesion project, the removal of old embankment fortifications was carried out in several locations.

3. Illegal and legal sediment (gravel) extraction

Bird experts have noted this threat several times on the Drava River (Grlica 2022). Also on the Mura River, some of the key nesting locations were affected by anthropogenic activities, such as gravel excavation (Božič 2022) but to a small extent.

Figure 27: Machinery for sediment gravel extraction on the Drava River in Croatia in 2021. Photo: Darko Grlica.

4. Climate change

In addition to the threats above, in recent years, the more prominent impact of climate change marked by extremely high and low water levels is evident. Grlica (2022) and Radišič (2022) report, that the threats to nesting birds on the Danube and Drava during the season 2021 is related to a fairly long period of high water.

Bird species breed on gravel/sand bars and steep banks in the TBR MDD between April and the end of July. The results of the lifelineMDD climate study (Greimel *et al.* 2022) show that there will be changes in the hydrological regime of rivers in the future, as well as more frequent flooding events on an annual basis. In case high water levels occur almost throughout the whole breeding season (something similar happened during the bird census in 2021 on the Drava and Danube rivers) and this repeats for several seasons, this can have a long-term effect on the populations of these birds as well.

5. Invasive species on river banks

The occurrence of non-native plant species at the steep river banks in the TBR MDD is considerable. Invasive species with strong and invasive root systems (Japanese knotweed *Reynoutria japonica*) on non-forested areas of river banks can be problematic, particularly in case the river banks are not very high and the steep river banks are very long. This can repel Sand Martins from nesting, which we also noticed at the location of the Mura River, where the lifelineMDD volunteering action was done in 2022. In the freshly prepared sand steep wall only the kingfisher nested (own observations).

This list of threats that have been recorded in the field can be supplemented withfollowing further threats well known from literature (Gattermayr *et al.* 2019, Grlica 2022).

6. Hydropeaking along free-flowing Drava

Sudden, massive changes in the water level caused by hydropower plants (hydropeaking) pose an additional threat to river breeding birds, particularly to bar breeders. Kralj (2019a) reports that the Common Tern has already disappeared from Slovenian rivers and the last colony on the Drava River in Croatia is severely threatened by frequent flooding.

The hydropeaking study that was conducted in the frame of the project lifelineMDD (Greimel *et al.* 2022) found that the amplitude of the power plant operation in Donja Dubrava reaches heights of up to 2 m (50 km downstream) and even about 100 km downstream of the plant amplitudes of ca. half metre can still be detected. The morphological conditions include a wide discharge profile with shallow gravel banks.

Such flow changes have two different effects on birds. First, for bar breeding birds a higher water level means a flooded nest and destroyed brood, especially on lower gravel bars/islands. Secondly, the rapid fluctuations of the water level also affect the amount of food biomass available to birds.

7. Interrupted sediment transport by dams

Longitudinal sediment flow and lateral dynamics are crucial in long-termfor the conservation of river birds that breed on gravel bars and steep banks. The area and number of gravel and sand bars have decreased by 84% and 67% in hundreds of years respectively (Schwarz 2022). The sediment deficit and disturbances in upstream sediment supply due to the power plants or insufficient sediment supply will in long-term affects the river breeding birds in the entire TBR MDD. We can already conclude that the hydromorphological state of the rivers has changed severely and investigated bird species reflect this. Far-away barriers upstream have a significant impact on the area downstream. This can be seen in the sediment deficiency that was measured and is seen until today after for example building of last the HPPs on Drava. We are certain that also other similar barriers upstream have the same effect that is then just multiplying downstream. Sediment, crucial and vital for a river and shaping of habitats is stopped at the dams upstream. An integrated sediment management should therefore be in place.

the "Action plan" (Gattermayr *et al.* 2019)several more threats to river breeding birds are presented, we are only listing them and do not present them in detail in this report:

8. Water diversion at reservoirs for hydropower plants

9. Plans for new hydropower plants

10. Straightening of river course and disconnection of side branch systems (incl. floodplain)

11. Additional threats including navigation & agriculture

12. Lack of transboundary cooperation and harmonisation

4. SUMMARY, CONCLUSIONS AND ACTION RECOMMENDATIONS

4.1 Current status of riverbed breeding birds in TBR Mura-Drava-Danube in 2021–2022

Bird experts from Slovenia, Croatia and Serbia implemented the first-ever joint near complete 5-country river breeding bird mapping for the transboundary river corridor Mura-Drava-Danube (MDD). This report summarizes and combines the findings and results of three separate final reports by bird experts.

In 2021 and 2022, river bird surveys of selected breeding bird species were conducted in the MDD riverbed between Ceršak (SLO-AT) and Bačka Palanka (HR-RS) in a total length of 550 km. The survey covered almost entirely the main river channels of the MDD TBR, except the sections of Drava River between the accumulation reservoirs for power plants (Ormož, Varaždin, Dubrava) and 77 km of the Danube River between Fajsz (HU) and Batina/Bezdan (rkm 1510-rkm 1433). The field survey methods used mostly complied with common minimum standards for riverbed bird census in the TBR MDD area. Target species of the survey were Little Ringed Plover *Charadrius dubius* (LRP), Common Sandpiper *Actitis hypoleucos* (CS), Common Tern *Sterna hirundo* (CTER), Little Tern *Sternula albifrons* (LTER), Common Kingfisher *Alcedo atthis* (KIN), Sand Martin *Riparia riparia* (SMA) and the Bee-eater *Merops apiaster* (BEE). More than 2300 data was collected, digitized and interpreted according to special criteria. Additionally, 1882 existing data for target bird species in the TBR MDD area in Slovenia for the period 2000-2020 were purchased in the project lifelineMDD. This survey was conducted to assess the status quo of indicator river birds within the TBR MDD in 2021–2022 and learn from the distribution pattern and the breeding status of the target species and based on this to draw conclusions about the status of dynamic river habitats in the MDD corridor. Breeding distribution maps were prepared for all target species, and population and trend estimates were made where this was possible.

LRP population size on the 550 km of Mura, Drava and Danube riverbed was estimated at 100–106 pairs with a linear breeding density of 0,18–0,19 pairs/km in period 2021–2022, and for individual rivers as follows: for the Mura was estimated at 50-74 pairs (0,35-0,52 pairs/km), for the Drava at 21-41 pairs (0,18-0,33 pairs/km) and for the Danube at 6-13 pairs (0,06-0,08 pairs/km), in period 2021–2022. LRP Little Ringed Plover was very densely distributed only along the lower half of the Mura River and upper part of the Drava River upstream of Barcs(HU)/Terezino Polje (HR). The highest densities are reached from Mursko Središče to Legrad (rkm 070 to rkm 049), where linear density reached a record 1.9–2.1 (in 2021) and 1.3–1.4 pairs/km (in 2022), therefore, the conservation of the Little Ringed Plover population in this stretch is extremely important for the whole TBR MDD. Results from the Mura riverbed indicate that the breeding of the LRP depends exclusively on the availability of suitable gravel bars; 43.6 % of all gravel bars mapped in the Mura riverbed were occupied by LRP in at least one of the study years.

LRP population trend in the 2008–2022 period was estimated as uncertain. Variations in numbers detected over time can probably be explained by the availability of suitable gravel bars.

CTER and LTER population size in the 550 km of MDD riverbed could be estimated at only a few pairs. During the nesting season in 2022, only one pair of LTER was nesting on the Drava at Heresznye (187 rkm) and 8 pairs of CTER were nesting in two colonies at Repaš (rkm 205) and Heresznye (187 rkm). LTER and also CTER can be considered among the most endangered river bird species in the TBR MDD, therefore, urgently targeted measures have to be taken. Very likely, the Drava River is important for the population of terns, nesting on gravel pits very near the river (e.g. Šoderica), especially for feeding during the breeding season. For CTER and LTER a decreasing and most probably decreasing trend was found on the Drava in the MDD population in the period 2008–2022.

CS population size on the 550 km of Mura, Drava and Danube riverbed was estimated at 61–77 pairs with a linear breeding density of 0,11–0,14 pairs/km in period 2021–2022, and for individual rivers as follows: for the Mura it was estimated at 51-69 pairs (0,36-0,49 pairs/km), for the Drava at 8-10 pairs (0,03-0,04 pairs/km) and for the Danube at 0 pairs (0 pairs/km), in period 2021–2022. CS was the most frequently recorded species but a large part of the observations were without indication of breeding. Distribution pattern of breeding Common Sandpipers from 2021 and 2022 followed the distribution pattern of the Little Ringed Plover, with several kilometre long gaps between data on Drava and the exception that no single breeding pair of the Common Sandpiper were recorded on the Danube. In 2021 and 2022 more than 80 % of the TBR MDD breeding pairs of the CS were nesting on the Mura riverbed. The highest breeding densities of the CS in this survey were found on the Mura River in the river stretch from Mursko Središče to Dekanovec with linear densities of 0.9–1.1 in 2021 and 0.8–1.4 pairs/km in 2022, respectively. CS overall population trend in the 2008–2022 period was estimated as uncertain (for Mura and Drava), although on the Mura in Slovenia in the 2008–2022 period was estimated as moderate increase. In the survey in Slovenia, most of the pairs (81 % in 2021 and 89 % in 2022) selected gravel bars for breeding, while others nested in side arms, river banks and artificial structures with shingle surface or woody debris. 42.6 % of all gravel bars were occupied by CS in at least one of the study years. The isolated breeding locations of LRP and CS on the upper heavily regulated Mura are results of recent river restoration projects (Gosdorf, Sicheldorf, Hrastje-Mota). The gravel bar surface area determines occupancy probability of both species and has significant effect on the number of LRP and CS pairs nesting on it. Some of the key nesting locations were affected by anthropogenic activities, such as gravel excavation, off-road driving and prolonged recreational use.

KIN population size on the 550 km of Mura, Drava and Danube riverbed was estimated at 194–219 pairs with a linear breeding density of 0,35–0,040 pairs/km in period 2021–2022, and for individual rivers as follows: for the Mura it was estimated at 43-57 pairs (0,34-0,37 pairs/km), for the Drava at 81-101 pairs (0,30-0,37 pairs/km) and for the Danube at 59-72 pairs (0,45-0,52 pairs/km), in the period 2021–2022.

SMA population size on the 550 km of Mura, Drava and Danube riverbed was estimated at 6477–9676 pairs (in 61–64 colonies) with a linear breeding density of 11,8–17,6 pairs/km in period 2021–2022, and for individual rivers as follows: for the Mura it was estimated at 663-876 pairs in 19–21 colonies (density 5,8–5,0 pairs/km), for the Drava at 4591-7979 pairs in 8–13 colonies (density 29,2-16,8 pairs/km) and for the Danube at 871-1183 pairs (6,5-8,8 pairs/km), in the period 2021–2022.

BEE population size on the 550 km of Mura, Drava and Danube riverbed was estimated at 192–467 pairs with a linear breeding density of 0,35–0,85 pairs/km in the period 2021–2022, and for individual rivers as follows: for the Mura it was estimated at 5-14 pairs (0,04-0,10 pairs/km), for the Drava at 141-309 pairs (0,52-1,13 pairs/km) and for the Danube at 46-144 pairs (0,34-1,07 pairs/km), in period 2021–2022.

The surveys in 2021 and 2022 confirmed the national and international importance of the Mura, Drava and Danube River area between Ceršak (SLO) and Bačka Palanka (HR) for selected river bird species.

Information on their occurrence and linear breeding densities along the MDD riverbed provides valuable clues about the state of the riverine habitats and processes. While the lower Mura in the section Križovec–Dekanovec and upstream of the Mura-Drava confluence at Legrad, the Drava in the section Vizvár/Heresznye–Križnica and in the section Legrad–Hlebine and the Danube in the section Aljmaš–Borovo, upstream of Vukovar with predominant natural river flow are characterized by the continuous occurrence of target species in high densities, long stretches of the upper Mura between Ceršak and Gornja Radgona (rkm 110-145), the Drava from Barcs to Gornje Predrijevo, upstream of Noskovci (rkm 120-160) and short stretches of the Danube in the area of Šarengrad-Bačka Palanka (rkm 1295-1305) and thearea of Batina/Bezdan (rkm 1420-1430) hold few characteristic bird species of pristine riverine habitats. Such-mentioned sections should be considered as priority in planning future river restoration projects. In addition, results show that restoration projects are essential for connectivity, as in the heavily regulated upper reaches of the Mura River, indicator bird species were only recorded in the areas of the lifelineMDD pilot restoration site at Hrastje-Mota or other previous restoration sites on the Austrian riverbank (Gosdorf, Sicheldorf). River bird species are good indicators of a dynamic river landscape, so with restoration and protection measures also many other species benefit.

In the separate reports of three bird experts from Slovenia, Croatia, and Serbia, which are annexed to this joint report, more detailed results and some additional detailed information can be found: i) recorded data of other non-target bird species in the TBR MDD in 2021 and 2022, ii) recorded data of Common Kingfisher outside the Mura riverbed in Slovenia in 2022 (side arms), iii) recorded data of target bird species in selected gravel pits (Križovec near Mura and Šoderica near Drava), iv) assessed height of nesting holes and the nesting walls above the water level for Kingfisher and Sand Martin nest-sites along the Mura riverbed, etc.

4.2 Importance and natural potential of the studied area

The bird survey confirmed the national and international importance of the Mura, Drava, and Danube Rivers between Ceršak (SLO) and Bačka Palanka (RS) for seven targeted river bird species. This underpins that app. 6.000-10.000 pairs of nesting Sand Martins, app. 200-450 nesting pairs of European Bee-eaters and app. 195–220 nesting pairs of Kingfishers are breeding in natural steep banks, and sand and gravel bars and islands inhabit approximately 100–105 Little Ringed Plovers and 60–80 Common Sandpiper. The largest colonies of Sand Martins reached 1000 to 1500 pairs on one large steep bank along the main channel, followed by Bee Eater colonies with some 55–80 pairs. The Croatian stretch of the Drava in the TBR MDD between Legrad and Ferdinandovec is one of the rare well-preserved river sections in Europe where the Little Tern is nesting (e.g., Loire in France, Vistula in Poland, Po in Italy, Sava in Croatia) (Sojanović *et al.* 2017). Otherwise, larger populations of this species live on the coast only. This particularly underlines the high ecological value and the international importance of the TBR MDD area.

Linear breeding densities for individual species for shorter sections in the MDD riverbed, i.e., river segments 5 km long (Mura, Drava) and 10 km long (Danube) at some locations reach record values (Table 13).

Linear densities of Little Ringed Plover breeding pairs on the best survey section(-s) on the Mura upstream the of the Mura-Drava confluence (Božič 2022) were higher than those recorded on most comparable sections of the Central European rivers, where these only rarely exceed 1 pair/km, mostly on wide, natural or restored stretches of large rivers (see Božič & Denac 2010, Arlettaz *et al.* 2012, Schmidt 2016). Similarly, the linear density of c. 1 pair/km of the Common Sandpiper isrecorded only in one survey section on the lower Mura, a value characteristic of high-quality sections on a diverse array of rivers, from alpine to lowlands (see Božič & Denac 2010, Frühauf & Dvorak 1996, Arlettaz *et al.* 2012). Božič (2022) reports that within or close to the territory of the TBR Mura-Drava-Danube, similar linear densities of both species as in the most downstream section of the Mura riverbed were only reported for a few sections of the Drava River between 236 and 180 rkm (mostly in Hungary) and 319–305 rkm in Slovenia (Fenyősi 2005, Božič & Denac 2010, 2017). Such high densities of breeding pairs only occur in river sections with numerous extensive and sparsely vegetated gravel bars, most of which are occupied by several pairs of either or both species. However, exceptional densities along vast natural river corridors can surpass these values for both species (e.g. Reich 1994, Elas & Meissner 2014).

The Kingfisher densities of well below 1 pair/km on most survey sections in the Mura riverbed are more typical of the rivers in Central Europe (see Božič & Denac 2010). These recorded low values reflect the current prevailing situation along the riverbed studied, with the main river channel largely regulated by rock ripraps and presumably not consistent with the great natural potential of the river. Under optimal conditions, the expected Kingfisher densities would be c. 1 pair/km of the riverbed as found on some of the large natural rivers (Westermann & Westermann 1998, Griesser 2022).

