Co-financed by the Connecting Europe Facility of the European Union

Monitoring of hydrological, hydraulic and morphological characteristics of the Danube and inventory of biodiversity components of the Croatian-Serbian common section of the Danube

Inventory of biodiversity components

–

preliminary results

31.01.2024 / Matija Kresonja, Ana Đanić, Ivona Žiža / OIKON Ltd.; Tibor Mikuška / HDZPP

Preparing FAIRway2 works in the Rhine Danube Corridor (2019-EU-TM-0262-S and 2019-HR-TMC-0263-S)

2. BIODIVERSITY INVENTORY and 3. ESTABLISHMENT OF GIS

2. BIODIVERSITY INVENTORY

2.1 Fish fauna inventory

2.2 Habitat inventory

2.3 Bird fauna inventory

2.4 River benthos type inventory

3. ESTABLISHMENT OF A GEOINFORMATION SYSTEM (GIS)

2.1 Fish fauna inventory

- The electrofishing (day and night) portion of the field work was conducted between July and October 2023.
- 17 critical sections of the river from Batina to Ilok on Croatian side + Serbian protected areas
- Depending on the length of each critical section, one to four transects of 500 m were sampled
- In total:
  - 43 transects of daytime electrofishing
  - 13 transects of nighttime electrofishing
  - 5 transects of daytime electrofishing on Serbian side

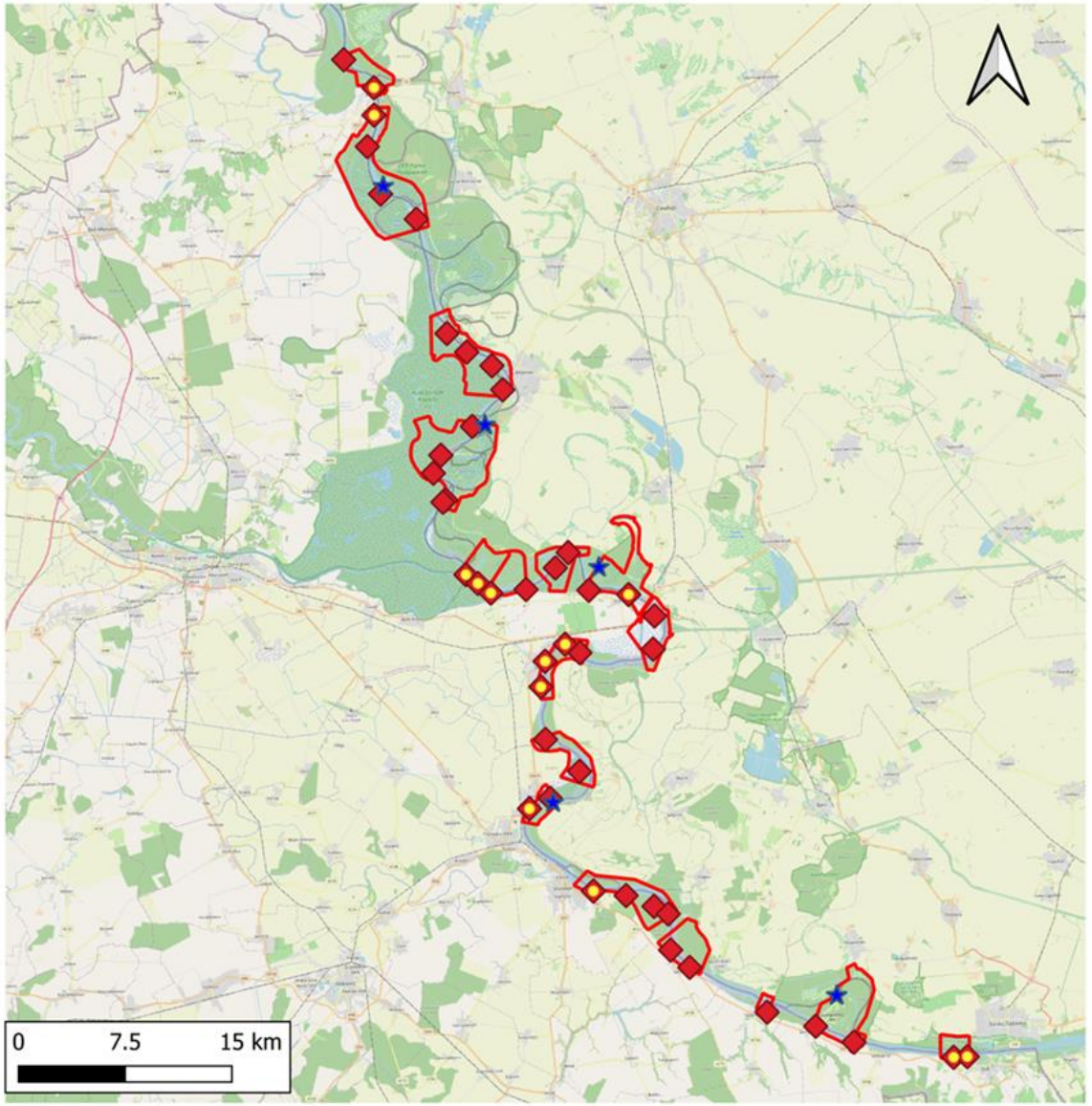
Fish sampling locations

Red diamonds indicate electrofishing transects during the day,

Red diamonds with yellow dot indicate electro fishing transects during the day and night,

Blue stars indicate electro fishing transects on Serbian side.

1. Batina
2. Siga
3. Apatin
4. Židovski rukavac
5. Ušće Drave
6. Aljmaš
7. Staklar
8. Erdut
9. Bogojevo
10. Dalj
11. Borovo I
12. Borovo II
13. Vukovar
14. Sotin
15. Opatovac
16. Mohovo
17. Ilok