Contrasting linear breeding densities of the target species divided in two groups – bar breeders and bank breeders in the individual 5 km or 10 km survey segments along the Mura & Drava River or Danube River studied imply a different state of the riverine habitats and processes on separate parts of the river channel. This pattern can be ascertained on the two maps with densities of all seven species registered in the MDD riverbed combined (Figure 8 and Figure 9). The lower Mura between Mursko Središče and Mura-Drava confluence in Legrad and Drava from confluence downstream to Pitomača/Križnica with predominant completely natural river flow clearly stands out, while long stretches of upper Mura from Ceršak to Gornja Radgona and Drava from Barcs to Gornje Predrijevo upstream of Noskovci obviously hold only few characteristic bird species of pristine riverine habitats. Such sections should be considered a priority in planning future river restoration projects. These should focus primarily on large-scale removal of rock ripraps and other types of lateral embankments but also river sediment supply.

As reported by Božič (2022) a considerable number of best-practice examples from various Central European countries demonstrates a positive effect of such measures on target species, including a substantial recovery of once depleted breeding populations to the levels at estimated carrying capacity of the river ecosystem in a short time (Metzner 2002, Petutschnig 2004, Arlettaz *et al.* 2012, Uhl & Weissmair 2012, Griesser 2022).

4.3 River segments and stretches for protection and restoration actions in TBR MDD

The recent data on riverbed breeding bird nesting sites, which we obtained in this study in 2021 and 2022, must be taken into account when preparing a river strategy for the long-term conservation and improvement of the dynamic corridor of the Mura, Drava and Danube Rivers throughout the TBR MDD area. Despite the high-water levels in 2021, the data recorded in 2022 are relevant enough for this purpose.

Based on the data on seven target river breeding birds, we would recommend in the future strategic planning of restoration projects with two objectives.

Based on the collected data on the seven target river nesting birds, we recommend that the TBR MDD be strategically planned so as to achieve the following two goals in the long run.

This would mean to define:

I. prioritised river segments/stretches for protection and conservation actions,

II. prioritised river segments/stretches for river restoration actions.

According to the simple analysis of bird breeding data also the most important river segments with highest density and/or river breeding bird biodiversity (number of different species) of the rivers Mura, Drava and Danube were identified (Table 14).

1. Prioritised sections for protection and conservation actions

On the one hand those river segments (5km or 10 km) or stretches should be defined, where significant parts of the population of individual bird species have been identified. For Sand Martins this would for example besection of the Drava between rkm 190 and rkm 175 (Ferdinandovac–Pitomača/Križnica), where about 30% of the population nested in 2021. Another example would be;the Little Ringed Plover that reached a breeding density from 1.0 up to 2.5 breeding pairs per km, in season 2021 on Mura River between the rkm 60 and rkm 50 (Miklavec–Dekanovec).

The most important river segments with the highest breeding pair densities and/or river breeding bird biodiversity (number of different species) of the rivers Mura, Drava and Danube are intense green in Table 14, followed by light green. These intense green segments or these in colour identical segments, combined into longer river stretches have to be prioritiesed in the preservation/conservation of natural or near-natural river segments in the TBR MDD and are based on bird data from 2022 as follows:

i. on the Mura River between Križovec (HR) and Domašinec (HR)/Muraszemenye (HU) (rkm 045-065) and upstream of the Mura-Drava confluence at Legrad (rkm 000-005);
ii. on the Drava River segments are existing between Ferdinandovac (HR)/ Vizvár/Heresznye(HU) and Križnica (HR) (rkm 175-190), between Legrad and Hlebine (rkm 215-235), between Repaš and Čambina (rkm 200-210) and short stretches downstream of Dubrava hydropower reservoir/lake (rkm 240-250) and in the area of Trnovec (rkm 290-295);
iii. one segment on the Danube River in between Aljmaš and Borovo, upstream of Vukovar (rkm 1340-1380).

These stretches represent the sensitive breeding areas for river birds; therefore, recreational use should be strictly regulated, including the use of motor-boats. According to the "Action plan" (Gattermayr *et al.* 2019) in objective 9, reducing the impact of human disturbance due to recreational activities along the river and, particulary action 30 : "Establishing protected zones ("no-go" areas") are ofvery high priority. Within protected areas highly sensitive and ecologically important zones. especially for breeding birds, can be found. These zones are important retreats and should be declared as "no-go" areas for visitors. Relevant species are in particular breeding sites of colony breeders (e.g. Little and Common Tern, Sand Martin)."

2. Prioritised sections for river restoration actions

For futureriver restoration actions we must also identify specific river segments, where we found only a few or no breeding riverbed bird species, which are indicators of river

dynamics. Such longer river stretches defined based on bird census in 2022 are coloured in red in Table 14 and are as follows:

i. long stretche of the upper Mura between Ceršak and Gornja Radgona (rkm 110-145);
ii. Drava from Barcs to Gornje Predrijevo upstream of Noskovci (rkm 120-160) and
iii. short stretches of the Danube in the area of Šarengrad-Bačka Palanka (rkm1295-1305) and
iv. also, the area of Batina/Bezdan (rkm 1420-1430) hold only few characteristic bird species of pristine riverine habitats.

We recommend these river stretches to be considered as a priority in planning future river restoration projects.

Large scale river restoration is the most effective measure to improve sediment balance and hydro-morphological conditions and thus to stop river and floodplain degradation. This is also the reason why we defined longer stretches of the MDD river corridor, which require river dynamics restoration actions/projects. based on the collected data on nesting indicator river birds, in the very near future.

For the long-term preservation of riverbed breeding bird populations in the TBR MDD area, it is necessary to ensure the existence of their specific habitats - gravel bars and steep banks. This, however, strongly depends on the sediment in the river. Therefore, for the river breeding birds the most important restoration actions are those that include sediment management activities and ensure the constant input of gravel into the river. Maybe we should also think about the removal of some barriers to ensure connectivity for sediment and for fishes as well.

4.4 General conclusions, data gaps and uncertainties & need for actions and future research

1. Concretisation of the plan for river restoration projects in TBR MDD and later implementation (include also the land ownership information!).

Based on the results of the study on birds, together with other project studies, the planning of areas in the TBR MDD, which are suitable and a priority for restoration projects, must be carried out. An important and often time-consuming step before the implementation of restoration measures in reality (in the field) is knowing the ownership of these proposed areas for the potential restoration based on project studies. For the purpose of verifying the feasibility of restoration projects in reality in these potential areas, in the first phase it is absolutely necessary to prepare an ownership review for potential priority areas in the TBR MDD. Experience shows that approvals for the implementation of projects in nature are probably the easiest and fastest to be obtained in areas where the ownership is mainly public/state.

2. In this bird study the first joint (nearly) complete river bird census/mapping/ monitoring of breeding river birds in 5-country Biosphere Reserve Mura–Drava–Danube and with the common minimum standards (ToR) was conducted, in 2021 and 2022 respectively. Also, the unified form (attribute table) of data collection in the digital layer for use from now on was defined.

This standardized methodology and data forms should also be taken into account in all future river bird census/mapping/monitoring in the TBR MBB. A TBR-wide river bird monitoring should be conducted regularly as only in this way a good and crucial basis for monitoring the population trend of indicator bird species and all further conservation activities can be obtained. In order to improve the current bird monitoring ToR, we recommend that the entire river course of Mura, Drava and Danube should be included in a regular TBR MDD bird monitoring, i.e., also the **upper reaches of the Hungarian Danube of the TBR MDD between rkm 1425-1510**, which wasn't surveyed in 2021 and 2022. Based on the field observations and results from 2021 and 2022, we recommend that the census/monitoring period should be shortened, so that the census/monitoring period in the TBR MDD is standardized between the end **of April and the first third of July.** The reports of experts showed that later in July the migrations of some species of birds already begin (e.g., Common Sandpiper as reported by Radišić 2022). Overall long-term bird monitoring across the TBR MDD would be a value added to recognise long-term tendencies and allow for monitoring effects of changes in hydromorphology or other factors.

3. In the bird survey in 2021 and 2022, Little Tern and Common Terns were nesting in one respectively two colonies at Repaš (rkm 205) and/or Heresznye (187 rkm) only at the Drava in the entire TBR MDD. The common Tern, right after the Little Tern, can be considered among the most endangered river bird species in TBR MDD. Therefore, urgently targeted measures have to be taken for both species.

The recommendation is to conduct a study to assess the impact of **hydropeaking** on Terns and other bar breeding birds as well as the benthic invertebrate fauna (bird food) downstream the last power plant on the Drava (Donja Dubrava). Based on the study results, efforts should be made to find measures to mitigate the impacts during the time of Tern nesting. The managers of the protected area must ensure that the gravel bars/islands with Tern nesting sites are quiet (without human disturbance) during the entire time of nesting and rearing of young.

4. This bird study shows that the Drava section between Barcs (HU)/Terezino Polje (HR) **and the confluence of the Drava and the Danube is characterised by a lack of bar breeding birds, in 2021 and 2022.** The reason may be the lack of gravel bars and islands in this stretch or there is at least a lack of sediment due to different reasons. It is also possible that this is a consequence of different disturbances, e.g., high water level or human disturbance, that prevent nesting on the existing gravel bars. LifelineMDD sediment balance and transport study for the TBR MDD (Klösch *et al*. 2022) reports, that in Terezino Polje (HR) or Barcs (HU) there is a drastic situation with the riverbed incision, where over the last 96 years the riverbed incised 2.7 m, which translates to a rate of 2.8

cm per year. Not only that, Klösch *et al*. (2022) also found that at five out of six study points (locations) in the entire section between Terezino Polje and the Drava-Danube confluence, the riverbed incision was 0,6–2,0 cm per year.

5. Survey of the carrying capacity of the TBR MDD for indicator bar breeders and bank breeders (e.g. inventory of the number and size of gravel/sand bars and steep banks in the TBR MDD), if possible every 5-10 years and comparison between years). Habitat structures, especially gravel bars/islands and river banks, are very important for the targeted bird species for which we conducted the first joint near complete and standardised river bird census/mapping in the TBR MDD. Nevertheless, in this study all potential gravel bars and steep walls were not systematically mapped. This should be done in future studies/projects.

6. There is still a lack of data on the distribution of target bird species along the side arms/branches, backwaters and main tributaries in the area of the TBR MDD. This gap should be filled in the future. It should be emphasized that, unlike the previous two target species, the Table 10 given above does not constitute estimates of the total number of breeding pairs in the area of the Mura, Drava and Danube River studied in the TBR MDD as the Kingfisher distribution is not entirely limited to the main river channel. Grlica (2022) also emphasized this when he wrote in his report, that the actual number of Kingfishers can be up to 50% higher because not all river branches are monitored and nests are often hidden, so they are easy to overlook. These are also confirmed in results of the study in the target area in Slovenia by Božič (2022), where an additional survey of different localities outside the main river channel in 2022, resulted in 18 registrations.

7. Conduct an inventory of river bird species on all gravel pits in the immediate vicinity of the Mura, Drava and Danube rivers in the TBR MDD, as it turned out that they can host a significant part of the population, e.g. Common tern, which in the past nested on the river course (Kralj et al. 2019) and probably moved because of the fluctuation of the water lever due to hydropower plants and because of human disturbances.

8. A systematic inventory of threats (where & what type of threats) to river breeding birds in the TBR MDD along the entire stretch of rivers Mura, Drava, and Danube, and assessment of the degree threats of the tourism and recreation to nesting on gravel bars.

9. The importance of the Drava River, particularly for bar breeding birds is probably underestimated and higher than indicated in this study as the survey there was carried out by only two persons, in contrary, with the Slovenian Mura, where 4 persons carried out the survey. Moreover, total length of the Drava for the bird census was significantly longer than the length of the Mura, and the dimensions (width) of the river were also greater than on the Mura, which maked the census more difficult. Therefore, in the future the survey methodology maybe can be further upgraded and standardized in this area as well.

5. REFERENCES

Andretzke H., Schikore T., Schröder K. (2005): Artsteckbriefe. pp. 135–695 In: Südbeck P., Andretzke H., Fischer S., Gedeon K., Schikore T., Schröder K., Sudfeldt C. (eds.): Methodenstandards zur Erfassung der Brutvögel Deutschlands. – Radolfzell.

Arlettaz R., Lugon A., Sierro A., Werner P., Kery M., Oggier P. A. (2011): River bed restoration boosts habitat mosaics and the demography of two rare non-aquatic vertebrates. – Biological Conservation 144 (8): 2126–2132.

Bauer H.-G., Bezzel E., Fiedler W. (eds.) (2005): Das Kompendium der Vögel Mitteleuropas. – AULA Verlag, Wiebelsheim.

Berndt, R. K., Hein, K. & Gall, T. (1994): Stabile Brutbestände der Uferschwalbe Riparia riparia in Schleswig-Holstein zwischen 1979 und 1991. – Vogelwelt 115: 29-37.

Bezzel E., Fünfstück H.-J., Kirchner J. (1995): Der Flußuferläufer Actitis hypoleucos im Werdenfelser Land 1966 bis 1994: Lebensraum, Durchzug, Brutbestand und Schutzprobleme. – Garmischer Vogelkundliche Berichte 24: 47–60.

BirdLife International (2021): Common Sandpiper Actitis hypoleucos. – The IUCN Red List of Threatened Species 2021: e.T22693264A166252539. [https://dx.doi.org/10.2305/IUCN.UK. 2021-3.RLTS.T22693264A166252539.en].

Bogaart P., van der Loo M., Pannekoek J. (2018): rtrim: Trends and Indices for Monitoring Data. Version 2.0.6. – 24 Aug 2018. [https://cran.r-project.org/web/packages/rtrim/index.html].

Božič L. (2007): Analiza živega sveta na območju Mure med Šentiljem in Veržejem. Segment: Ptiči (Aves). Zaključno poročilo. Naročnik: Vodnogospodarski biro Maribor d.d. – DOPPS, Ljubljana.

Božič L., Denac D. (2010): Številčnost in razširjenost izbranih gnezdilk struge reke Drave med Mariborom in Središčem ob Dravi (SV Slovenija) v letih 2006 in 2009 ter vzroki za zmanjšanje njihovih populacij. – Acrocephalus 31 (144): 27–45.

Božič L., Denac D. (2017): Population dynamics of five riverbed breeding bird species on the lower Drava River, NE Slovenia. – Acrocephalus 38 (174/175): 85–126.

Božič L., Koce U. (2020): Vodomec Alcedo atthis. str. 10–21. V: Denac K., Božič L., Kmecl P., Mihelič T., Denac D., Bordjan D., Koce U.: Monitoring populacij izbranih ciljnih vrst ptic na območjih Natura 2000 v letu 2020 in sinteza monitoringa 2019–2020. Poročilo. Naročnik: Ministrstvo za kmetijstvo, gozdarstvo in prehrano. – DOPPS, Ljubljana.

Božič L. (2021a): Popis izbranih ptic gnezdilk struge reke Mure v Sloveniji na odseku Ceršak–Dekanovec v letu 2021 in 2022 ter odkup obstoječih podatkov izbranih vrst ptic na območju TBR Mura-Drava-Donava. SKLOP 1: Odkup podatkov izbranih vrst ptic na območju TBR MDD. Pregledno poročilo. Projekt »Protecting and restoring ecological connectivity in the Mura-Drava-Danube river corridor through cross-sectoral cooperation«, lifelineMDD (DTP33082.3lifelineMDD). DOPPS, Ljubljana. (including digital layers)

Božič L. (2021b): Popis izbranih ptic gnezdilk struge reke Mure v Sloveniji na odseku Ceršak (SLO) – Dekanovec (HR) v letu 2021. Project »Protecting and restoring ecological connectivity in the Mura-

Drava-Danube river corridor through cross-sectoral cooperation«, lifelineMDD (DTP33082.3lifelineMDD). DOPPS, Ljubljana. Contractor: Institute of the Republic of Slovenia for Nature Conservation, Ljubljana. (including digital layers)

Božič, L. (2022): Census of selected riverbed breeding bird species on the Mura River between Ceršak (SLO) and Dekanovec (HR). Final report. Project »Protecting and restoring ecological connectivity in the Mura-Drava-Danube river corridor through cross-sectoral cooperation«, lifelineMDD (DTP33082.3lifelineMDD). DOPPS, Ljubljana. Contractor: Institute of the Republic of Slovenia for Nature Conservation, Ljubljana. 74 p. (including digital layers)

Bračko F. (2000): Reka Mura. str. 161–171 V: Polak S. (ur.): Mednarodno pomembna območja za ptice v Sloveniji. Important Bird Areas (IBA) in Slovenia. Monografija DOPPS št. 1. – DOPPS, Ljubljana.

Cegnar T. (2012): Podnebne razmere v februarju 2012. Naše okolje. Bilten Agencije RS za okolje 19 (2): 3–22.

Čech P. (2006): Reprodukční biologie ledňáčka říčního (Alcedo atthis) a možnosti jeho ochrany v současných podmínkách České republiky. – Sylvia 42: 49–65.

Denac D., Božič L., Basle T., 2017. Riparian ecosystem restoration of the lower Drava River in Slovenia: layman's report. DOPPS Brirdlife Slovenia.

Elas M., Meissner W. (2014): Number and distribution of breeding Common Sandpiper Actitis hypoleucos in the Middle Vistula, Poland. Poster. – International Wader Study Group Annual Conference, Haapsalu, Estonia, 26–29 September 2014.

ESRI (2009): ArcGIS, ver. 9.3. – ESRI, Redlands.

Fenyősi L. (2005): Studies of avian communities along river Drava between 2000–2004 (Aves). – Natura Somogyiensis 7: 119–141.

Frühauf J., Dvorak M. (1996): Der Flussuferläufer (Actitis hypoleucos) in Österreich: Brutbestand 1994/95, Habitat und Gefahrdung. – BirdLife Österreich: Wien.

Gattermayr M., Mohl A., Nemmert A. (2019). Action plan for river birds in the planned five-country Biosphere Reserve "MuraDrava-Danube". LIFE14 NAT/HR/000115 – DRAVA LIFE Action A.7. Revital, WWF. 90 p

Greimel, F., Zeiringer, B. & G. Unfer (2022): Hydrological characterization of the sub-daily flow regimes in the Drava River basin with a focus on the hydropower plant Donja Dubrava: hydrological impacts, potential ecological effects and mitigation measures. Hydropeaking study, Danube Transnational Programme: Protecting and restoring ecological connectivity in the Mura-Drava-Danube river corridor through cross-sectoral Cooperation (lifelineMDD), 68 p., WWF Adria, Zagreb.

Griesser M. (2022): 30-jähriges Monitoring und Artenförderung des Eisvogels Alcedo atthis an der zürcherischen Thur. – Ornithologischer Beobachter 119 (3): 246–256.

Gilvear D., Francis R., Willby N., Gurnell A. (2008): Gravel bars: a key habitat of gravel-bed rivers for vegetation. pp. 677–700. In: Habersack H., Piegay H., Rinaldi M. (eds.): Gravel-bed rivers VI: From process understanding to river restoration. – Elsevier, Amsterdam.

Grlica I. (2018a): Monitoring bregunica, vodomara, pčelarice, kulika sljepčića i male prutke na rijeci Dravi u Osječko-baranjskoj županiji 2018. godine. (Monitoring of Sand Martin, Kingfisher,Bee-eater, Little Ringed Plover and Common Sandpiper on the river Drava in Osijek-Branja County in 2018).

Grlica I. (2018b): Monitoring bregunica, vodomara, pčelarice, kulika sljepčića i male prutke na rijeci Dravi u Virovitičko-podravskoj županiji 2018. godine. (Monitoring of Sand Martin, Kingfisher,Bee-eater, Little Ringed Plover and Common Sandpiper on the river Drava in Virovitica-Podravina County in 2018).

Grlica I. (2019a): Monitoring bregunica, vodomara, pčelarice, kulika sljepčića i male prutke na rijeci Dravi u Osječko-baranjskoj županiji 2019.godine. (Monitoring of Sand Martin, Kingfisher,Bee-eater, Little Ringed Plover and Common Sandpiper on the river Drava in Osijek-Baranja County in 2019).

Grlica I. (2019b): Monitoring bregunica, vodomara, pčelarice, kulika sljepčića i male prutke na rijeci Dravi u Virovitičko-podravskoj županiji 2019. godine. (Monitoring of Sand Martin, Kingfisher,Bee-eater, Little Ringed Plover and Common Sandpiper on the river Drava in Virovitica-Podravina County in 2019).

Grlica I. (2020): Monitoring bregunica, vodomara, pčelarica, kulika sljepčića i male prutke na rijeci Dravi 2020. godine. (Monitoring of Sand Martin, Kingfisher,Bee-eater, Little Ringed Plover and Common Sandpiper on the river Drava in 2020).

Grlica, D. (2022): Final river birds breeding report for Croatia. Project »Protecting and restoring ecological connectivity in the Mura-Drava-Danube river corridor through cross-sectoral cooperation«, lifelineMDD (DTP33082.3lifelineMDD). Natural History Society Drava, Ljubljana. Contractor: WWF Adria, Zagreb. 59 p. (including digital layers)

Hagemeier W. J. M., Blair M. J. (eds.). (1997): The EBCC Atlas of European Breeding Birds. Their Distribution and Abundance. – T & A D Poyser, London.

Hartwig S. (2005): Analyse zum Nisthabitat des Eisvogels (Alcedo atthis) in der Region Oberes Elbtal, Osterzgebirge. – Mitteilungen des Vereins Sächsischer Ornithologen 9: 507–525.

Isotti R., Consiglio C. (1998): Characteristics of kingfisher's, Alcedo atthis, nesting site. – Rivista Italiana di Ornitologia 68 (1): 57–62.

Keller V., Herrando S., Voříšek P., Franch M., Kipson M., Milanesi P., Martí D., Anton M., Klvaňová A., Kalyakin M. V., Bauer H.-G., Foppen R. P. B. (2020). European Breeding Bird Atlas 2: Distribution, Abundance and Change. – European Bird Census Council & Lynx Edicions, Barcelona.

Klösch, M., Dunst, R., Habersack, H. (2022). Sediment balance and transport in the Five-country Biosphere Reserve Mura-Drava-Danube, deliverable D.T1.2.3 for the EU-Interreg DTP project 'lifelineMDD'.

Kralj J. (2019). Studying terns to efficiently conserve their riverine habitats. – Acrocephalus 40 (180/181): 1–3.

Kralj J., Martinović M., Rubinić T., Krnjeta D., Jurinović L. (2019). Dynamics of Common Sterna hirundo and Little Tern Sternula albifrons populations along the Sava River in North-western Croatia between 2002 and 2019. – Acrocephalus 40 (180/181): 49–54.

Kuhnen K. (1978): Zur Methodik der Erfassung von Uferschwalben (Riparia riparia)-Populationen. – Vogelwelt 99: 161–176.

Lengyel S. (1998): Distribution and status of the Common Sandpiper (Actitis hypoleucos) and Little Ringed Plover (Charadrius dubius) along two rivers in North-Eastern Hungary. – Aquila 103/104: 47–57.

Liška I., Wagner F., Sengl M., Deutsch K., Slobodník J. (eds.). (2014): Joint Danube Survey 3: a comprehensive analysis of Danube water quality. International Commission for the Protection of the Danube River (ICPDR), Vienna, 369 p.

Michor K., Senfter S., Nemmert A., Unterlercher M., Reisinger M., 2021. Sava River restoration from Brežice to Rugvica – a feasibility study. River restoration concept based on calculations of optimal river width. REVTAL Integrative Naturraumplanung, Nußdorf-Debant (Austria). Client: EuroNatur, Radolfzell (Germany). 130 pp.

Metzner J. (2002): Die Bestandsentwicklung des Flussuferläufers Actitis hypoleucos am Obermain nach Renaturierung und Einwirkungen von Hochwasserprozessen – Ornithologischer Anzeiger 41 (1): 41–49.

Mihelič T., Kmecl P., Denac K., Koce U., Vrezec A., Denac D. (eds.) (2019): Atlas ptic Slovenije. Popis gnezdilk 2002–2017. – DOPPS, Ljubljana.

Mikuska T., Grlica D. I. (2013): Istraživanje bregunice (Riparia riparia), kulika sljepčića (Charadrius dubius) na rijeci Savi od Zagreba do Stare Gradiške. Konačno izvješće. – Hrvatsko društvo za zaštitu ptica i prirode, Osijek.

Mikuška T., Grlica D.I. & all. (2015). Fauna ptica hrvatskog dijela Rezervata biosfere „Mura-Drava-Dunav". Hrvatsko društvo za zaštitu ptica i prirode, Osijek.

Morgan R., Glue D. (1977): Breeding, Mortality and Movements of Kingfishers. – Bird Study 24 (1): 15–24.

Pannekoek J., Van Strien A. J. (2005): TRIM 3 Manual (Trends & Indices for Monitoring Data). – Statistics Netherlands, Voorburg.

Pannekoek J., Van Strien A. J., Gmelig Meyling A. W. (2005): TRIM 3.51. – Statistics Netherlands. [http://www.ebcc.info/trim.html].

Pearce-Higgins J. W., Yalden D. W., Dougall T. W., Beale C. M. (2009): Does climate change explain the decline of a trans-Saharan Afro-Palaearctic migrant? – Oecologia 159 (3): 649–659.

Pearce J., Mallory M. L., Metz K. (2020): Common Merganser (Mergus merganser), version 1.0. In Birds of the World (S. M. Billerman, Editor). – Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.commer.01

Petutschnig W. (2004): Der Flussuferläufer (Actitis hypoleucos L.) in Kärnten. – Kärntner Naturschutzberichte 9: 5–13.

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. (2015): Ptice Srbije: procena veličina populacija i trendova gnezdarica 2008–2013. Društvo za zaštitu i proučavanje ptica Srbije i Prirodno–matematički fakultet, Novi Sad, pp. 160.

Radišić, D. (2022): River bird survey on the Danube in Serbia (1298-1433 river kilometer). Final report. Project »Protecting and restoring ecological connectivity in the Mura-Drava-Danube river corridor through cross-sectoral cooperation«, lifelineMDD (DTP33082.3lifelineMDD). The University of Novi Sad, Faculty of Science, Department for Biology and Ecology, Novi Sad. Contractor: Institute for Nature Conservation of Vojvodina Province, Novi Sad. 24 p. (including digital layers)

Reeder D., Mohl A., Schneider-Jacoby M., Stumberger B. (2006): 11. The protection of the Drava-Mura wetlands. pp. 110–120. In: Terry A., Ullrich K. & Riecken U. (eds.): The green belt of Europe: from vision to reality. – IUCN, Gland.

Reich M. (1994): Kies- und schotterreiche Wildflußlandschaften – primäre Lebensräume des Flußregenpfeifers (Charadrius dubius). – Vogel und Umwelt 8 (1/2): 43–52.

Sackl P. (1997): Eisvogel Alcedo atthis. pp. 182–183. In: Sackl P., Samwald O. (eds.): Atlas der Brutvögel der Steiermark. – BirdLife Österreich-Landesgruppe Steiermark & Steiermärkisches Landesmuseum Joanneum, Graz.

Schmidt M. (2016): Ergebnisse der Erhebung der Kiesbrüterbestände (Flussregenpfeifer Charadrius dubius & Flussuferläufer Actitis hypoleucos) im Nationalpark Donau-Auen im Jahr 2015. Kurzbericht. – BirdLife Österreich, Wien.

Schmidt M., Zuna-Kratky T. (2009): Bestandsentwicklungen und limitierende Faktoren für ausgewählte flussgebundene Vogelarten in den March-Thaya-Auen (Flussuferläufer, Flussregenpfeifer und Eisvogel). – BirdLife Österreich, Wien.

Schmidt M. (ed.) (2012). Dynamic Danube Natural Values. Brochure. Danubeparks – a network of protected areas. https://danubeparks.org/sharepoint/public/1608648042_uploads.pdf

Schmidt M., Bandacu D., Bogdea L., Bozhinova S., Costea G., Gáborik A., Grlica I. D., Hima V., Kiss G., Koev V., Kovarik A., Mešíková M., Milenkovic- Srbulovic M., Parrag T., Petrova V., Raluca A., Rožac V., Šakić R., Schneider T., Surovec P., Tatai S., Tóth B., Tucakov M., Vasić I., Frank G. (2015): Riparian bird species (Little Ringed Plover, Sand Martin) as indicators for river dynamics and morphology. pp. 72–79 In: Liška I., Wagner F., Sengl M., Deutsch K., Slobodník J. (eds.): Joint Danube Survey 3. A Comprehensive Analysis of Danube Water Quality. – ICPDR – International Commission for the Protection of the Danube River, Vienna.

Schmid, H., M. Kestenholz, P. Knaus, L. Rey & Sattler, T. (2018) Zustand der Vogelwelt in der Schweiz: Sonderausgabe zum Brutvogelatlas 2013–2016. Schweizerische Vogelwarte, Sempach.

Schödl M. (2003): Brutzeitraum und Daten zu Schlüpfen und Flüggewerden des Flussuferläufers Actitis hypoleucos an Ammer und Oberer Isar. – Ornithologische Anzeiger 42: 51–56.

Schwarz U. (2022): River Training Structures and Historical Mapping within the Mura-Drava-Danube TBR. Deliverable report for EU-Interreg DTP project "lifelineMDD", pp. 79, Vienna.

Silverman B. W. (1986): Density Estimation for Statistics and Data Analysis. – Chapman and Hall, New York.

Stojanović B., Španiček B., Mohl A., Nikowitz T. (2017). Little tern - Ambassador of the Living Drava. Broshure. WWF Austria.

Straka O., Grim T. (2007): Nest site selection in the Kingfisher (Alcedo atthis). – Sylvia 43: 109–122.

Szép T. (1993): Changes of the Sand Martin (Riparia riparia) population in Eastern Hungary: the role of the adult survival and migration between colonies in 1986–1993. – Ornis Hungarica 3 (2): 56–66.

Szép T., Szabó D. Z., Vallner J. (2003): Integrated population monitoring of Sand Martin Riparia riparia – an opportunity to monitor the effects of environmental disasters along the River Tisza. – Ornis Hungarica 12/13: 169–182.

Tome D., Martinovič M., Kralj J., Božič L., Basle T., Jurinović L., 2019. Area use and important areas for Common Tern Sterna hirundo inland populations breeding in Slovenia and Croatia.– Acrocephalus 40 (180/181): 55–67.

Uhl H., Weißmair W. (2012): Artenschutzprojekt Flussuferläufer (Actitis hypoleucos) in Oberösterreich 2010 mit Anmerkungen zum Flussregenpfeifer (Charadrius dubius). – Vogelkundliche Nachrichten aus Oberösterreich, Naturschutz aktuell 20 (1/2): 93–122.

Van Vessem J., Hecker N., Tucker G. M. (1997): Inland wetlands. pp. 125–158. In: Tucker G. M., Evans M. I. (eds.): Habitats for birds in Europe: a conservation strategy for the wider environment. BirdLife Conservation Series No. 6. – BirdLife International, Cambridge.

Weggler M., Schwarzenbach Y., Widmer M. (2015): Stabiler Lokalbestand und langjährig benutzte Brutplätze beim Eisvogel Alcedo atthis am Hochrhein. – Ornithologischer Beobachter 112 (4): 251–258.

Westermann K., Westermann S. (1998): Der Brutbestand des Eisvogels (Alcedo atthis) in den Jahren 1990 bis 1996 in der südbadischen Rheinniederung. – Naturschutz Südlicher Oberrhein 2: 261–269.