Field work

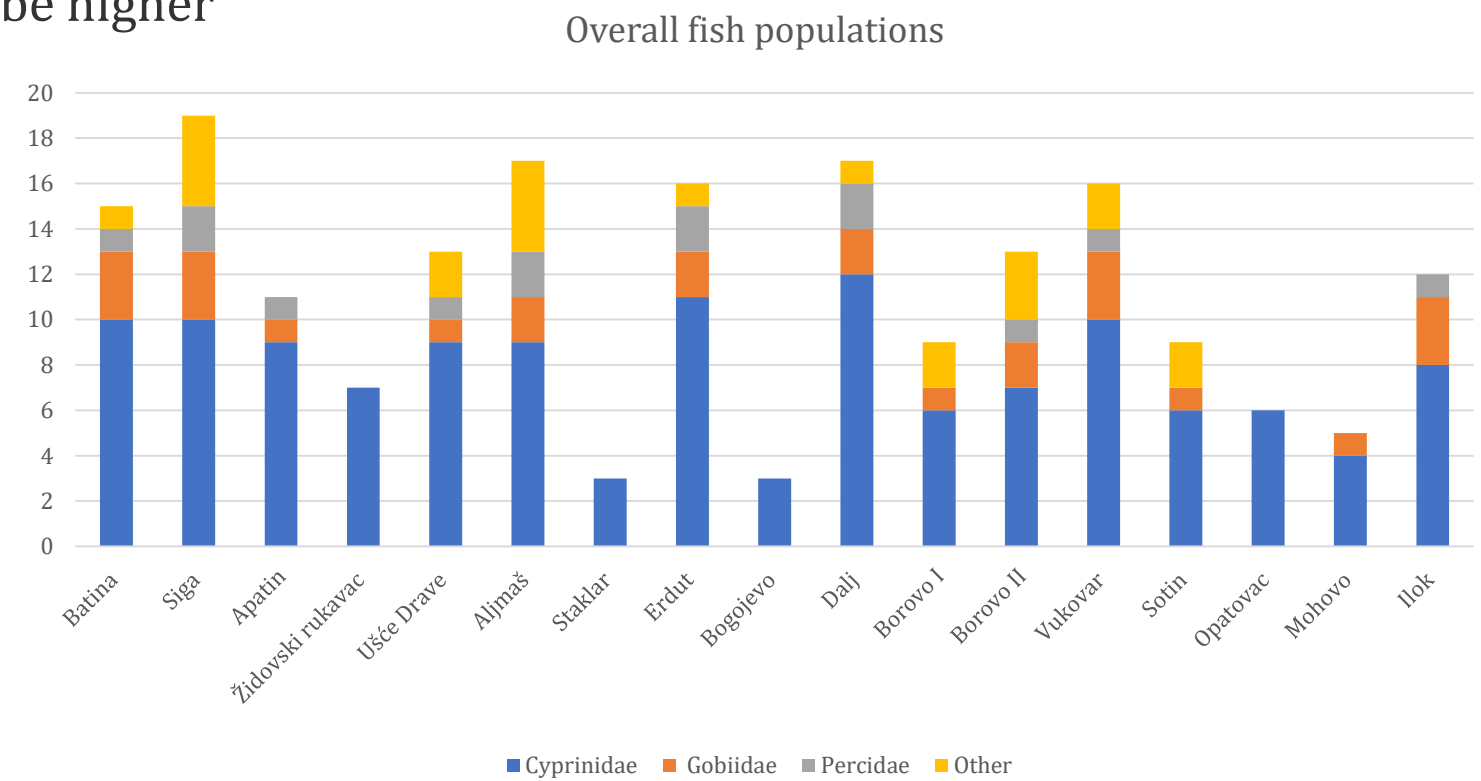
Electrofishing during the day (July 2023)


OIKON

Electrofishing during the night (September/October 2023)

Preliminary results

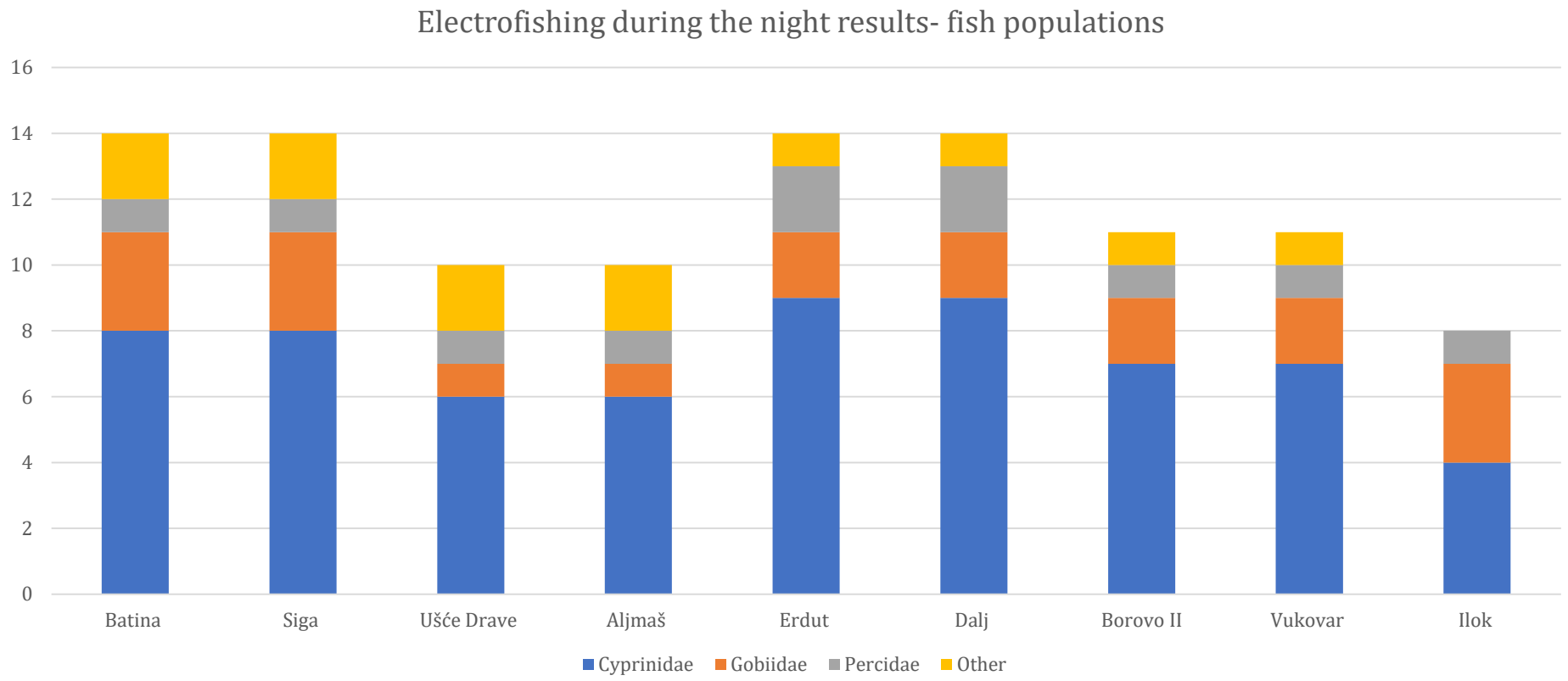
- 37 species caught including electrofishing during day and night on Croatian side and Serbian side of Danube.
- Cyprdinidae family is most abundant and present on all 17 critical sections
- NOTE: This results are temporary, number of species can possibly be higher