Woodall P. F. (2020): Common Kingfisher (Alcedo atthis), version 1.0. In: Birds of the World (del Hoyo J., Elliott A., Sargatal J., Christie D. A., de Juana E. (eds.). – Cornell Lab of Ornithology, Ithaca, NY, USA. [https://doi.org/10.2173/bow.comkin1.01]

Yalden D. W. (1992): The influence of recreational disturbance on common sandpipers Actitis hypoleucos breeding by an upland reservoir, in England. – Biological Conservation 61 (1): 41–49.

http://www.hidmet.gov.rs/latin/prognoza/prognoza_voda.php

https://www.google.com/maps

http://www.plovput.rs/vesti/1/1047

https://www.vogelwarte.ch/en/atlas/focus/gravel-nesting-birds-under-threat

6. ANNEXES / APPENDIX

Annex 6.1 – Božič (2022)

Božič, L. (2022): Census of selected riverbed breeding bird species on the Mura River between Ceršak (SLO) and Dekanovec (HR). Final report. Project »Protecting and restoring ecological connectivity in the Mura-Drava-Danube river corridor through cross-sectoral cooperation«, lifelineMDD (DTP33082.3lifelineMDD). DOPPS, Ljubljana. Contractor: Institute of the Republic of Slovenia for Nature Conservation, Ljubljana. 74 p. (PDF + including digital layers)

Annex 6.2 - Grlica (2022)

Grlica, D. (2022): Final river birds breeding report for Croatia. Project »Protecting and restoring ecological connectivity in the Mura-Drava-Danube river corridor through cross-sectoral cooperation«, lifelineMDD (DTP33082.3lifelineMDD). Natural History Society Drava, Ljubljana. Contractor: WWF Adria, Zagreb. 59 p. (PDF + including digital layers)

Annex 6.3 - Radišič (2022)

Radišić, D. (2022): River bird survey on the Danube in Serbia (1298-1433 river kilometers). Final report. Project »Protecting and restoring ecological connectivity in the Mura-Drava-Danube river corridor through cross-sectoral cooperation«, lifelineMDD (DTP33082.3lifelineMDD). The University of Novi Sad, Faculty of Science, Department for Biology and Ecology, Novi Sad. Contractor: Institute for Nature Conservation of Vojvodina Province, Novi Sad. 24 p. (PDF + including digital layers)

Appendix 6.4: Datasets stored in the digital layer (.shp files)

- lifelineMDD_birds_2021, (separate file)
- lifelineMDD_birds_2022, (separate file)
- lifelineMDD_birds_2022_additional. (separate file)

Appendix 6.5: Terms of Reference (ToR)

Terms of Reference (ToR) for 1st river breeding bird report/mapping in 5-Transboudary Biosphere Reserve Mura – Drava – Danube (TBR MDD)

1. Monitoring requirements:
   - 1 monitoring round per year (total 2 monitoring round in 2021 and 2022) within the wider monitoring time frame (end of April– July):
   - In case of unfavourable weather or water levels, the visit must be optimised to make sure birds can already be nesting, or repeated later, under favourable conditions
   - Monitoring done at least 10 days after high water levels (if possible, based on weather conditions and water levels)

2. Monitoring time frame:
   - 2021 (end of April – July)
   - 2022 (end of April– July)

3. Monitored area:
   - River Mura (SI-AT, IRSNC): from Šentilj/Spielfeld to Dekanovec (a tributary of the Big Krka)
   - River Mura (HR-HU): from Dekanovec to Mura-Drava confluence (Legrad) (0-49rkm)
   - River Drava (HR-HU): from Lovrečan - Ormož- Svibovec to Varaždin, and downstream of Donja Dubrava to the Drava-Danube confluence
   - gravel pit Šoderica
   - River Danube (HR): from Batina to Ilok, right river bank
   - River Danube (RS): from Bezdan to Bačka Palanka (Ilok), left river bank

4. Monitored bird species:
   - Little Tern (*Sternula albifrons*)
   - Common Tern (*Sterna hirundo*)
   - Little-ringed Plover (*Charadrius dubius*)
   - Common Sandpiper (*Actitis hypoleucos*)
   - Sand Martin (*Riparia riparia*)
   - Common Kingfisher (*Alcedo atthis*)
   - European Bee-Eater (*Merops apiaster*)
   - Additional species will be defined on the joint meeting of all experts (e.g. White-tailed eagle (*Haliaeetus albicilla*), black stork (*Ciconia nigra*) etc.)

5. Meetings of client and project partners:

- selected client and relevant project partners will meet before the monitoring starts (May 2021) virtually (via zoom or any other platform)
- project partner and the selected client will meet after each monitoring round is done to ensure all relevant sites are checked (due to situation the meetings could be held virtually) – in case of meetings in person, travel costs for 2 meetings the expert are to be included in the offer
- meetings will be held by each country (Croatia, Serbia or Slovenia), probably on-line

6. Equipment:

- monitoring done by vessels (electro boat or similar vessel that will not disturb the birds)
- gravel pit Šoderica to be checked by foot
- good quality camera and GPS
- GIS programme and similar tools
- all equipment used during monitoring and processing of data to be secured by the client

7. Collection of data:

- client should use unified data collecting table (monitoring and additional data) included as Attachment no. 2
- GPS coordinate recording is mandatory for each nesting pair/nest of the target species or in the case of the nesting target species in colony, the GPS coordinate of the start and end point must be recorded,
- it is desirable to record target species with GPS coordinates also if target species do not nest. In the case not doing so, the total number of non-nesting specimens of target species in concrete section of the river must be recorded (section in a way - (a) from river km to river km, b) or from settlement to settlement must be recorded)
- if feasible, zero data should also be recorded during the censuses (for example, if a gravel/steep bank where little ringed plover/kingfisher are expected is inspected, thus should be noted that the species was not present - date, location, name and surname of leg. & det. should be noted)
- all selected clients should collect photo data (with GPS coordinates and time the photo was taken) of breeding sites (vegetation & water edge line (overview & detailed photos)) and river training infrastructure near each breeding site
    - locations of recorded target bird species are recorded by GPS, recording on orthophoto or satellite maps at a scale (e.g., 1:5.000) that fits best to the river dimensions

- data must be submitted in ESRI .shp format in WGS 84 (degrees, decimal)
- for the collection of photos of breeding sites, locations (if possible with information on the coordinates of the photograph) where the species was observed have to be taken
- the time on the GPS and the time on the camera should be coordinated before the start of each inventory
- for each location, a photo is taken up close (so that the vegetation and water level are visible) and a photo from the distance so that any river infrastructure near the nesting site is also observed/noted

8. Reports and deadlines:

- 2 data reports have to be prepared in English (with summary in national):

a) 1st report to be delivered until 1st of September 2021
b) final river bird breeding report to be delivered by 20th of August 2022

- reports to include maps and raw data (data collection table)
- 1st report to be prepared in Croatian with and English summary
- final river bird breeding report ~~report~~ to be prepared in English (the official language of the Interreg Danube Transnational Program projects) with an extended summary in Croatian

- in the final river bird breeding report the client should also provide an expert assessment of the habitat status with a description of a number of key habitat/nesting parameters, with regard to river sediments and structures (gravel, sand, wall…). The aim of this is to assess the connection between river sediments (gravel, sand…) and the choice of nesting sites of target bird species
  - the final river bird breeding report is a study that contains a synthesis of conducted monitoring visits with expert interpretation of results, an assessment of the population status for each species for the period 2021 and 2022 and an argumentation of the results of conducted censuses
  - for the purposes of preparing the synthesis report of the three countries, the final river bird breeding report will have a harmonized structure. A harmonized, more detailed structure and scope of the content of the report will be determined by the contracting authority subsequently, but no later than June 2021

- both reports have to be texts in MS Word or compatible format
- spreadsheet data has to be in MS Excel or compatible format

- spatial database in ESRI .shp format in WGS 84 (degrees, decimal) with attached metadata, which will contain the points where the species was recorded
- raster images (photos of bird locations, sketches, etc.) in JPEG or BMP; GIF or PNG format
- the client shall submit to the contracting authority two copies of each report with textual and graphic work
- all data must also be delivered in digital form as well
- both reports must indicate they were produced in the lifelineMDD project (DTP3-308-2.3-lifelineMDD)

Appendix 6.6: Linear density (pairs per 10 km) of the seven target bird species for eight river segments (after Schwarz 2022) in Mura, Drava and Danube Rivers corridor, based on registrations of breeding pairs in season 2022

River Section		River Length	Little Ringed Plover	Common Sandpiper	Common Tern	Little Tern	European Bee-eater	Common Kingfisher	Sandmartin
Mura I	Ceršak/Spielfeld – Croatian border	58	0,34	2,07	0,00	0,00	0,00	0,21	17,24
Mura II	Croatian border – Hungarian border	40	8,50	8,00	0,00	0,00	0,00	5,00	65,50
Mura III	Hungarian border - Drava confluence	45	1,33	2,44	0,00	0,00	1,11	3,11	91,78
Drava I	Ormož – Mura confluence	75	1,60	1,07	0,00	0,00	0,40	3,20	33,33
Drava II	Mura confluence – Heresznye	50	3,00	0,40	1,60	0,20	13,40	3,80	306,00
Drava III	Heresznye – Danube confluence	185	0,76	0,00	0,00	0,00	3,84	3,14	151,95
Danube I	Sio confluence – Drava confluence	43	0,93	0,00	0,00	0,00	0,00	6,98	0,00
Danube II	Drava confluence – Bačka Palanka	83	0,48	0,00	0,00	0,00	5,54	4,70	99,16
TOGETHER 550 km MDD	Ceršak - Bačka palanka	550	0,17	0,12	0,01	0,00	0,35	0,39	112,53

Appendix 6.7: Tables with breeding sites & breeding pairs numbers per species in 550 km riverbed of Mura, Drava and Danube in TBR MDD

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Sandpiper	*Actitis hypoleucos*	122	3.07.2021	1	1	DRA310-315
Common Sandpiper	*Actitis hypoleucos*	60	30.06.2021	1	1	MUR000-005
Common Sandpiper	*Actitis hypoleucos*	63	30.06.2021	1	2	MUR000-005
Common Sandpiper	*Actitis hypoleucos*	51	30.06.2021	1	2	MUR010-015
Common Sandpiper	*Actitis hypoleucos*	52	30.06.2021	1	2	MUR010-015
Common Sandpiper	*Actitis hypoleucos*	44	30.06.2021	1	1	MUR020-025
Common Sandpiper	*Actitis hypoleucos*	48	30.06.2021	1	2	MUR020-025
Common Sandpiper	*Actitis hypoleucos*	39	30.06.2021	1	2	MUR025-030
Common Sandpiper	*Actitis hypoleucos*	43	30.06.2021	1	2	MUR025-030
Common Sandpiper	*Actitis hypoleucos*	28	30.06.2021	1	2	MUR035-040
Common Sandpiper	*Actitis hypoleucos*	29	30.06.2021	1	1	MUR035-040
Common Sandpiper	*Actitis hypoleucos*	19	30.06.2021	1	1	MUR040-045
Common Sandpiper	*Actitis hypoleucos*	22	30.06.2021	1	2	MUR040-045
Common Sandpiper	*Actitis hypoleucos*	24	30.06.2021	1	1	MUR040-045
Common Sandpiper	*Actitis hypoleucos*	25	30.06.2021	1	3	MUR040-045
Common Sandpiper	*Actitis hypoleucos*	189	29.04.2021	1	1	MUR045-050
Common Sandpiper	*Actitis hypoleucos*	8	30.06.2021	1	2	MUR045-050
Common Sandpiper	*Actitis hypoleucos*	10	30.06.2021	1	1	MUR045-050
Common Sandpiper	*Actitis hypoleucos*	12	30.06.2021	1	2	MUR045-050
Common Sandpiper	*Actitis hypoleucos*	15	30.06.2021	1	2	MUR045-050
Common Sandpiper	*Actitis hypoleucos*	154	29.04.2021	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	156	29.04.2021	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	165	29.04.2021	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	172	29.04.2021	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	175	29.04.2021	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	179	29.04.2021	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	184	29.04.2021	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	187	29.04.2021	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	67	9.06.2021	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	68	9.06.2021	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	142	29.04.2021	1	1	MUR055-060
Common Sandpiper	*Actitis hypoleucos*	149	29.04.2021	1	1	MUR055-060

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Sandpiper	*Actitis hypoleucos*	43	9.06.2021	1	1	MUR055-060
Common Sandpiper	*Actitis hypoleucos*	49	9.06.2021	1	1	MUR055-060
Common Sandpiper	*Actitis hypoleucos*	58	9.06.2021	1	1	MUR055-060
Common Sandpiper	*Actitis hypoleucos*	87	29.04.2021	1	1	MUR060-065
Common Sandpiper	*Actitis hypoleucos*	107	29.04.2021	1	1	MUR060-065
Common Sandpiper	*Actitis hypoleucos*	112	29.04.2021	1	1	MUR060-065
Common Sandpiper	*Actitis hypoleucos*	19	9.06.2021	1	1	MUR060-065
Common Sandpiper	*Actitis hypoleucos*	34	9.06.2021	1	2	MUR060-065
Common Sandpiper	*Actitis hypoleucos*	64	29.04.2021	1	1	MUR065-070
Common Sandpiper	*Actitis hypoleucos*	70	29.04.2021	1	1	MUR065-070
Common Sandpiper	*Actitis hypoleucos*	14	9.06.2021	1	1	MUR065-070
Common Sandpiper	*Actitis hypoleucos*	52	29.04.2021	1	1	MUR070-075
Common Sandpiper	*Actitis hypoleucos*	62	10.06.2021	1	1	MUR070-075
Common Sandpiper	*Actitis hypoleucos*	3	29.04.2021	1	1	MUR075-080
Common Sandpiper	*Actitis hypoleucos*	10	29.04.2021	1	1	MUR075-080
Common Sandpiper	*Actitis hypoleucos*	25	29.04.2021	1	1	MUR075-080
Common Sandpiper	*Actitis hypoleucos*	47	10.06.2021	1	2	MUR075-080
Common Sandpiper	*Actitis hypoleucos*	50	10.06.2021	1	1	MUR075-080
Common Sandpiper	*Actitis hypoleucos*	203	25.04.2021	1	1	MUR080-085
Common Sandpiper	*Actitis hypoleucos*	216	25.04.2021	1	1	MUR080-085
Common Sandpiper	*Actitis hypoleucos*	221	25.04.2021	1	1	MUR080-085
Common Sandpiper	*Actitis hypoleucos*	1	29.04.2021	1	1	MUR080-085
Common Sandpiper	*Actitis hypoleucos*	23	10.06.2021	1	1	MUR085-090
Common Sandpiper	*Actitis hypoleucos*	170	25.04.2021	1	1	MUR090-095
Common Sandpiper	*Actitis hypoleucos*	11	10.06.2021	1	1	MUR090-095
Common Sandpiper	*Actitis hypoleucos*	95	25.04.2021	1	1	MUR105-110
Common Sandpiper	*Actitis hypoleucos*	97	25.04.2021	1	1	MUR105-110
Common Sandpiper	*Actitis hypoleucos*	60	25.04.2021	1	1	MUR120-125
Common Sandpiper	*Actitis hypoleucos*	49	25.04.2021	1	1	MUR125-130
Common Sandpiper	*Actitis hypoleucos*	5	4.06.2021	1	1	MUR140-145
Common Sandpiper	*Actitis hypoleucos*	6	4.06.2021	1	1	MUR140-145
Common Sandpiper	*Actitis hypoleucos*	8	1.07.2021	1	1	DRA245-250
Common Sandpiper	*Actitis hypoleucos*	132	3.07.2021	1	1	DRA290-295
Common Sandpiper	*Actitis hypoleucos*	9	11.06.2022	1	1	DRA245-250
Common Sandpiper	*Actitis hypoleucos*	46	11.06.2022	1	1	DRA220-225
Common Sandpiper	*Actitis hypoleucos*	72	11.06.2022	1	1	DRA185-190

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Sandpiper	*Actitis hypoleucos*	1	19.06.2022	1	1	DRA320-315
Common Sandpiper	*Actitis hypoleucos*	2	19.06.2022	1	1	DRA320-315
Common Sandpiper	*Actitis hypoleucos*	6	19.06.2022	1	1	DRA310-315
Common Sandpiper	*Actitis hypoleucos*	8	19.06.2022	1	1	DRA310-315
Common Sandpiper	*Actitis hypoleucos*	9	19.06.2022	1	1	DRA310-315
Common Sandpiper	*Actitis hypoleucos*	12	19.06.2022	1	1	DRA290-295
Common Sandpiper	*Actitis hypoleucos*	19	19.06.2022	1	1	DRA290-295
Common Sandpiper	*Actitis hypoleucos*	92	12.06.2022	1	1	MUR045-050
Common Sandpiper	*Actitis hypoleucos*	93	12.06.2022	1	2	MUR045-050
Common Sandpiper	*Actitis hypoleucos*	96	12.06.2022	1	2	MUR045-050
Common Sandpiper	*Actitis hypoleucos*	98	12.06.2022	1	2	MUR040-045
Common Sandpiper	*Actitis hypoleucos*	100	12.06.2022	1	1	MUR040-045
Common Sandpiper	*Actitis hypoleucos*	102	12.06.2022	1	3	MUR035-040
Common Sandpiper	*Actitis hypoleucos*	104	12.06.2022	1	1	MUR035-040
Common Sandpiper	*Actitis hypoleucos*	122	12.06.2022	1	1	MUR020-025
Common Sandpiper	*Actitis hypoleucos*	126	12.06.2022	1	1	MUR005-010
Common Sandpiper	*Actitis hypoleucos*	137	12.06.2022	1	2	MUR000-005
Common Sandpiper	*Actitis hypoleucos*	1	25.04.2022	1	1	MUR140-145
Common Sandpiper	*Actitis hypoleucos*	36	25.04.2022	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	148	25.04.2022	1	1	MUR105-110
Common Sandpiper	*Actitis hypoleucos*	151	25.04.2022	1	1	MUR105-110
Common Sandpiper	*Actitis hypoleucos*	5	26.04.2022	1	1	MUR090-095
Common Sandpiper	*Actitis hypoleucos*	15	26.04.2022	1	1	MUR090-095
Common Sandpiper	*Actitis hypoleucos*	24	26.04.2022	1	1	MUR085-090
Common Sandpiper	*Actitis hypoleucos*	49	26.04.2022	1	1	MUR085-090
Common Sandpiper	*Actitis hypoleucos*	74	26.04.2022	1	1	MUR080-085
Common Sandpiper	*Actitis hypoleucos*	80	26.04.2022	1	1	MUR080-085
Common Sandpiper	*Actitis hypoleucos*	101	26.04.2022	1	1	MUR080-085
Common Sandpiper	*Actitis hypoleucos*	107	26.04.2022	1	1	MUR075-080
Common Sandpiper	*Actitis hypoleucos*	108	26.04.2022	1	1	MUR080-085
Common Sandpiper	*Actitis hypoleucos*	113	26.04.2022	1	1	MUR075-080
Common Sandpiper	*Actitis hypoleucos*	7	28.04.2022	1	1	MUR065-070
Common Sandpiper	*Actitis hypoleucos*	8	28.04.2022	1	1	MUR065-070
Common Sandpiper	*Actitis hypoleucos*	12	28.04.2022	1	1	MUR065-070
Common Sandpiper	*Actitis hypoleucos*	44	28.04.2022	1	1	MUR060-065
Common Sandpiper	*Actitis hypoleucos*	45	28.04.2022	1	1	MUR060-065

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Sandpiper	*Actitis hypoleucos*	48	28.04.2022	1	1	MUR060-065
Common Sandpiper	*Actitis hypoleucos*	61	28.04.2022	1	1	MUR055-060
Common Sandpiper	*Actitis hypoleucos*	98	28.04.2022	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	118	28.04.2022	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	131	28.04.2022	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	67	6.06.2022	1	1	MUR120-125
Common Sandpiper	*Actitis hypoleucos*	97	6.06.2022	1	1	MUR105-110
Common Sandpiper	*Actitis hypoleucos*	9	7.06.2022	1	1	MUR090-095
Common Sandpiper	*Actitis hypoleucos*	39	7.06.2022	1	1	MUR085-090
Common Sandpiper	*Actitis hypoleucos*	66	7.06.2022	1	1	MUR075-080
Common Sandpiper	*Actitis hypoleucos*	13	12.06.2022	1	1	MUR065-070
Common Sandpiper	*Actitis hypoleucos*	21	12.06.2022	1	1	MUR060-065
Common Sandpiper	*Actitis hypoleucos*	44	12.06.2022	1	2	MUR055-060
Common Sandpiper	*Actitis hypoleucos*	56	12.06.2022	1	1	MUR055-060
Common Sandpiper	*Actitis hypoleucos*	72	12.06.2022	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	76	12.06.2022	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	84	12.06.2022	1	1	MUR050-055
Common Sandpiper	*Actitis hypoleucos*	99	12.06.2022	1	2	MUR050-055
Common Kingfisher	*Alcedo atthis*	OD05	8.07.2021	1	1	DAN1295-1300
Common Kingfisher	*Alcedo atthis*	132	22.07.2021	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	127	22.07.2021	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	126	22.07.2021	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	138	22.07.2021	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	99	21.07.2021	1	1	DAN1320-1330
Common Kingfisher	*Alcedo atthis*	75	15.06.2021	1	1	DAN1320-1330
Common Kingfisher	*Alcedo atthis*	76	15.06.2021	1	1	DAN1320-1330
Common Kingfisher	*Alcedo atthis*	77	15.06.2021	1	1	DAN1320-1330
Common Kingfisher	*Alcedo atthis*	79	15.06.2021	1	1	DAN1320-1330
Common Kingfisher	*Alcedo atthis*	80	15.06.2021	1	1	DAN1320-1330
Common Kingfisher	*Alcedo atthis*	105	21.07.2021	1	1	DAN1330-1340
Common Kingfisher	*Alcedo atthis*	101	21.07.2021	1	1	DAN1330-1340
Common Kingfisher	*Alcedo atthis*	64	15.06.2021	1	1	DAN1330-1340
Common Kingfisher	*Alcedo atthis*	115	21.07.2021	1	1	DAN1340-1350
Common Kingfisher	*Alcedo atthis*	59	15.06.2021	1	1	DAN1340-1350
Common Kingfisher	*Alcedo atthis*	63	15.06.2021	1	1	DAN1340-1350
Common Kingfisher	*Alcedo atthis*	46	14.06.2021	1	1	DAN1350-1360

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	47	14.06.2021	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	52	15.06.2021	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	56	15.06.2021	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	57	15.06.2021	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	70	15.07.2021	1	1	DAN1360-1370
Common Kingfisher	*Alcedo atthis*	74	15.07.2021	1	1	DAN1360-1370
Common Kingfisher	*Alcedo atthis*	93	15.07.2021	1	1	DAN1360-1370
Common Kingfisher	*Alcedo atthis*	39	14.06.2021	1	1	DAN1360-1370
Common Kingfisher	*Alcedo atthis*	42	14.06.2021	1	1	DAN1360-1370
Common Kingfisher	*Alcedo atthis*	44	14.07.2021	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	OD22	15.07.2021	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	90	15.07.2021	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	29	14.06.2021	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	30	14.06.2021	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	31	14.06.2021	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	32	14.06.2021	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	33	14.06.2021	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	35	14.06.2021	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	36	14.06.2021	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	46	14.07.2021	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	56	14.07.2021	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	22	14.06.2021	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	25	14.06.2021	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	SPRUD08	14.07.2021	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	63	14.07.2021	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	16	14.06.2021	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	20	14.06.2021	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	21	14.06.2021	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	OD11	14.07.2021	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	9	14.06.2021	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	10	14.06.2021	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	12	14.06.2021	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	13	14.06.2021	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	OD05_a	13.07.2021	1	1	DAN1410-1420
Common Kingfisher	*Alcedo atthis*	OD08	13.07.2021	1	1	DAN1410-1420
Common Kingfisher	*Alcedo atthis*	3	14.06.2021	1	1	DAN1410-1420

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	5	14.06.2021	1	1	DAN1410-1420
Common Kingfisher	*Alcedo atthis*	6	14.06.2021	1	1	DAN1410-1420
Common Kingfisher	*Alcedo atthis*	OD02	13.07.2021	1	1	DAN1420-1430
Common Kingfisher	*Alcedo atthis*	77	11.06.2021	1	1	DRA005-010
Common Kingfisher	*Alcedo atthis*	78	11.06.2021	1	1	DRA005-010
Common Kingfisher	*Alcedo atthis*	73	11.06.2021	1	1	DRA010-015
Common Kingfisher	*Alcedo atthis*	74	11.06.2021	1	1	DRA010-015
Common Kingfisher	*Alcedo atthis*	71	11.06.2021	1	1	DRA020-025
Common Kingfisher	*Alcedo atthis*	65	9.06.2021	1	1	DRA035-040
Common Kingfisher	*Alcedo atthis*	66	11.06.2021	1	1	DRA035-040
Common Kingfisher	*Alcedo atthis*	68	11.06.2021	1	1	DRA035-040
Common Kingfisher	*Alcedo atthis*	64	9.06.2021	1	1	DRA040-045
Common Kingfisher	*Alcedo atthis*	61	9.06.2021	1	1	DRA050-055
Common Kingfisher	*Alcedo atthis*	59	9.06.2021	1	1	DRA055-060
Common Kingfisher	*Alcedo atthis*	60	9.06.2021	1	1	DRA055-060
Common Kingfisher	*Alcedo atthis*	49	9.06.2021	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	51	9.06.2021	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	52	9.06.2021	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	55	9.06.2021	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	56	9.06.2021	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	57	9.06.2021	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	48	9.06.2021	1	1	DRA065-070
Common Kingfisher	*Alcedo atthis*	40	9.06.2021	1	1	DRA080-085
Common Kingfisher	*Alcedo atthis*	34	9.06.2021	1	1	DRA085-090
Common Kingfisher	*Alcedo atthis*	26	9.06.2021	1	1	DRA090-095
Common Kingfisher	*Alcedo atthis*	27	9.06.2021	1	1	DRA090-095
Common Kingfisher	*Alcedo atthis*	21	8.06.2021	1	1	DRA105-110
Common Kingfisher	*Alcedo atthis*	22	8.06.2021	1	1	DRA105-110
Common Kingfisher	*Alcedo atthis*	19	8.06.2021	1	1	DRA110-115
Common Kingfisher	*Alcedo atthis*	20	8.06.2021	1	1	DRA110-115
Common Kingfisher	*Alcedo atthis*	17	8.06.2021	1	1	DRA120-125
Common Kingfisher	*Alcedo atthis*	16	8.06.2021	1	1	DRA125-130
Common Kingfisher	*Alcedo atthis*	14	8.06.2021	1	1	DRA140-145
Common Kingfisher	*Alcedo atthis*	118	2.07.2021	1	1	DRA165-170
Common Kingfisher	*Alcedo atthis*	119	2.07.2021	1	1	DRA165-170
Common Kingfisher	*Alcedo atthis*	111	2.07.2021	1	1	DRA170-175

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	112	2.07.2021	1	1	DRA170-175
Common Kingfisher	*Alcedo atthis*	115	2.07.2021	1	1	DRA170-175
Common Kingfisher	*Alcedo atthis*	116	2.07.2021	1	1	DRA170-175
Common Kingfisher	*Alcedo atthis*	117	2.07.2021	1	1	DRA170-175
Common Kingfisher	*Alcedo atthis*	102	2.07.2021	1	1	DRA175-180
Common Kingfisher	*Alcedo atthis*	103	2.07.2021	1	1	DRA175-180
Common Kingfisher	*Alcedo atthis*	109	2.07.2021	1	1	DRA175-180
Common Kingfisher	*Alcedo atthis*	110	2.07.2021	1	1	DRA175-180
Common Kingfisher	*Alcedo atthis*	98	2.07.2021	1	1	DRA180-185
Common Kingfisher	*Alcedo atthis*	100	2.07.2021	1	1	DRA180-185
Common Kingfisher	*Alcedo atthis*	101	2.07.2021	1	1	DRA180-185
Common Kingfisher	*Alcedo atthis*	84	2.07.2021	1	1	DRA185-190
Common Kingfisher	*Alcedo atthis*	90	2.07.2021	1	1	DRA185-190
Common Kingfisher	*Alcedo atthis*	78	2.07.2021	1	1	DRA195-200
Common Kingfisher	*Alcedo atthis*	79	2.07.2021	1	1	DRA195-200
Common Kingfisher	*Alcedo atthis*	82	2.07.2021	1	1	DRA195-200
Common Kingfisher	*Alcedo atthis*	68	1.07.2021	1	1	DRA205-210
Common Kingfisher	*Alcedo atthis*	73	1.07.2021	1	1	DRA205-210
Common Kingfisher	*Alcedo atthis*	62	1.07.2021	1	1	DRA210-215
Common Kingfisher	*Alcedo atthis*	56	1.07.2021	1	1	DRA215-220
Common Kingfisher	*Alcedo atthis*	59	1.07.2021	1	1	DRA215-220
Common Kingfisher	*Alcedo atthis*	60	1.07.2021	1	1	DRA215-220
Common Kingfisher	*Alcedo atthis*	44	1.07.2021	1	1	DRA220-225
Common Kingfisher	*Alcedo atthis*	46	1.07.2021	1	1	DRA220-225
Common Kingfisher	*Alcedo atthis*	47	1.07.2021	1	1	DRA220-225
Common Kingfisher	*Alcedo atthis*	49	1.07.2021	1	1	DRA220-225
Common Kingfisher	*Alcedo atthis*	36	1.07.2021	1	1	DRA225-230
Common Kingfisher	*Alcedo atthis*	39	1.07.2021	1	1	DRA225-230
Common Kingfisher	*Alcedo atthis*	43	1.07.2021	1	1	DRA225-230
Common Kingfisher	*Alcedo atthis*	31	1.07.2021	1	1	DRA230-235
Common Kingfisher	*Alcedo atthis*	34	1.07.2021	1	1	DRA230-235
Common Kingfisher	*Alcedo atthis*	35	1.07.2021	1	1	DRA230-235
Common Kingfisher	*Alcedo atthis*	26	1.07.2021	1	1	DRA235-240
Common Kingfisher	*Alcedo atthis*	27	1.07.2021	1	1	DRA235-240
Common Kingfisher	*Alcedo atthis*	66	30.06.2021	1	1	DRA235-240
Common Kingfisher	*Alcedo atthis*	18	1.07.2021	1	1	DRA240-245

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	20	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	22	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	1	1.07.2021	1	1	DRA250-255
Common Kingfisher	*Alcedo atthis*	59	30.06.2021	1	1	MUR000-005
Common Kingfisher	*Alcedo atthis*	61	30.06.2021	1	1	MUR000-005
Common Kingfisher	*Alcedo atthis*	64	30.06.2021	1	1	MUR000-005
Common Kingfisher	*Alcedo atthis*	55	30.06.2021	1	1	MUR005-010
Common Kingfisher	*Alcedo atthis*	56	30.06.2021	1	1	MUR005-010
Common Kingfisher	*Alcedo atthis*	57	30.06.2021	1	1	MUR005-010
Common Kingfisher	*Alcedo atthis*	53	30.06.2021	1	1	MUR010-015
Common Kingfisher	*Alcedo atthis*	49	30.06.2021	1	1	MUR015-020
Common Kingfisher	*Alcedo atthis*	45	30.06.2021	1	1	MUR020-025
Common Kingfisher	*Alcedo atthis*	46	30.06.2021	1	1	MUR020-025
Common Kingfisher	*Alcedo atthis*	47	30.06.2021	1	1	MUR020-025
Common Kingfisher	*Alcedo atthis*	37	30.06.2021	1	1	MUR025-030
Common Kingfisher	*Alcedo atthis*	31	30.06.2021	1	1	MUR030-035
Common Kingfisher	*Alcedo atthis*	32	30.06.2021	1	1	MUR030-035
Common Kingfisher	*Alcedo atthis*	36	30.06.2021	1	1	MUR030-035
Common Kingfisher	*Alcedo atthis*	27	30.06.2021	1	1	MUR035-040
Common Kingfisher	*Alcedo atthis*	19	30.06.2021	1	1	MUR040-045
Common Kingfisher	*Alcedo atthis*	20	30.06.2021	1	1	MUR040-045
Common Kingfisher	*Alcedo atthis*	23	30.06.2021	1	1	MUR040-045
Common Kingfisher	*Alcedo atthis*	25	30.06.2021	1	1	MUR040-045
Common Kingfisher	*Alcedo atthis*	88	9.06.2021	1	1	MUR045-050
Common Kingfisher	*Alcedo atthis*	9	30.06.2021	1	1	MUR045-050
Common Kingfisher	*Alcedo atthis*	12	30.06.2021	1	1	MUR045-050
Common Kingfisher	*Alcedo atthis*	16	30.06.2021	1	1	MUR045-050
Common Kingfisher	*Alcedo atthis*	17	30.06.2021	1	1	MUR045-050
Common Kingfisher	*Alcedo atthis*	59	9.06.2021	1	1	MUR050-055
Common Kingfisher	*Alcedo atthis*	72	9.06.2021	1	1	MUR050-055
Common Kingfisher	*Alcedo atthis*	139	29.04.2021	1	1	MUR055-060
Common Kingfisher	*Alcedo atthis*	150	29.04.2021	1	1	MUR055-060
Common Kingfisher	*Alcedo atthis*	44	9.06.2021	1	1	MUR055-060
Common Kingfisher	*Alcedo atthis*	45	9.06.2021	1	1	MUR055-060
Common Kingfisher	*Alcedo atthis*	50	9.06.2021	1	1	MUR055-060
Common Kingfisher	*Alcedo atthis*	102	29.04.2021	1	1	MUR060-065