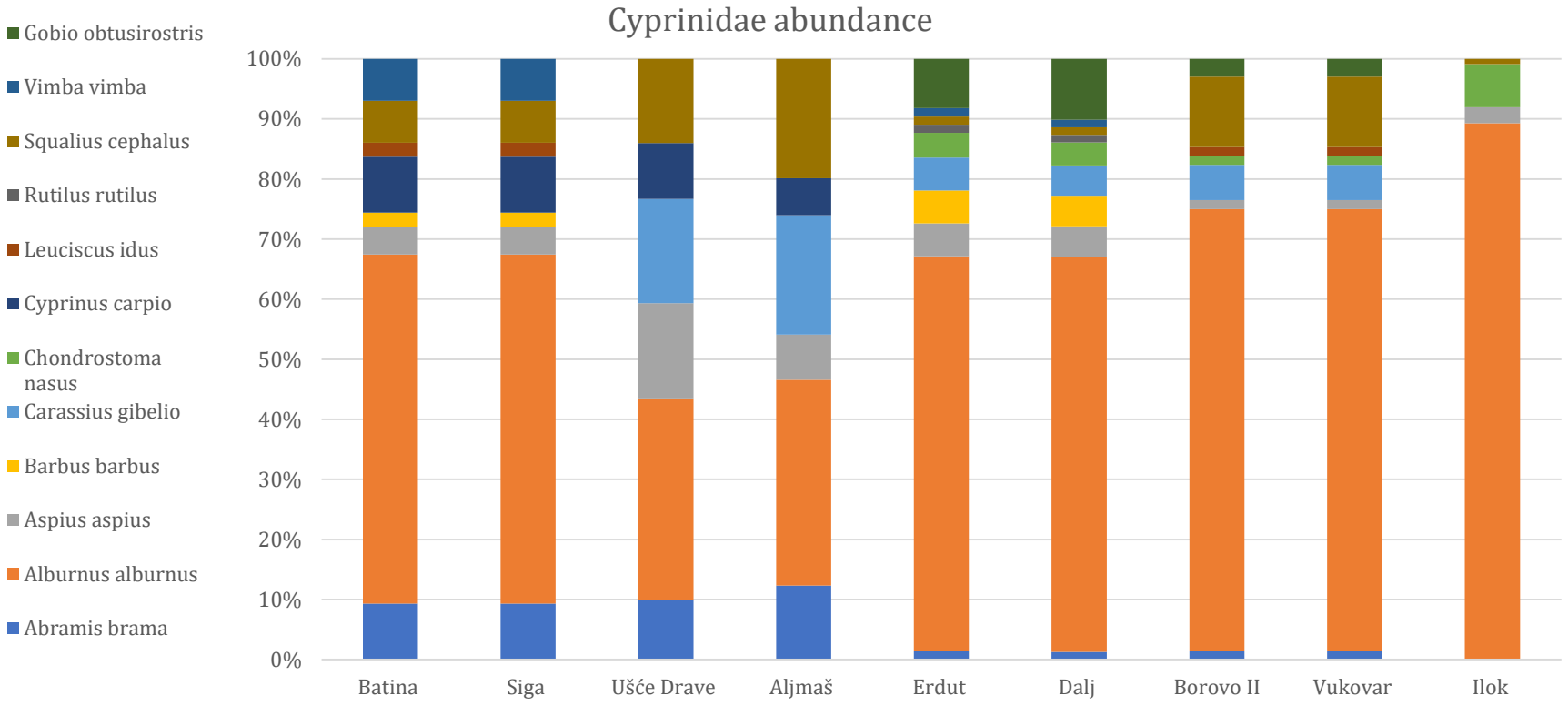
List of all species sampled by now on Croatian side and Serbian side of Danube

Family	Species	Croatian side	Serbian side
Cyprinidae	Abramis brama	*	*
Cyprinidae	Alburnus alburnus	*	*
Cyprinidae	Aspius aspius	*	*
Cyprinidae	Barbus barbus	*	*
Cyprinidae	Carassius gibelio	*	*
Cyprinidae	Chondrostoma nasus	*	*
Cyprinidae	Ctenopharyngodon idella	*	
Cyprinidae	Cyprinus carpio	*	*
Cyprinidae	Gobio obtusirostris	*	
Cyprinidae	Hypophthalmichthys molitrix	*	
Cyprinidae	Leuciscus idus	*	*
Cyprinidae	Rhodeus amarus	*	
Cyprinidae	Romanogobio albipinnatus		*
Cyprinidae	Rutilus rutilus	*	*
Cyprinidae	Rutilus virgo	*	
Cyprinidae	Squalius cephalus	*	*
Cyprinidae	Vimba vimba	*	*
Gobiidae	Babka gymnotrachelus	*	*
Gobiidae	Neogobius fluviatilis	*	*
Gobiidae	Neogobius melanostomus	*	*
Gobiidae	Ponticola kessleri	*	*
Gobiidae	Proterorhinus semilunaris		*
Percidae	Gymnocephalus baloni		*
Percidae	Gymnocephalus cernua		*
Percidae	Gymnocephalus schraetser	*	*
Percidae	Perca fluviatilis	*	*
Percidae	Sander lucioperca	*	*
Percidae	Zingel zingel		*
Ictaluridae	Ameiurus melas	*	
Cobitidae	Cobitis elongata	*	
Cobitidae	Cobitis elongatoides		*
Esocidae	Esox lucius	*	*
Petromyzontidae	Eudontomyzon sp.		*
Petromyzontidae	Eudontomyzon vladykovi	*	
Centrarchidae	Lepomis gibbosus	*	
Centrarchidae	Micropterus salmonides		*
Gadidae	Lota lota	*	*
Siluridae	Silurus glanis	*	*

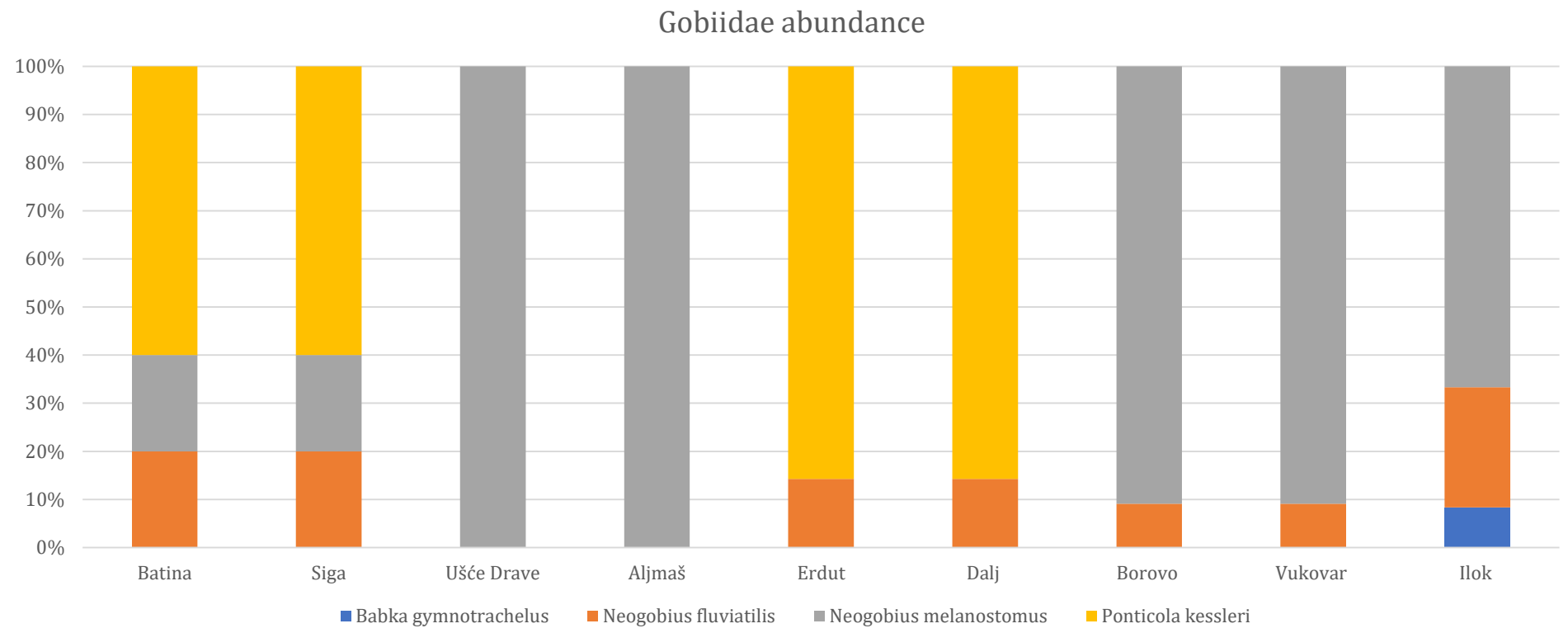
Results of electrofishing during the night