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	27	9.06.2021	1	1	MUR060-065
Common Kingfisher	*Alcedo atthis*	29	9.06.2021	1	1	MUR060-065
Common Kingfisher	*Alcedo atthis*	66	29.04.2021	1	1	MUR065-070
Common Kingfisher	*Alcedo atthis*	12	9.06.2021	1	1	MUR065-070
Common Kingfisher	*Alcedo atthis*	13	9.06.2021	1	1	MUR065-070
Common Kingfisher	*Alcedo atthis*	49	29.04.2021	1	1	MUR070-075
Common Kingfisher	*Alcedo atthis*	71	10.06.2021	1	1	MUR070-075
Common Kingfisher	*Alcedo atthis*	73	10.06.2021	1	1	MUR070-075
Common Kingfisher	*Alcedo atthis*	29	10.06.2021	1	1	MUR085-090
Common Kingfisher	*Alcedo atthis*	30	10.06.2021	1	1	MUR085-090
Common Kingfisher	*Alcedo atthis*	112	25.04.2021	1	1	MUR100-105
Common Kingfisher	*Alcedo atthis*	102	4.06.2021	1	1	MUR100-105
Common Kingfisher	*Alcedo atthis*	85	4.06.2021	1	1	MUR105-110
Common Kingfisher	*Alcedo atthis*	74	4.06.2021	1	1	MUR110-115
Common Kingfisher	*Alcedo atthis*	55	25.04.2021	1	1	MUR125-130
Common Kingfisher	*Alcedo atthis*	47	4.06.2021	1	1	MUR125-130
Common Kingfisher	*Alcedo atthis*	79	11.06.2021	1	1	DRA000-005
Common Kingfisher	*Alcedo atthis*	80	11.06.2021	1	1	DRA000-005
Common Kingfisher	*Alcedo atthis*	OD53	22.07.2021	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	136	22.07.2021	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	131	22.07.2021	1	1	DAN1300-1310
Common Kingfisher	*Alcedo atthis*	3	1.07.2021	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	6	1.07.2021	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	9	1.07.2021	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	11	1.07.2021	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	13	1.07.2021	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	124	3.07.2021	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	126	3.07.2021	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	128	3.07.2021	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	128	22.07.2021	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	5	4.06.2022	1	1	DAN1410-1420
Common Kingfisher	*Alcedo atthis*	6	4.06.2022	1	1	DAN1410-1420
Common Kingfisher	*Alcedo atthis*	7	4.06.2022	1	1	DAN1410-1420
Common Kingfisher	*Alcedo atthis*	8	4.06.2022	1	1	DAN1410-1420
Common Kingfisher	*Alcedo atthis*	9	4.06.2022	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	10	4.06.2022	1	1	DAN1400-1410

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	11	4.06.2022	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	12	4.06.2022	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	13	4.06.2022	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	14	4.06.2022	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	15	4.06.2022	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	16	4.06.2022	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	17	4.06.2022	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	18	4.06.2022	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	20	4.06.2022	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	22	4.06.2022	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	23	4.06.2022	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	24	4.06.2022	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	26	4.06.2022	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	27	4.06.2022	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	28	4.06.2022	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	29	4.06.2022	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	32	4.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	33	4.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	34	4.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	35	4.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	36	4.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	37	4.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	38	4.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	44	4.06.2022	1	1	DAN1360-1370
Common Kingfisher	*Alcedo atthis*	47	4.06.2022	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	49	4.06.2022	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	52	4.06.2022	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	54	4.06.2022	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	55	4.06.2022	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	57	4.06.2022	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	58	4.06.2022	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	59	4.06.2022	1	1	DAN1340-1350
Common Kingfisher	*Alcedo atthis*	66	4.06.2022	1	1	DAN1340-1350
Common Kingfisher	*Alcedo atthis*	67	4.06.2022	1	1	DAN1340-1350
Common Kingfisher	*Alcedo atthis*	71	5.06.2022	1	1	DAN1320-1330
Common Kingfisher	*Alcedo atthis*	72	7.06.2022	1	1	DAN1320-1330

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	73	5.06.2022	1	1	DAN1320-1330
Common Kingfisher	*Alcedo atthis*	75	5.06.2022	1	1	DAN1320-1330
Common Kingfisher	*Alcedo atthis*	10	30.05.2022	1	1	DRA140-145
Common Kingfisher	*Alcedo atthis*	16	30.05.2022	1	1	DRA125-130
Common Kingfisher	*Alcedo atthis*	18	31.05.2022	1	1	DRA120-125
Common Kingfisher	*Alcedo atthis*	19	31.05.2022	1	1	DRA110-115
Common Kingfisher	*Alcedo atthis*	20	31.05.2022	1	1	DRA110-115
Common Kingfisher	*Alcedo atthis*	21	31.05.2022	1	1	DRA105-110
Common Kingfisher	*Alcedo atthis*	22	31.05.2022	1	1	DRA095-100
Common Kingfisher	*Alcedo atthis*	26	31.05.2022	1	1	DRA090-095
Common Kingfisher	*Alcedo atthis*	29	31.05.2022	1	1	DRA090-095
Common Kingfisher	*Alcedo atthis*	32	31.05.2022	1	1	DRA090-095
Common Kingfisher	*Alcedo atthis*	34	31.05.2022	1	1	DRA085-090
Common Kingfisher	*Alcedo atthis*	35	31.05.2022	1	1	DRA085-090
Common Kingfisher	*Alcedo atthis*	38	31.05.2022	1	1	DRA085-090
Common Kingfisher	*Alcedo atthis*	39	31.05.2022	1	1	DRA080-085
Common Kingfisher	*Alcedo atthis*	41	31.05.2022	1	1	DRA075-080
Common Kingfisher	*Alcedo atthis*	43	31.05.2022	1	1	DRA075-080
Common Kingfisher	*Alcedo atthis*	46	31.05.2022	1	1	DRA065-070
Common Kingfisher	*Alcedo atthis*	47	31.05.2022	1	1	DRA065-070
Common Kingfisher	*Alcedo atthis*	48	31.05.2022	1	1	DRA065-070
Common Kingfisher	*Alcedo atthis*	49	31.05.2022	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	51	31.05.2022	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	52	31.05.2022	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	54	31.05.2022	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	56	31.05.2022	1	1	DRA060-065
Common Kingfisher	*Alcedo atthis*	58	31.05.2022	1	1	DRA055-060
Common Kingfisher	*Alcedo atthis*	60	31.05.2022	1	1	DRA050-055
Common Kingfisher	*Alcedo atthis*	63	31.05.2022	1	1	DRA040-045
Common Kingfisher	*Alcedo atthis*	64	31.05.2022	1	1	DRA040-045
Common Kingfisher	*Alcedo atthis*	65	31.05.2022	1	1	DRA040-045
Common Kingfisher	*Alcedo atthis*	69	1.06.2022	1	1	DRA035-040
Common Kingfisher	*Alcedo atthis*	70	1.06.2022	1	1	DRA030-035
Common Kingfisher	*Alcedo atthis*	71	1.06.2022	1	1	DRA030-035
Common Kingfisher	*Alcedo atthis*	72	1.06.2022	1	1	DRA030-035
Common Kingfisher	*Alcedo atthis*	74	1.06.2022	1	1	DRA025-030

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	75	1.06.2022	1	1	DRA025-030
Common Kingfisher	*Alcedo atthis*	76	1.06.2022	1	1	DRA020-025
Common Kingfisher	*Alcedo atthis*	77	1.06.2022	1	1	DRA020-025
Common Kingfisher	*Alcedo atthis*	78	1.06.2022	1	1	DRA010-015
Common Kingfisher	*Alcedo atthis*	80	1.06.2022	1	1	DRA005-010
Common Kingfisher	*Alcedo atthis*	82	1.06.2022	1	1	DRA005-010
Common Kingfisher	*Alcedo atthis*	83	1.06.2022	1	1	DRA000-005
Common Kingfisher	*Alcedo atthis*	84	1.06.2022	1	1	DRA000-005
Common Kingfisher	*Alcedo atthis*	2	11.06.2022	1	1	DRA250-255
Common Kingfisher	*Alcedo atthis*	7	11.06.2022	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	10	11.06.2022	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	14	11.06.2022	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	15	11.06.2022	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	17	11.06.2022	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	19	11.06.2022	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	20	11.06.2022	1	1	DRA245-250
Common Kingfisher	*Alcedo atthis*	22	11.06.2022	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	23	11.06.2022	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	25	11.06.2022	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	26	11.06.2022	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	29	11.06.2022	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	32	11.06.2022	1	1	DRA235-240
Common Kingfisher	*Alcedo atthis*	34	11.06.2022	1	1	DRA235-240
Common Kingfisher	*Alcedo atthis*	38	11.06.2022	1	1	DRA230-235
Common Kingfisher	*Alcedo atthis*	39	11.06.2022	1	1	DRA225-230
Common Kingfisher	*Alcedo atthis*	41	11.06.2022	1	1	DRA225-230
Common Kingfisher	*Alcedo atthis*	43	11.06.2022	1	1	DRA225-230
Common Kingfisher	*Alcedo atthis*	47	11.06.2022	1	1	DRA220-225
Common Kingfisher	*Alcedo atthis*	49	11.06.2022	1	1	DRA220-225
Common Kingfisher	*Alcedo atthis*	50	11.06.2022	1	1	DRA220-225
Common Kingfisher	*Alcedo atthis*	51	11.06.2022	1	1	DRA220-225
Common Kingfisher	*Alcedo atthis*	54	11.06.2022	1	1	DRA220-225
Common Kingfisher	*Alcedo atthis*	55	11.06.2022	1	1	DRA220-225
Common Kingfisher	*Alcedo atthis*	57	11.06.2022	1	1	DRA215-220
Common Kingfisher	*Alcedo atthis*	63	11.06.2022	1	1	DRA205-210
Common Kingfisher	*Alcedo atthis*	65	11.06.2022	1	1	DRA205-210

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	67	11.06.2022	1	1	DRA200-205
Common Kingfisher	*Alcedo atthis*	68	11.06.2022	1	1	DRA195-200
Common Kingfisher	*Alcedo atthis*	69	11.06.2022	1	1	DRA195-200
Common Kingfisher	*Alcedo atthis*	75	11.06.2022	1	1	DRA185-190
Common Kingfisher	*Alcedo atthis*	83	11.06.2022	1	1	DRA180-185
Common Kingfisher	*Alcedo atthis*	88	11.06.2022	1	1	DRA180-185
Common Kingfisher	*Alcedo atthis*	1	16.06.2022	1	1	DRA180-185
Common Kingfisher	*Alcedo atthis*	4	16.06.2022	1	1	DRA180-185
Common Kingfisher	*Alcedo atthis*	6	16.06.2022	1	1	DRA180-185
Common Kingfisher	*Alcedo atthis*	7	16.06.2022	1	1	DRA175-180
Common Kingfisher	*Alcedo atthis*	11	16.06.2022	1	1	DRA175-180
Common Kingfisher	*Alcedo atthis*	13	16.06.2022	1	1	DRA175-180
Common Kingfisher	*Alcedo atthis*	15	16.06.2022	1	1	DRA175-180
Common Kingfisher	*Alcedo atthis*	16	16.06.2022	1	1	DRA175-180
Common Kingfisher	*Alcedo atthis*	18	16.06.2022	1	1	DRA170-175
Common Kingfisher	*Alcedo atthis*	20	16.06.2022	1	1	DRA170-175
Common Kingfisher	*Alcedo atthis*	22	16.06.2022	1	1	DRA170-175
Common Kingfisher	*Alcedo atthis*	25	16.06.2022	1	1	DRA170-175
Common Kingfisher	*Alcedo atthis*	26	16.06.2022	1	1	DRA165-170
Common Kingfisher	*Alcedo atthis*	28	16.06.2022	1	1	DRA165-170
Common Kingfisher	*Alcedo atthis*	4	19.06.2022	1	1	DRA320-315
Common Kingfisher	*Alcedo atthis*	5	19.06.2022	1	1	DRA320-315
Common Kingfisher	*Alcedo atthis*	7	19.06.2022	1	1	DRA310-315
Common Kingfisher	*Alcedo atthis*	14	19.06.2022	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	15	19.06.2022	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	16	19.06.2022	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	18	19.06.2022	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	20	19.06.2022	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	21	19.06.2022	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	22	19.06.2022	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	23	19.06.2022	1	1	DRA290-295
Common Kingfisher	*Alcedo atthis*	91	12.06.2022	1	1	MUR045-050
Common Kingfisher	*Alcedo atthis*	95	12.06.2022	1	1	MUR045-050
Common Kingfisher	*Alcedo atthis*	97	12.06.2022	1	1	MUR040-045
Common Kingfisher	*Alcedo atthis*	106	12.06.2022	1	1	MUR030-035
Common Kingfisher	*Alcedo atthis*	111	12.06.2022	1	1	MUR030-035

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	113	12.06.2022	1	1	MUR030-035
Common Kingfisher	*Alcedo atthis*	115	12.06.2022	1	1	MUR025-030
Common Kingfisher	*Alcedo atthis*	118	12.06.2022	1	1	MUR025-030
Common Kingfisher	*Alcedo atthis*	121	12.06.2022	1	1	MUR020-025
Common Kingfisher	*Alcedo atthis*	123	12.06.2022	1	1	MUR015-020
Common Kingfisher	*Alcedo atthis*	125	12.06.2022	1	1	MUR005-010
Common Kingfisher	*Alcedo atthis*	127	12.06.2022	1	1	MUR005-010
Common Kingfisher	*Alcedo atthis*	129	12.06.2022	1	1	MUR000-005
Common Kingfisher	*Alcedo atthis*	131	12.06.2022	1	1	MUR000-005
Common Kingfisher	*Alcedo atthis*	133	12.06.2022	1	1	MUR000-005
Common Kingfisher	*Alcedo atthis*	137	12.06.2022	1	1	MUR000-005
Common Kingfisher	*Alcedo atthis*	OD20	24.05.2022	1	1	DAN1300-1310
Common Kingfisher	*Alcedo atthis*	OD11	23.05.2022	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	OD12	23.05.2022	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	OD09	23.05.2022	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	T005	23.05.2022	1	1	DAN1310-1320
Common Kingfisher	*Alcedo atthis*	OD08	23.05.2022	1	1	DAN1320-1330
Common Kingfisher	*Alcedo atthis*	OD07	23.05.2022	1	1	DAN1330-1340
Common Kingfisher	*Alcedo atthis*	RUK01	23.05.2022	1	1	DAN1330-1340
Common Kingfisher	*Alcedo atthis*	OD05	23.05.2022	1	1	DAN1340-1350
Common Kingfisher	*Alcedo atthis*	OD03	23.05.2022	1	1	DAN1340-1350
Common Kingfisher	*Alcedo atthis*	T015	23.05.2022	1	1	DAN1340-1350
Common Kingfisher	*Alcedo atthis*	OD01	23.05.2022	1	1	DAN1350-1360
Common Kingfisher	*Alcedo atthis*	OD42	3.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	T040	3.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	T041	3.06.2022	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	OD23	25.05.2022	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	T002	3.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	T044	3.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	OD43	3.06.2022	1	1	DAN1370-1380
Common Kingfisher	*Alcedo atthis*	OD03_a	25.05.2022	1	1	DAN1380-1390
Common Kingfisher	*Alcedo atthis*	T027	25.05.2022	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	T030	25.05.2022	1	1	DAN1390-1400
Common Kingfisher	*Alcedo atthis*	T053	3.06.2022	1	1	DAN1400-1410
Common Kingfisher	*Alcedo atthis*	OD02_a	25.05.2022	1	1	DAN1410-1420
Common Kingfisher	*Alcedo atthis*	OD01_a	25.05.2022	1	1	DAN1430-1440