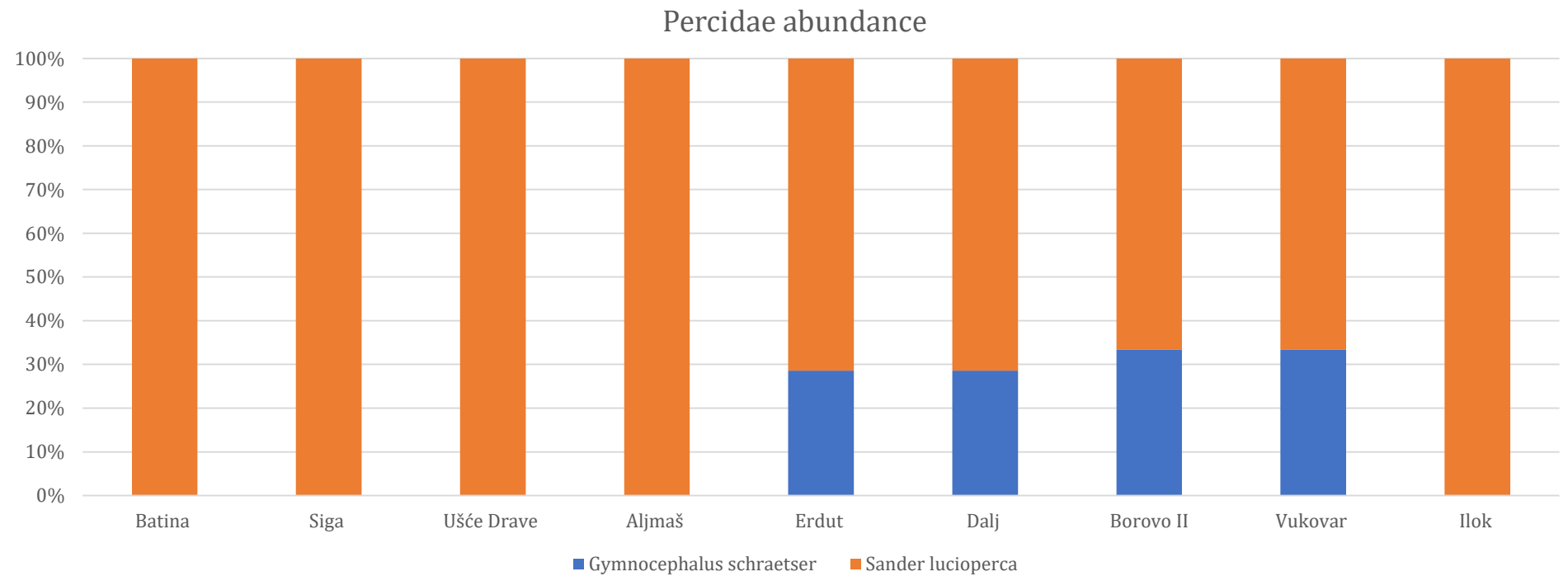
782 ind. of Cyprinidae family were sampled



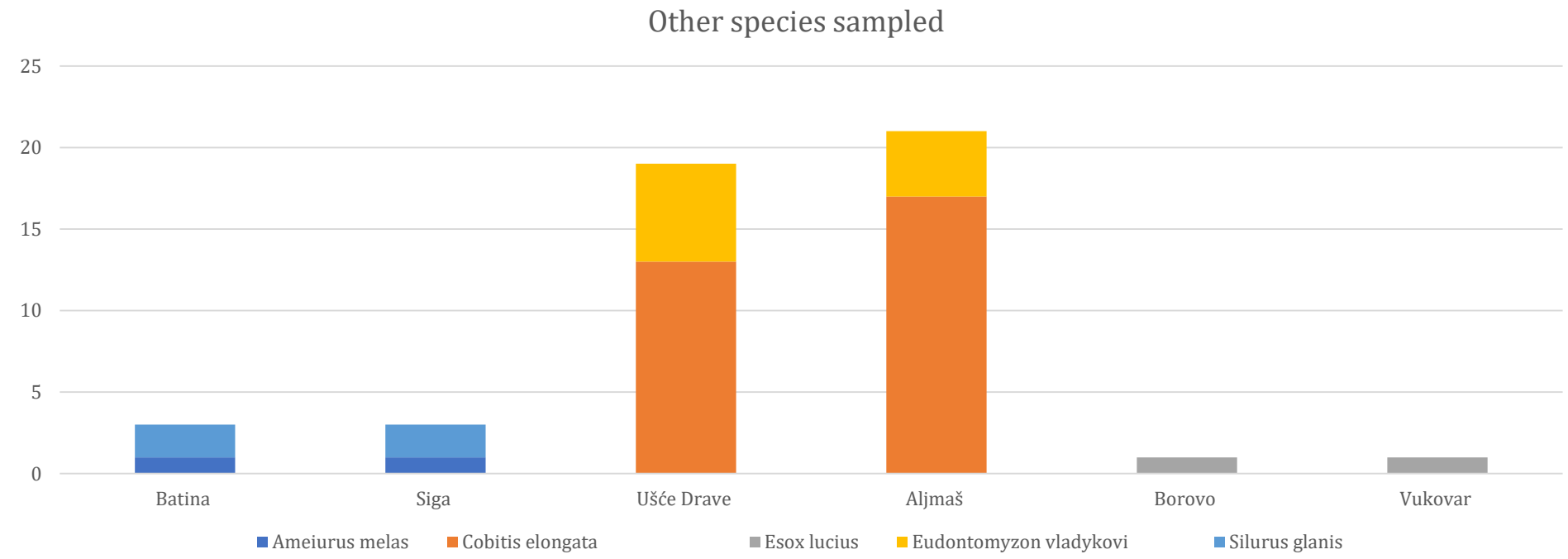
150 ind. of Gobiidae family were sampled



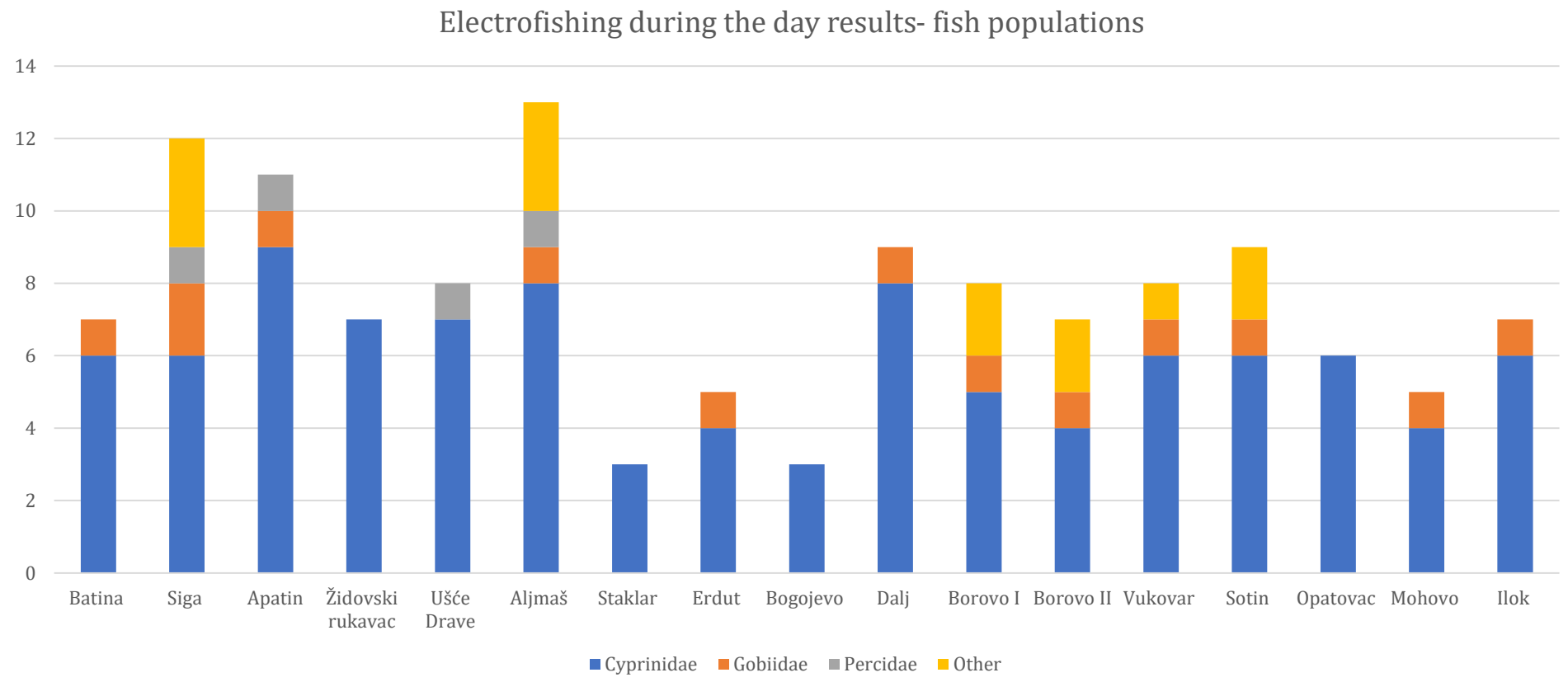
- 125 ind. of Percidae family were sampled



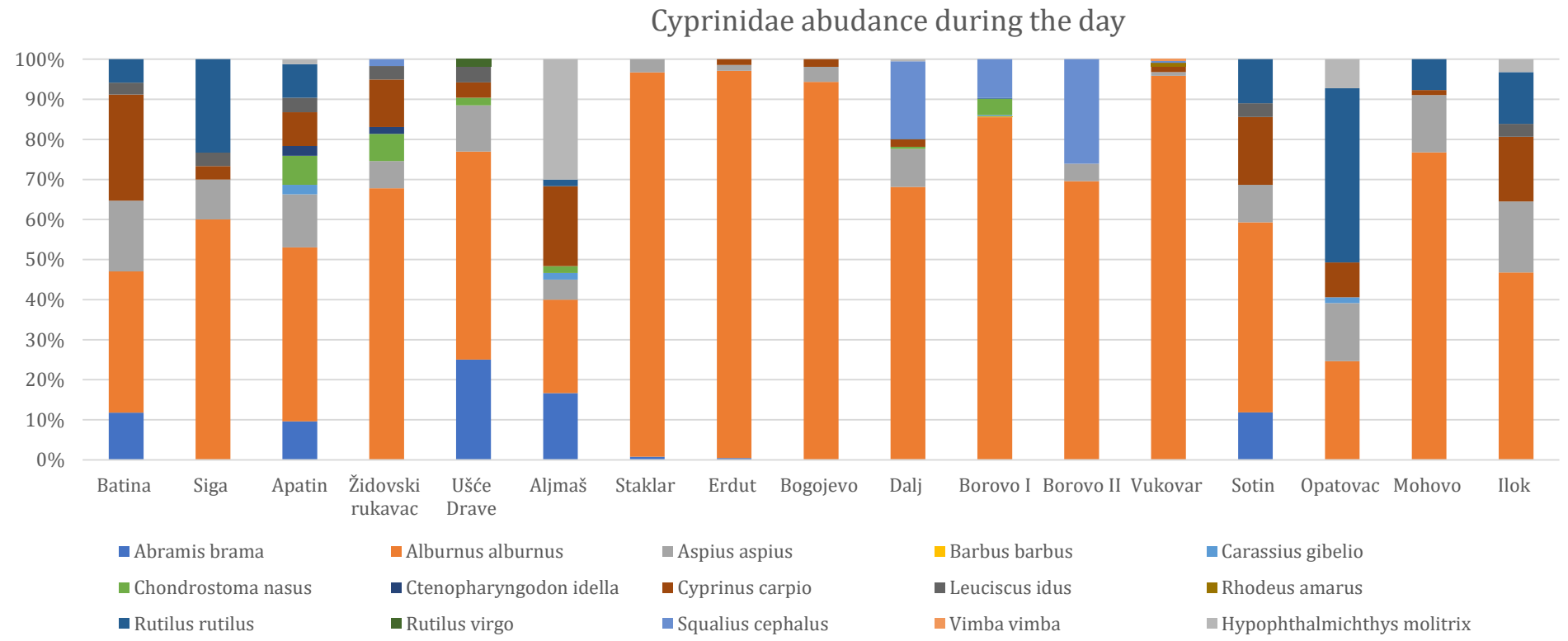
48 ind. of other fish familys were sampled