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Common Kingfisher	*Alcedo atthis*	74	25.04.2022	1	1	MUR125-130
Common Kingfisher	*Alcedo atthis*	132	25.04.2022	1	1	MUR110-115
Common Kingfisher	*Alcedo atthis*	57	26.04.2022	1	1	MUR085-090
Common Kingfisher	*Alcedo atthis*	87	26.04.2022	1	1	MUR080-085
Common Kingfisher	*Alcedo atthis*	134	26.04.2022	1	1	MUR075-080
Common Kingfisher	*Alcedo atthis*	159	26.04.2022	1	1	MUR070-075
Common Kingfisher	*Alcedo atthis*	65	28.04.2022	1	1	MUR055-060
Common Kingfisher	*Alcedo atthis*	84	28.04.2022	1	1	MUR050-055
Common Kingfisher	*Alcedo atthis*	100	28.04.2022	1	1	MUR050-055
Common Kingfisher	*Alcedo atthis*	20	6.06.2022	1	1	MUR135-140
Common Kingfisher	*Alcedo atthis*	39	6.06.2022	1	1	MUR130-135
Common Kingfisher	*Alcedo atthis*	57	6.06.2022	1	1	MUR125-130
Common Kingfisher	*Alcedo atthis*	61	6.06.2022	1	1	MUR125-130
Common Kingfisher	*Alcedo atthis*	99	6.06.2022	1	1	MUR105-110
Common Kingfisher	*Alcedo atthis*	115	6.06.2022	1	1	MUR100-105
Common Kingfisher	*Alcedo atthis*	119	6.06.2022	1	1	MUR100-105
Common Kingfisher	*Alcedo atthis*	4	7.06.2022	1	1	MUR090-095
Common Kingfisher	*Alcedo atthis*	30	7.06.2022	1	1	MUR085-090
Common Kingfisher	*Alcedo atthis*	53	7.06.2022	1	1	MUR080-085
Common Kingfisher	*Alcedo atthis*	75	7.06.2022	1	1	MUR075-080
Common Kingfisher	*Alcedo atthis*	87	7.06.2022	1	1	MUR070-075
Common Kingfisher	*Alcedo atthis*	10	12.06.2022	1	1	MUR065-070
Common Kingfisher	*Alcedo atthis*	30	12.06.2022	1	1	MUR060-065
Common Kingfisher	*Alcedo atthis*	32	12.06.2022	1	1	MUR060-065
Common Kingfisher	*Alcedo atthis*	42	12.06.2022	1	1	MUR055-060
Common Kingfisher	*Alcedo atthis*	49	12.06.2022	1	1	MUR055-060
Common Kingfisher	*Alcedo atthis*	50	12.06.2022	1	1	MUR055-060
Common Kingfisher	*Alcedo atthis*	79	12.06.2022	1	1	MUR050-055
Common Kingfisher	*Alcedo atthis*	83	12.06.2022	1	1	MUR050-055
Common Kingfisher	*Alcedo atthis*	104	12.06.2022	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	POLUSPRUD02	14.07.2021	1	1	DAN1370-1380
Little Ringed Plover	*Charadrius dubius*	SPRUD10	14.07.2021	1	3	DAN1370-1380
Little Ringed Plover	*Charadrius dubius*	SPRUD09	14.07.2021	1	3	DAN1380-1390
Little Ringed Plover	*Charadrius dubius*	SPRUD03	13.07.2021	1	3	DAN1410-1420
Little Ringed Plover	*Charadrius dubius*	SPRUD04	13.07.2021	1	1	DAN1410-1420
Little Ringed Plover	*Charadrius dubius*	84	2.07.2021	1	1	DRA185-190

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Little Ringed Plover	*Charadrius dubius*	92	2.07.2021	1	1	DRA185-190
Little Ringed Plover	*Charadrius dubius*	95	2.07.2021	1	1	DRA185-190
Little Ringed Plover	*Charadrius dubius*	83	2.07.2021	1	1	DRA190-195
Little Ringed Plover	*Charadrius dubius*	80	2.07.2021	1	3	DRA195-200
Little Ringed Plover	*Charadrius dubius*	75	1.07.2021	1	1	DRA200-205
Little Ringed Plover	*Charadrius dubius*	76	1.07.2021	1	1	DRA200-205
Little Ringed Plover	*Charadrius dubius*	72	1.07.2021	1	1	DRA205-210
Little Ringed Plover	*Charadrius dubius*	54	1.07.2021	1	1	DRA215-220
Little Ringed Plover	*Charadrius dubius*	38	1.07.2021	1	1	DRA225-230
Little Ringed Plover	*Charadrius dubius*	40	1.07.2021	1	1	DRA225-230
Little Ringed Plover	*Charadrius dubius*	17	1.07.2021	1	1	DRA240-245
Little Ringed Plover	*Charadrius dubius*	15	1.07.2021	1	1	DRA245-250
Little Ringed Plover	*Charadrius dubius*	16	1.07.2021	1	2	DRA245-250
Little Ringed Plover	*Charadrius dubius*	2	1.07.2021	1	1	DRA250-255
Little Ringed Plover	*Charadrius dubius*	63	30.06.2021	1	2	MUR000-005
Little Ringed Plover	*Charadrius dubius*	56	30.06.2021	1	1	MUR005-010
Little Ringed Plover	*Charadrius dubius*	52	30.06.2021	1	1	MUR010-015
Little Ringed Plover	*Charadrius dubius*	50	30.06.2021	1	1	MUR015-020
Little Ringed Plover	*Charadrius dubius*	44	30.06.2021	1	1	MUR020-025
Little Ringed Plover	*Charadrius dubius*	48	30.06.2021	1	2	MUR020-025
Little Ringed Plover	*Charadrius dubius*	38	30.06.2021	1	1	MUR025-030
Little Ringed Plover	*Charadrius dubius*	34	30.06.2021	1	1	MUR030-035
Little Ringed Plover	*Charadrius dubius*	22	30.06.2021	1	1	MUR040-045
Little Ringed Plover	*Charadrius dubius*	25	30.06.2021	1	2	MUR040-045
Little Ringed Plover	*Charadrius dubius*	190	29.04.2021	1	1	MUR045-050
Little Ringed Plover	*Charadrius dubius*	8	30.06.2021	1	2	MUR045-050
Little Ringed Plover	*Charadrius dubius*	11	30.06.2021	1	1	MUR045-050
Little Ringed Plover	*Charadrius dubius*	12	30.06.2021	1	2	MUR045-050
Little Ringed Plover	*Charadrius dubius*	155	29.04.2021	1	3	MUR050-055
Little Ringed Plover	*Charadrius dubius*	169	29.04.2021	1	4	MUR050-055
Little Ringed Plover	*Charadrius dubius*	170	29.04.2021	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	181	29.04.2021	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	185	29.04.2021	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	185	29.04.2021	1	2	MUR050-055
Little Ringed Plover	*Charadrius dubius*	65	9.06.2021	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	65	9.06.2021	1	1	MUR050-055

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Little Ringed Plover	*Charadrius dubius*	66	9.06.2021	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	124	29.04.2021	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	126	29.04.2021	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	134	29.04.2021	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	145	29.04.2021	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	148	29.04.2021	1	2	MUR055-060
Little Ringed Plover	*Charadrius dubius*	48	9.06.2021	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	55	9.06.2021	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	56	9.06.2021	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	89	29.04.2021	1	1	MUR060-065
Little Ringed Plover	*Charadrius dubius*	106	29.04.2021	1	1	MUR060-065
Little Ringed Plover	*Charadrius dubius*	109	29.04.2021	1	1	MUR060-065
Little Ringed Plover	*Charadrius dubius*	33	9.06.2021	1	1	MUR060-065
Little Ringed Plover	*Charadrius dubius*	39	9.06.2021	1	5	MUR060-065
Little Ringed Plover	*Charadrius dubius*	68	29.04.2021	1	1	MUR065-070
Little Ringed Plover	*Charadrius dubius*	69	29.04.2021	1	2	MUR065-070
Little Ringed Plover	*Charadrius dubius*	7	29.04.2021	1	1	MUR075-080
Little Ringed Plover	*Charadrius dubius*	9	29.04.2021	1	1	MUR075-080
Little Ringed Plover	*Charadrius dubius*	44	10.06.2021	1	2	MUR075-080
Little Ringed Plover	*Charadrius dubius*	200	25.04.2021	1	2	MUR080-085
Little Ringed Plover	*Charadrius dubius*	201	25.04.2021	1	2	MUR080-085
Little Ringed Plover	*Charadrius dubius*	204	25.04.2021	1	1	MUR080-085
Little Ringed Plover	*Charadrius dubius*	34	10.06.2021	1	1	MUR080-085
Little Ringed Plover	*Charadrius dubius*	154	25.04.2021	1	1	MUR090-095
Little Ringed Plover	*Charadrius dubius*	166	25.04.2021	1	1	MUR090-095
Little Ringed Plover	*Charadrius dubius*	166	25.04.2021	1	1	MUR090-095
Little Ringed Plover	*Charadrius dubius*	169	25.04.2021	1	1	MUR090-095
Little Ringed Plover	*Charadrius dubius*	4	1.07.2021	1	1	DRA245-250
Little Ringed Plover	*Charadrius dubius*	5	1.07.2021	1	1	DRA245-250
Little Ringed Plover	*Charadrius dubius*	125	3.07.2021	1	1	DRA290-295
Little Ringed Plover	*Charadrius dubius*	70	5.06.2022	1	2	DAN1320-1330
Little Ringed Plover	*Charadrius dubius*	1	30.05.2022	1	1	DRA160-165
Little Ringed Plover	*Charadrius dubius*	3	30.05.2022	1	1	DRA155-160
Little Ringed Plover	*Charadrius dubius*	61	31.05.2022	1	1	DRA045-050
Little Ringed Plover	*Charadrius dubius*	1	11.06.2022	1	1	DRA250-255
Little Ringed Plover	*Charadrius dubius*	4	11.06.2022	1	2	DRA250-255

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Little Ringed Plover	*Charadrius dubius*	5	11.06.2022	1	1	DRA250-255
Little Ringed Plover	*Charadrius dubius*	9	11.06.2022	1	3	DRA245-250
Little Ringed Plover	*Charadrius dubius*	18	11.06.2022	1	2	DRA245-250
Little Ringed Plover	*Charadrius dubius*	24	11.06.2022	1	1	DRA240-245
Little Ringed Plover	*Charadrius dubius*	42	11.06.2022	1	1	DRA225-230
Little Ringed Plover	*Charadrius dubius*	58	11.06.2022	1	1	DRA215-220
Little Ringed Plover	*Charadrius dubius*	63	11.06.2022	1	1	DRA205-210
Little Ringed Plover	*Charadrius dubius*	66	11.06.2022	1	4	DRA200-205
Little Ringed Plover	*Charadrius dubius*	70	11.06.2022	1	2	DRA195-200
Little Ringed Plover	*Charadrius dubius*	72	11.06.2022	1	1	DRA185-190
Little Ringed Plover	*Charadrius dubius*	77	11.06.2022	1	3	DRA185-190
Little Ringed Plover	*Charadrius dubius*	78	11.06.2022	1	2	DRA185-190
Little Ringed Plover	*Charadrius dubius*	79	11.06.2022	1	1	DRA180-185
Little Ringed Plover	*Charadrius dubius*	3	16.06.2022	1	2	DRA180-185
Little Ringed Plover	*Charadrius dubius*	14	16.06.2022	1	1	DRA175-180
Little Ringed Plover	*Charadrius dubius*	27	16.06.2022	1	3	DRA165-170
Little Ringed Plover	*Charadrius dubius*	30	16.06.2022	1	4	DRA160-165
Little Ringed Plover	*Charadrius dubius*	11	19.06.2022	1	1	DRA295-300
Little Ringed Plover	*Charadrius dubius*	13	19.06.2022	1	1	DRA290-295
Little Ringed Plover	*Charadrius dubius*	89	12.06.2022	1	1	MUR045-050
Little Ringed Plover	*Charadrius dubius*	92	12.06.2022	1	3	MUR045-050
Little Ringed Plover	*Charadrius dubius*	98	12.06.2022	1	2	MUR040-045
Little Ringed Plover	*Charadrius dubius*	126	12.06.2022	1	2	MUR005-010
Little Ringed Plover	*Charadrius dubius*	137	12.06.2022	1	2	MUR000-005
Little Ringed Plover	*Charadrius dubius*	T067	12.07.2022	1	1	DAN1340-1350
Little Ringed Plover	*Charadrius dubius*	Sprud1_a	12.07.2022	1	1	DAN1350-1360
Little Ringed Plover	*Charadrius dubius*	sprud22_a	14.07.2022	1	1	DAN1380-1390
Little Ringed Plover	*Charadrius dubius*	SPRUD21	25.05.2022	1	1	DAN1400-1410
Little Ringed Plover	*Charadrius dubius*	SP02	25.05.2022	1	1	DAN1410-1420
Little Ringed Plover	*Charadrius dubius*	SP01	25.05.2022	1	1	DAN1410-1420
Little Ringed Plover	*Charadrius dubius*	23	26.04.2022	1	1	MUR090-095
Little Ringed Plover	*Charadrius dubius*	49	26.04.2022	1	1	MUR085-090
Little Ringed Plover	*Charadrius dubius*	75	26.04.2022	1	1	MUR080-085
Little Ringed Plover	*Charadrius dubius*	79	26.04.2022	1	1	MUR080-085
Little Ringed Plover	*Charadrius dubius*	109	26.04.2022	1	1	MUR075-080
Little Ringed Plover	*Charadrius dubius*	114	26.04.2022	1	1	MUR075-080

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Little Ringed Plover	*Charadrius dubius*	185	26.04.2022	1	1	MUR065-070
Little Ringed Plover	*Charadrius dubius*	110	28.04.2022	1	2	MUR050-055
Little Ringed Plover	*Charadrius dubius*	124	28.04.2022	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	125	28.04.2022	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	4	12.06.2022	1	1	MUR065-070
Little Ringed Plover	*Charadrius dubius*	39	12.06.2022	1	1	MUR060-065
Little Ringed Plover	*Charadrius dubius*	43	12.06.2022	1	3	MUR060-065
Little Ringed Plover	*Charadrius dubius*	51	12.06.2022	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	52	12.06.2022	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	57	12.06.2022	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	58	12.06.2022	1	1	MUR055-060
Little Ringed Plover	*Charadrius dubius*	71	12.06.2022	1	2	MUR055-060
Little Ringed Plover	*Charadrius dubius*	75	12.06.2022	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	74	12.06.2022	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	81	12.06.2022	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	82	12.06.2022	1	1	MUR050-055
Little Ringed Plover	*Charadrius dubius*	86	12.06.2022	1	4	MUR050-055
Little Ringed Plover	*Charadrius dubius*	103	12.06.2022	1	2	MUR050-055
European Bee-eater	*Merops apiaster*	86	15.06.2021	1	10	DAN1300-1310
European Bee-eater	*Merops apiaster*	88	15.06.2021	1	3	DAN1300-1310
European Bee-eater	*Merops apiaster*	67	15.06.2021	1	35	DAN1330-1340
European Bee-eater	*Merops apiaster*	68	15.06.2021	1	5	DAN1330-1340
European Bee-eater	*Merops apiaster*	69	15.06.2021	1	3	DAN1330-1340
European Bee-eater	*Merops apiaster*	70	15.06.2021	1	5	DAN1330-1340
European Bee-eater	*Merops apiaster*	72	15.06.2021	1	4	DAN1330-1340
European Bee-eater	*Merops apiaster*	OD44	21.07.2021	1	3	DAN1340-1350
European Bee-eater	*Merops apiaster*	OD45	21.07.2021	1	5	DAN1340-1350
European Bee-eater	*Merops apiaster*	60	15.06.2021	1	10	DAN1340-1350
European Bee-eater	*Merops apiaster*	61	15.06.2021	1	35	DAN1340-1350
European Bee-eater	*Merops apiaster*	OD43	21.07.2021	1	3	DAN1350-1360
European Bee-eater	*Merops apiaster*	49	15.06.2021	1	5	DAN1350-1360
European Bee-eater	*Merops apiaster*	50	15.06.2021	1	5	DAN1350-1360
European Bee-eater	*Merops apiaster*	51	15.06.2021	1	3	DAN1350-1360
European Bee-eater	*Merops apiaster*	53	15.06.2021	1	2	DAN1350-1360
European Bee-eater	*Merops apiaster*	55	15.06.2021	1	5	DAN1350-1360
European Bee-eater	*Merops apiaster*	32	9.06.2021	1	3	DRA085-090