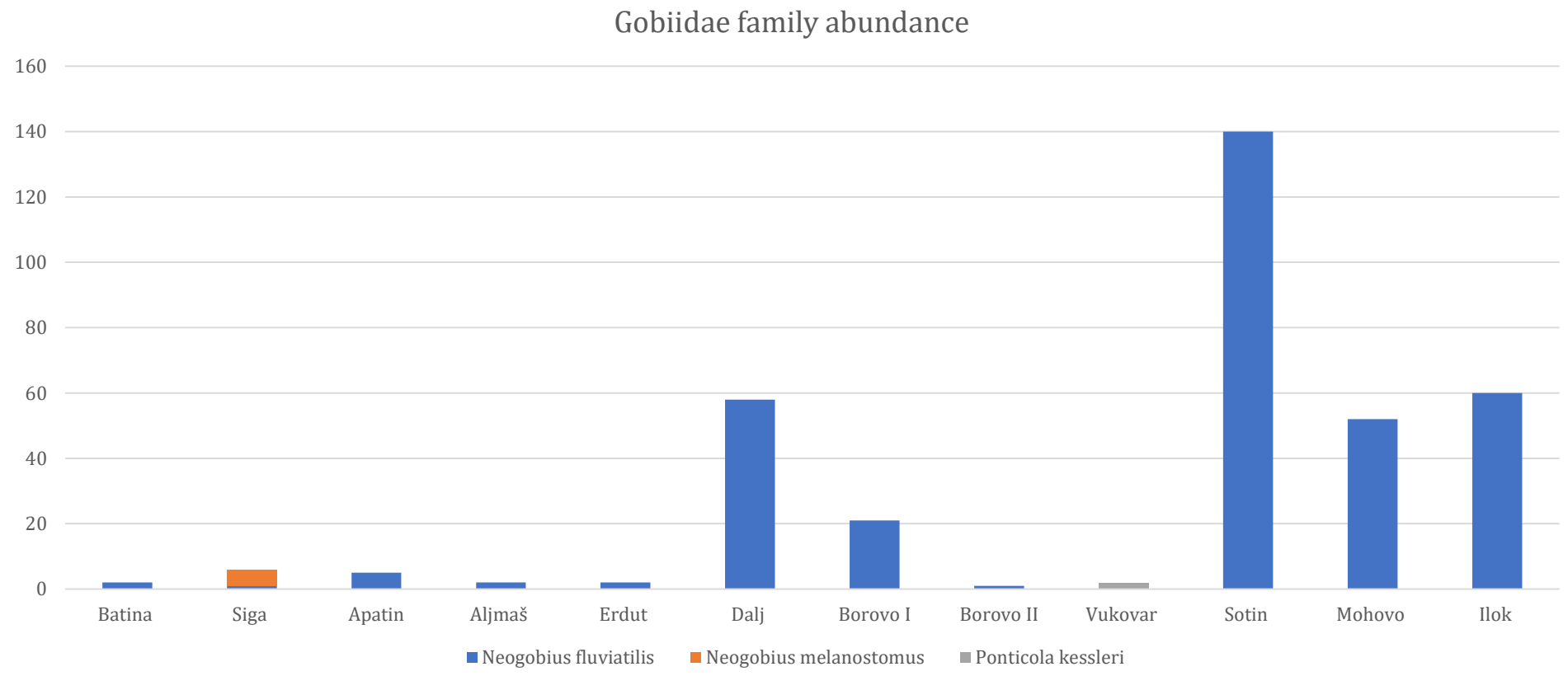
Results of electrofishing during the day



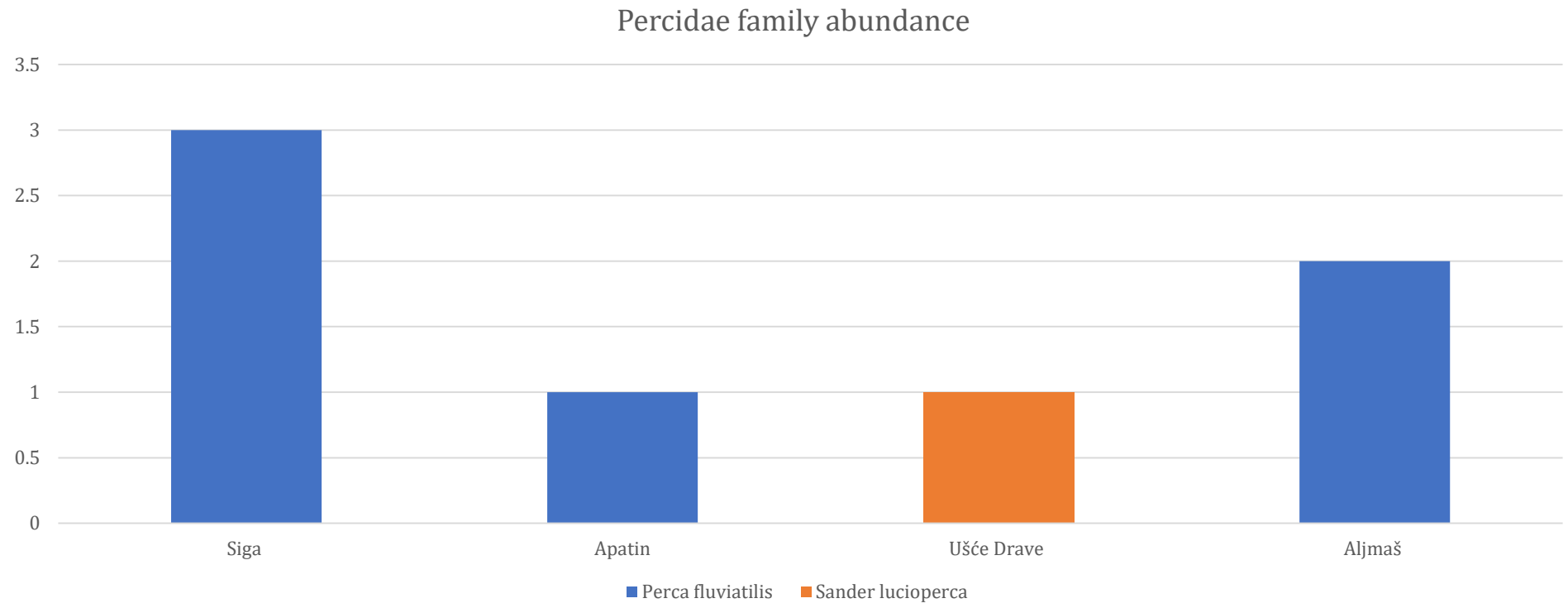
3647 ind. of Cyprinidae family were sampled



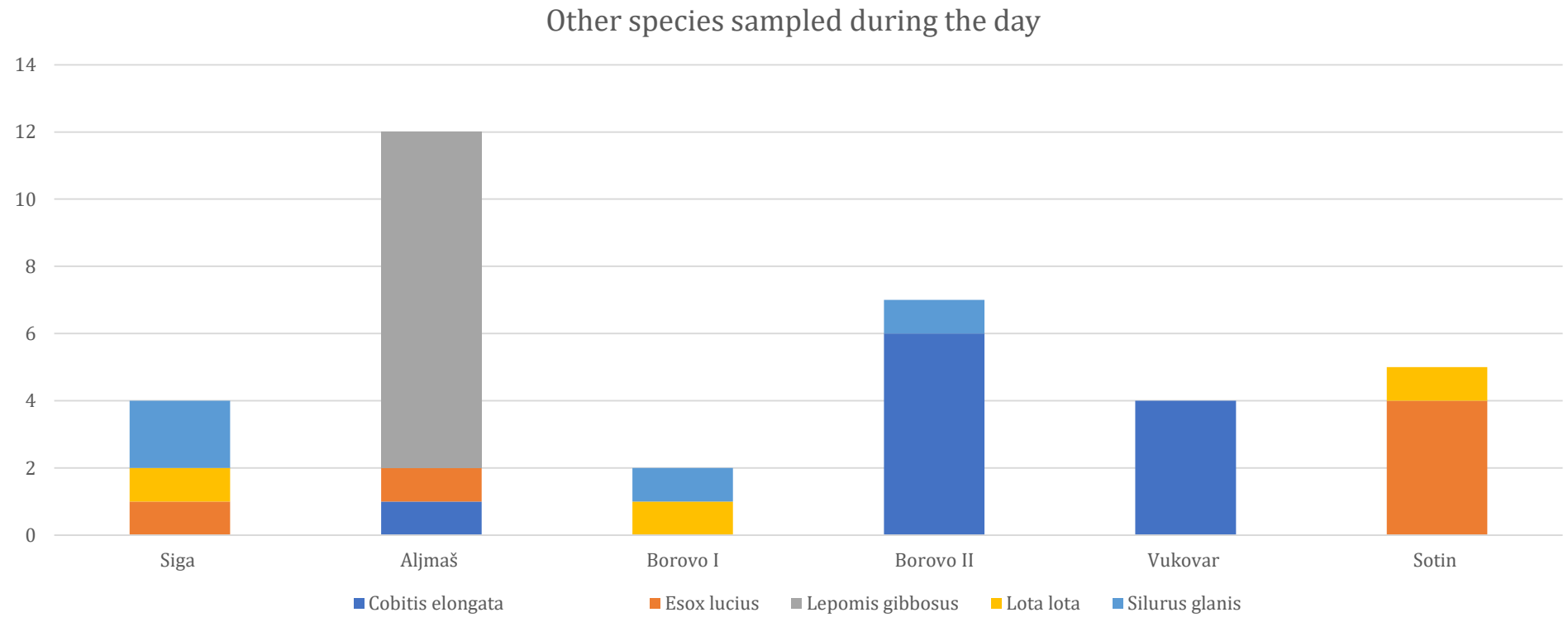
351 ind. of Gobiidae family were sampled



- 7 ind. of Percidae family were sampled



- 34 ind. of other fish familys were sampled



Future actions?

- Electrified dredge (February- March 2024.)
- Monitoring of winter habitats with sonar (December 2023. - February 2024.)

Progress on Serbian side of Danube

- All permits are gathered
- Monitoring of fish (electrofishing): Done
- Data analysis is in progress

2.2 Habitat inventory

Methods

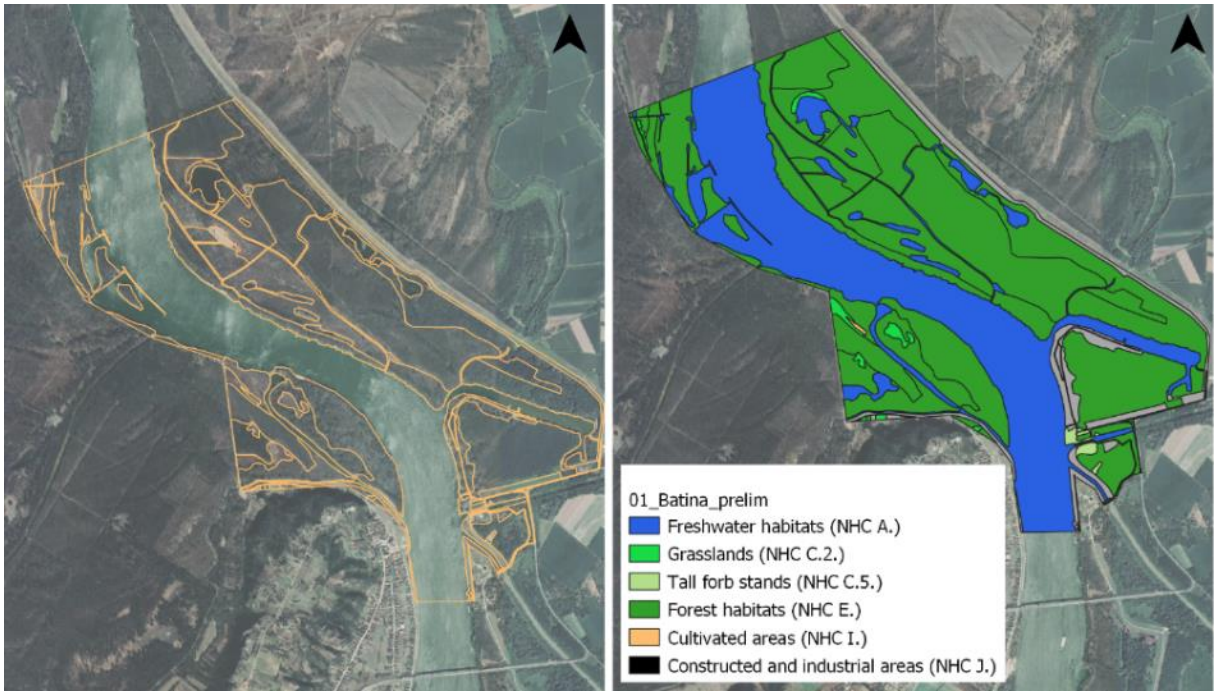
- 17 critical sections on joint Croatian-Serbian part of the Danube
- Mapping of target habitat types of the critical sections in the Danube floodplain
- Final habitat map integrated into GIS database, scale 1:5.000
- Data on target habitat distribution incorporated and presented as part of the Biodiversity Catalogue

Methods

- Field survey - focusing on mapping of 5 target habitat types

1. **One forest habitat type – riparian forests periodically inundated by the annual rise of the river –** 91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
2. **Two habitats occuring on standing water bodies**
   - **Amphibious short annual vegetation, pioneer of land interface zones of standing water bodies** with nutrient poor soils, or which grows during periodic drying of these standing waters – 3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea
   - **Lakes and ponds with free-floating surface communities** or, in deep, open waters, with large pondweeds – 3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition
3. **One habitat type occurring along the shallow muddy banks of the Danube**, with annual pioneer nitrophilous vegetation – 3270 Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation
4. **One habitat belonging to alluvial type of meadows with natural flooding regime –** 6440 Alluvial meadows of river valleys of the Cnidion dubii

- Existing data gathered (habitat maps, available data on other habitat and vegetation surveys conducted in the Danube floodplain
- Preliminary map is (the basis for field survey) is prepared
- Field survey has been completed by the end of vegetation season on both sides of the Danube



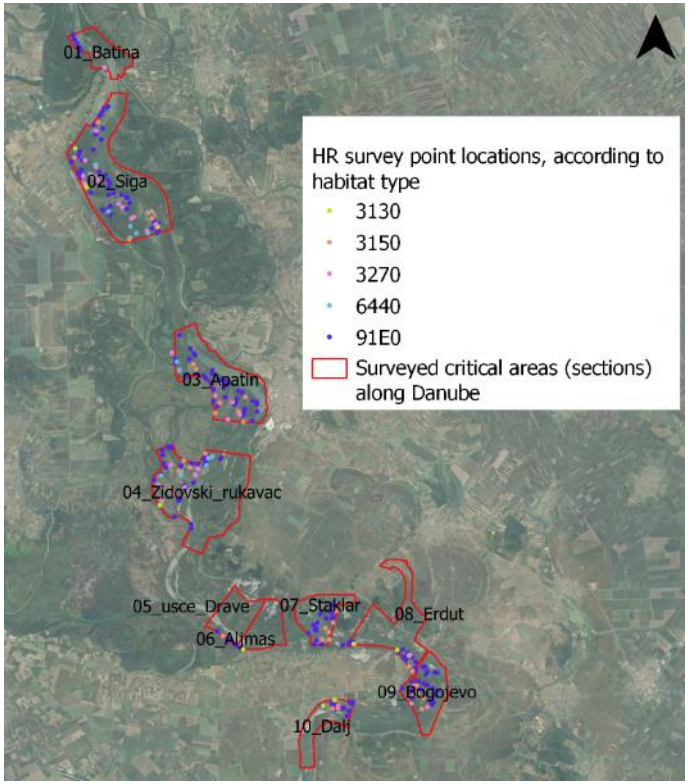
Habitat sampling locations on the Danube (right side)