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
European Bee-eater	*Merops apiaster*	33	9.06.2021	1	2	DRA085-090
European Bee-eater	*Merops apiaster*	35	9.06.2021	1	3	DRA085-090
European Bee-eater	*Merops apiaster*	36	9.06.2021	1	3	DRA085-090
European Bee-eater	*Merops apiaster*	37	9.06.2021	1	5	DRA085-090
European Bee-eater	*Merops apiaster*	38	9.06.2021	1	3	DRA085-090
European Bee-eater	*Merops apiaster*	39	9.06.2021	1	55	DRA085-090
European Bee-eater	*Merops apiaster*	28	9.06.2021	1	15	DRA090-095
European Bee-eater	*Merops apiaster*	29	9.06.2021	1	3	DRA090-095
European Bee-eater	*Merops apiaster*	30	9.06.2021	1	30	DRA090-095
European Bee-eater	*Merops apiaster*	25	8.06.2021	1	6	DRA095-100
European Bee-eater	*Merops apiaster*	12	8.06.2021	1	2	DRA145-150
European Bee-eater	*Merops apiaster*	13	8.06.2021	1	1	DRA145-150
European Bee-eater	*Merops apiaster*	97	2.07.2021	1	5	DRA180-185
European Bee-eater	*Merops apiaster*	85	2.07.2021	1	80	DRA185-190
European Bee-eater	*Merops apiaster*	53	1.07.2021	1	45	DRA215-220
European Bee-eater	*Merops apiaster*	45	1.07.2021	1	6	DRA220-225
European Bee-eater	*Merops apiaster*	48	1.07.2021	1	7	DRA220-225
European Bee-eater	*Merops apiaster*	50	1.07.2021	1	12	DRA220-225
European Bee-eater	*Merops apiaster*	52	1.07.2021	1	3	DRA220-225
European Bee-eater	*Merops apiaster*	33	1.07.2021	1	6	DRA230-235
European Bee-eater	*Merops apiaster*	13	30.06.2021	1	7	MUR045-050
European Bee-eater	*Merops apiaster*	14	30.06.2021	1	7	MUR045-050
European Bee-eater	*Merops apiaster*	OD53	22.07.2021	1	3	DAN1310-1320
European Bee-eater	*Merops apiaster*	4	17.06.2021	1	4	0
European Bee-eater	*Merops apiaster*	7	1.07.2021	1	14	DRA245-250
European Bee-eater	*Merops apiaster*	51	4.06.2022	1	15	DAN1350-1360
European Bee-eater	*Merops apiaster*	53	4.06.2022	1	15	DAN1350-1360
European Bee-eater	*Merops apiaster*	62	4.06.2022	1	5	DAN1340-1350
European Bee-eater	*Merops apiaster*	7	30.05.2022	1	2	DRA145-150
European Bee-eater	*Merops apiaster*	23	31.05.2022	1	2	DRA095-100
European Bee-eater	*Merops apiaster*	30	31.05.2022	1	35	DRA090-095
European Bee-eater	*Merops apiaster*	36	31.05.2022	1	25	DRA085-090
European Bee-eater	*Merops apiaster*	37	31.05.2022	1	3	DRA085-090
European Bee-eater	*Merops apiaster*	11	11.06.2022	1	3	DRA245-250
European Bee-eater	*Merops apiaster*	37	11.06.2022	1	4	DRA230-235
European Bee-eater	*Merops apiaster*	52	11.06.2022	1	18	DRA220-225

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
European Bee-eater	*Merops apiaster*	56	11.06.2022	1	25	DRA215-220
European Bee-eater	*Merops apiaster*	59	11.06.2022	1	5	DRA215-220
European Bee-eater	*Merops apiaster*	73	11.06.2022	1	15	DRA185-190
European Bee-eater	*Merops apiaster*	79	11.06.2022	1	4	DRA180-185
European Bee-eater	*Merops apiaster*	134	12.06.2022	1	5	MUR000-005
European Bee-eater	*Merops apiaster*	T004	23.05.2022	1	11	DAN1310-1320
Sand Martin	*Riparia riparia*	83	15.06.2021	1	13	DAN1310-1320
Sand Martin	*Riparia riparia*	76	15.06.2021	1	40	DAN1320-1330
Sand Martin	*Riparia riparia*	78	15.06.2021	1	40	DAN1320-1330
Sand Martin	*Riparia riparia*	OD41	21.07.2021	1	120	DAN1340-1350
Sand Martin	*Riparia riparia*	OD45	21.07.2021	1	20	DAN1340-1350
Sand Martin	*Riparia riparia*	61	15.06.2021	1	50	DAN1340-1350
Sand Martin	*Riparia riparia*	OD42	21.07.2021	1	3	DAN1350-1360
Sand Martin	*Riparia riparia*	54	15.06.2021	1	10	DAN1350-1360
Sand Martin	*Riparia riparia*	55	15.06.2021	1	30	DAN1350-1360
Sand Martin	*Riparia riparia*	40	14.06.2021	1	35	DAN1360-1370
Sand Martin	*Riparia riparia*	41	14.06.2021	1	100	DAN1360-1370
Sand Martin	*Riparia riparia*	43	14.06.2021	1	280	DAN1360-1370
Sand Martin	*Riparia riparia*	OD24	15.07.2021	1	130	DAN1370-1380
Sand Martin	*Riparia riparia*	67	11.06.2021	1	250	DRA035-040
Sand Martin	*Riparia riparia*	53	9.06.2021	1	40	DRA060-065
Sand Martin	*Riparia riparia*	54	9.06.2021	1	30	DRA060-065
Sand Martin	*Riparia riparia*	57	9.06.2021	1	700	DRA060-065
Sand Martin	*Riparia riparia*	58	9.06.2021	1	1500	DRA060-065
Sand Martin	*Riparia riparia*	31	9.06.2021	1	200	DRA090-095
Sand Martin	*Riparia riparia*	23	8.06.2021	1	22	DRA105-110
Sand Martin	*Riparia riparia*	13	8.06.2021	1	35	DRA145-150
Sand Martin	*Riparia riparia*	113	2.07.2021	1	350	DRA170-175
Sand Martin	*Riparia riparia*	114	2.07.2021	1	59	DRA170-175
Sand Martin	*Riparia riparia*	104	2.07.2021	1	40	DRA175-180
Sand Martin	*Riparia riparia*	105	2.07.2021	1	700	DRA175-180
Sand Martin	*Riparia riparia*	107	2.07.2021	1	300	DRA175-180
Sand Martin	*Riparia riparia*	108	2.07.2021	1	500	DRA175-180
Sand Martin	*Riparia riparia*	97	2.07.2021	1	250	DRA180-185
Sand Martin	*Riparia riparia*	99	2.07.2021	1	25	DRA180-185
Sand Martin	*Riparia riparia*	86	2.07.2021	1	600	DRA185-190

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Sand Martin	*Riparia riparia*	87	2.07.2021	1	400	DRA185-190
Sand Martin	*Riparia riparia*	91	2.07.2021	1	35	DRA185-190
Sand Martin	*Riparia riparia*	74	1.07.2021	1	8	DRA205-210
Sand Martin	*Riparia riparia*	63	1.07.2021	1	5	DRA210-215
Sand Martin	*Riparia riparia*	58	1.07.2021	1	250	DRA215-220
Sand Martin	*Riparia riparia*	60	1.07.2021	1	11	DRA215-220
Sand Martin	*Riparia riparia*	61	1.07.2021	1	9	DRA215-220
Sand Martin	*Riparia riparia*	51	1.07.2021	1	19	DRA220-225
Sand Martin	*Riparia riparia*	42	1.07.2021	1	400	DRA225-230
Sand Martin	*Riparia riparia*	32	1.07.2021	1	450	DRA230-235
Sand Martin	*Riparia riparia*	29	1.07.2021	1	500	DRA235-240
Sand Martin	*Riparia riparia*	24	1.07.2021	1	120	DRA240-245
Sand Martin	*Riparia riparia*	58	30.06.2021	1	230	MUR000-005
Sand Martin	*Riparia riparia*	61	30.06.2021	1	3	MUR000-005
Sand Martin	*Riparia riparia*	54	30.06.2021	1	25	MUR010-015
Sand Martin	*Riparia riparia*	38	30.06.2021	1	40	MUR025-030
Sand Martin	*Riparia riparia*	39	30.06.2021	1	10	MUR025-030
Sand Martin	*Riparia riparia*	42	30.06.2021	1	100	MUR025-030
Sand Martin	*Riparia riparia*	35	30.06.2021	1	80	MUR030-035
Sand Martin	*Riparia riparia*	21	30.06.2021	1	30	MUR040-045
Sand Martin	*Riparia riparia*	25	30.06.2021	1	3	MUR040-045
Sand Martin	*Riparia riparia*	10	30.06.2021	1	20	MUR045-050
Sand Martin	*Riparia riparia*	13	30.06.2021	1	50	MUR045-050
Sand Martin	*Riparia riparia*	14	30.06.2021	1	90	MUR045-050
Sand Martin	*Riparia riparia*	71	9.06.2021	1	15	MUR050-055
Sand Martin	*Riparia riparia*	80	9.06.2021	1	25	MUR050-055
Sand Martin	*Riparia riparia*	81	9.06.2021	1	7	MUR050-055
Sand Martin	*Riparia riparia*	70	10.06.2021	1	12	MUR070-075
Sand Martin	*Riparia riparia*	48	10.06.2021	1	4	MUR080-085
Sand Martin	*Riparia riparia*	84	4.06.2021	1	3	MUR105-110
Sand Martin	*Riparia riparia*	84	4.06.2021	1	43	MUR105-110
Sand Martin	*Riparia riparia*	40	4.06.2021	1	3	MUR125-130
Sand Martin	*Riparia riparia*	40	4.06.2021	1	12	MUR125-130
Sand Martin	*Riparia riparia*	40	4.06.2021	1	24	MUR125-130
Sand Martin	*Riparia riparia*	40	4.06.2021	1	8	MUR125-130
Sand Martin	*Riparia riparia*	40	4.06.2021	1	17	MUR125-130

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Sand Martin	*Riparia riparia*	40	4.06.2021	1	25	MUR125-130
Sand Martin	*Riparia riparia*	1	17.06.2021	1	250	0
Sand Martin	*Riparia riparia*	2	17.06.2021	1	250	0
Sand Martin	*Riparia riparia*	3	17.06.2021	1	1700	0
Sand Martin	*Riparia riparia*	6	17.06.2021	1	70	0
Sand Martin	*Riparia riparia*	12	1.07.2021	1	11	DRA245-250
Sand Martin	*Riparia riparia*	129	3.07.2021	1	110	DRA290-295
Sand Martin	*Riparia riparia*	131	3.07.2021	1	50	DRA290-295
Sand Martin	*Riparia riparia*	45	4.06.2022	1	170	DAN1360-1370
Sand Martin	*Riparia riparia*	60	4.06.2022	1	400	DAN1340-1350
Sand Martin	*Riparia riparia*	75	5.06.2022	1	80	DAN1320-1330
Sandmartin	*Riparia riparia*	82	5.06.2022	1	20	DAN1310-1320
Sandmartin	*Riparia riparia*	8	30.05.2022	1	20	DRA145-150
Sandmartin	*Riparia riparia*	25	31.05.2022	1	2	DRA090-095
Sandmartin	*Riparia riparia*	27	31.05.2022	1	35	DRA090-095
Sandmartin	*Riparia riparia*	28	31.05.2022	1	55	DRA090-095
Sandmartin	*Riparia riparia*	31	31.05.2022	1	150	DRA090-095
Sandmartin	*Riparia riparia*	66	31.05.2022	1	450	DRA035-040
Sandmartin	*Riparia riparia*	13	11.06.2022	1	5	DRA245-250
Sandmartin	*Riparia riparia*	30	11.06.2022	1	25	DRA240-245
Sandmartin	*Riparia riparia*	33	11.06.2022	1	500	DRA235-240
Sandmartin	*Riparia riparia*	35	11.06.2022	1	100	DRA230-235
Sandmartin	*Riparia riparia*	36	11.06.2022	1	150	DRA230-235
Sandmartin	*Riparia riparia*	48	11.06.2022	1	25	DRA220-225
Sandmartin	*Riparia riparia*	49	11.06.2022	1	40	DRA220-225
Sandmartin	*Riparia riparia*	53	11.06.2022	1	40	DRA220-225
Sandmartin	*Riparia riparia*	60	11.06.2022	1	300	DRA215-220
Sandmartin	*Riparia riparia*	61	11.06.2022	1	50	DRA215-220
Sandmartin	*Riparia riparia*	65	11.06.2022	1	50	DRA205-210
Sandmartin	*Riparia riparia*	74	11.06.2022	1	250	DRA185-190
Sandmartin	*Riparia riparia*	76	11.06.2022	1	25	DRA185-190
Sandmartin	*Riparia riparia*	82	11.06.2022	1	40	DRA180-185
Sandmartin	*Riparia riparia*	88	11.06.2022	1	200	DRA180-185
Sandmartin	*Riparia riparia*	5	16.06.2022	1	40	DRA180-185
Sandmartin	*Riparia riparia*	8	16.06.2022	1	250	DRA175-180
Sandmartin	*Riparia riparia*	9	16.06.2022	1	100	DRA175-180

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Sandmartin	*Riparia riparia*	10	16.06.2022	1	250	DRA175-180
Sandmartin	*Riparia riparia*	12	16.06.2022	1	1000	DRA175-180
Sandmartin	*Riparia riparia*	19	16.06.2022	1	120	DRA170-175
Sandmartin	*Riparia riparia*	21	16.06.2022	1	50	DRA170-175
Sandmartin	*Riparia riparia*	23	16.06.2022	1	9	DRA170-175
Sandmartin	*Riparia riparia*	24	16.06.2022	1	40	DRA170-175
Sandmartin	*Riparia riparia*	3	19.06.2022	1	70	DRA320-315
Sandmartin	*Riparia riparia*	24	19.06.2022	1	150	DRA290-295
Sandmartin	*Riparia riparia*	90	12.06.2022	1	5	MUR045-050
Sandmartin	*Riparia riparia*	94	12.06.2022	1	100	MUR045-050
Sandmartin	*Riparia riparia*	108	12.06.2022	1	6	MUR030-035
Sandmartin	*Riparia riparia*	109	12.06.2022	1	12	MUR030-035
Sandmartin	*Riparia riparia*	110	12.06.2022	1	30	MUR030-035
Sandmartin	*Riparia riparia*	114	12.06.2022	1	20	MUR030-035
Sandmartin	*Riparia riparia*	116	12.06.2022	1	10	MUR025-030
Sandmartin	*Riparia riparia*	117	12.06.2022	1	12	MUR025-030
Sandmartin	*Riparia riparia*	119	12.06.2022	1	8	MUR025-030
Sandmartin	*Riparia riparia*	124	12.06.2022	1	130	MUR010-015
Sandmartin	*Riparia riparia*	130	12.06.2022	1	80	MUR000-005
Sandmartin	*Riparia riparia*	132	12.06.2022	1	30	MUR000-005
Sandmartin	*Riparia riparia*	134	12.06.2022	1	25	MUR000-005
Sandmartin	*Riparia riparia*	135	12.06.2022	1	50	MUR000-005
Sandmartin	*Riparia riparia*	T064	12.07.2022	1	3	DAN1340-1350
Sandmartin	*Riparia riparia*	OD44	3.06.2022	1	150	DAN1370-1380
Sandmartin	*Riparia riparia*	100	6.06.2022	1	7	MUR105-110
Sandmartin	*Riparia riparia*	118	6.06.2022	1	93	MUR100-105
Sandmartin	*Riparia riparia*	11	12.06.2022	1	3	MUR065-070
Sandmartin	*Riparia riparia*	27	12.06.2022	1	30	MUR060-065
Sandmartin	*Riparia riparia*	62	12.06.2022	1	8	MUR055-060
Sandmartin	*Riparia riparia*	89	12.06.2022	1	1	MUR050-055
Sandmartin	*Riparia riparia*	102	12.06.2022	1	114	MUR050-055
Sandmartin	*Riparia riparia*	106	12.06.2022	1	1	MUR050-055
Little Tern	*Sterna albifrons*	77	11.06.2022	1	1	DRA185-190
Common Tern	*Sterna hirundo*	66	11.06.2022	1	5	DRA200-205
Common Tern	*Sterna hirundo*	77	11.06.2022	1	3	DRA185-190
Common Tern	*Sterna hirundo*	0	17.06.2021	1	70	Šoderica

English_name	Scientific name	GPS_point	Date	Breeding_site	Pairs	River segment
Common Sandpiper	*Actitis hypoleucos*	22	25.04.2021	1	1	MUR135-140
Common Sandpiper	*Actitis hypoleucos*	89	2.07.2021	1	1	DRA185-190
Common Sandpiper	*Actitis hypoleucos*	81	2.07.2021	1	1	DRA195-200
Common Sandpiper	*Actitis hypoleucos*	37	1.07.2021	1	1	DRA225-230
Common Sandpiper	*Actitis hypoleucos*	28	1.07.2021	1	1	DRA235-240
Common Sandpiper	*Actitis hypoleucos*	19	1.07.2021	1	1	DRA240-245
Little Tern	*Sternula albifrons*	SPRUD10	14.07.2021	1	1	DAN1370-1380