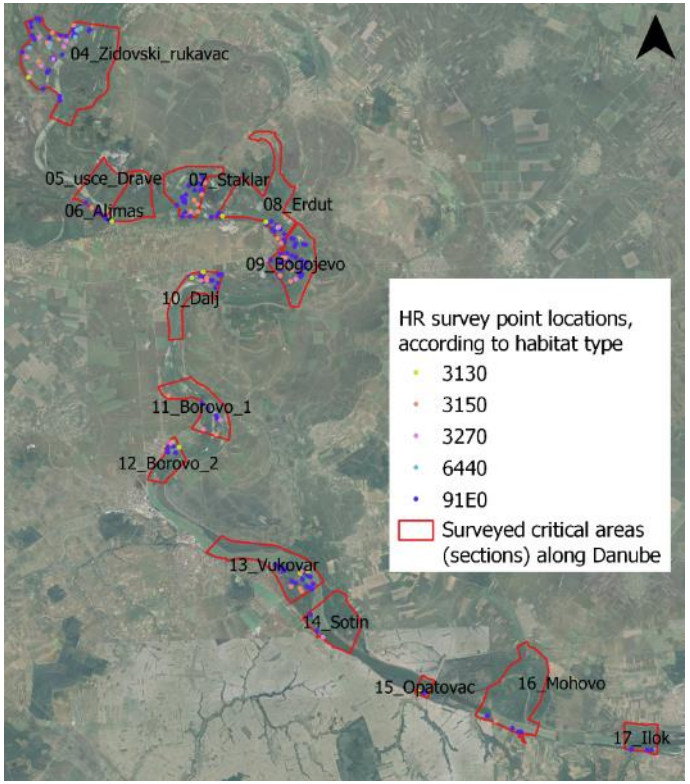
1. Batina
2. Siga
3. Apatin
4. Židovski rukavac
5. Ušće Drave
6. Aljmaš
7. Staklar
8. Erdut
9. Bogojevo
10. Dalj
11. Borovo I
12. Borovo II
13. Vukovar
14. Sotin
15. Opatovac
16. Mohovo
17. Ilok

Right (HR) side of the Danube:

342 sampling locations

223 plant species recorded





Occurence of surveyed habitat types along critical sections of the Danube

Natura 2000 habitat type	Occurence of habitat type																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
91E0* Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea	+	+		+		+		+		+		+	+		+		
3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition- type vegetation	+	+	+	+	+		+	+	+	+	+		+			+	
3270 Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation	+	+	+	+				+	+		+	+		+			

91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)

Preliminary results (HR side)

- Habitat type 91E0 sampled at 224 locations
- Recorded at 179 locations

Natura 2000 habitat type	91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)
Vegetation type or community	/ 91E0 Aluvijalne šume (Alno-Padion, Alnion incanae, Salicion albae) Alliance Salicion albae Soó 1951 Alliance Populion albae Br.-Bl. ex Tchou 1949, sveza Salicion albae Soó 1951 Alliance Alnion incanae Pawłowski et al. 1928 Alliances Alnion incanae Pawłowski et al. 1928 & Alnion glutinosae Malcuit 1929
Status (EU legislation)	Annex I. HD
Status (national legislation)	listed as rare and endangered habitat type (Annex III, Ordinance – RC OG 027/2021)

91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)

Occurence of plant species typical for the habitat type

Latin name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Salix alba	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Populus nigra	+	+	+	+		+	+	+	+	+	+		+			+	+
Fraxinus excelsior		+															
Salix fragilis		+															
Populus alba		+	+	+		+	+	+	+	+	+	+	+		+		+
Fraxinus angustifolia	+	+	+	+	+	+			+	+			+		+		
Prunus padus	+	+	+					+	+				+				
Viburnum opulus		+								+	+	+					
Salix purpurea	+	+		+				+		+			+		+		
Rubus caesius	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cornus sanguinea	+	+	+	+			+	+	+	+	+				+	+	+
Humulus lupulus		+						+	+	+							+
Lycopus europaeus	+	+	+					+			+		+	+			
Lysimachia vulgaris		+	+	+													
Carex remota		+	+	+			+			+							
Solanum dulcamara	+	+	+	+				+	+			+	+	+			
Carex elongata		+	+	+					+								
Lythrum salicaria		+	+	+		+			+			+					
Iris pseudacorus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Mentha aquatica		+		+							+						
Urtica dioica	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Polygonum hydropiper	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Carex elata	+	+	+		+	+	+	+	+	+	+		+		+		
Carex riparia	+	+	+	+		+	+	+	+	+	+	+	+				
Stachys palustris	+	+	+						+	+	+		+	+		+	
Galium palustre	+	+	+	+		+		+	+	+			+		+	+	
Carex brizoides	+	+	+	+			+	+	+	+			+				+
Stellaria nemorum		+							+								
Alisma plantago-aquatica								+								+	

3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea

Preliminary results (HR side)

- Habitat type 3130 observed on all sampled locations (20)

3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea

Occurence of plant species typical for the habitat type

Latin name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Lindernia dubia	+	+		+		+		+		+			+				
Eleocharis acicularis				+													
Cyperus fuscus	+	+						+		+	+		+		+		
Cyperus michelianus	+	+	+	+		+		+		+	+		+		+		
Lythrum portula	+	+		+				+									
Marsilea quadrifolia												+					

3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition

Preliminary results (HR side)

- 47 locations sampled
- Habitat type 3150 recorded on 44 locations

3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition

Occurence of plant species typical for the habitat type

Latin name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Lemna spp	+	+	+	+	+		+	+	+	+	+		+			+	
Spirodela polyrhiza	+	+	+	+	+		+	+	+	+	+		+			+	
Utricularia vulgaris			+						+								
Azolla filiculoides		+	+				+	+		+			+				
Potamogeton lucens									+	+							
Salvinia natans	+	+	+	+	+		+	+	+	+	+		+				

3270 Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation

Preliminary results (HR side)

- Habitat type 3270 sampled on 36 locations – recorded at 24

3270 Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation

Occurence of plant species typical for the habitat type

Latin name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Chenopodium rubrum	+							+		+	+		+		+		
Bidens frondosa	+	+	+	+		+		+			+		+				
Bidens tripartitus	+	+	+	+	+	+		+	+	+		+	+	+	+	+	
Polygonum lapathifolium	+	+	+					+			+	+					
Polygonum hydropiper	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Potentilla supina		+	+														
Xanthium sp		+	+					+			+	+					

6440 Alluvial meadows of river valleys of the Cnidion dubii

Preliminary results (HR side)

- Habitat type sampled on 15 locations
- Only 2 sampling locations – elements of the habitat type present

Plant species

- Total 223 plant species recorded (HR side)
- 8 strictly protected in Croatia
- Several endangered (one CR, one EN, three are sensitive – VU)

Plant species

Marsilea quadrifolia

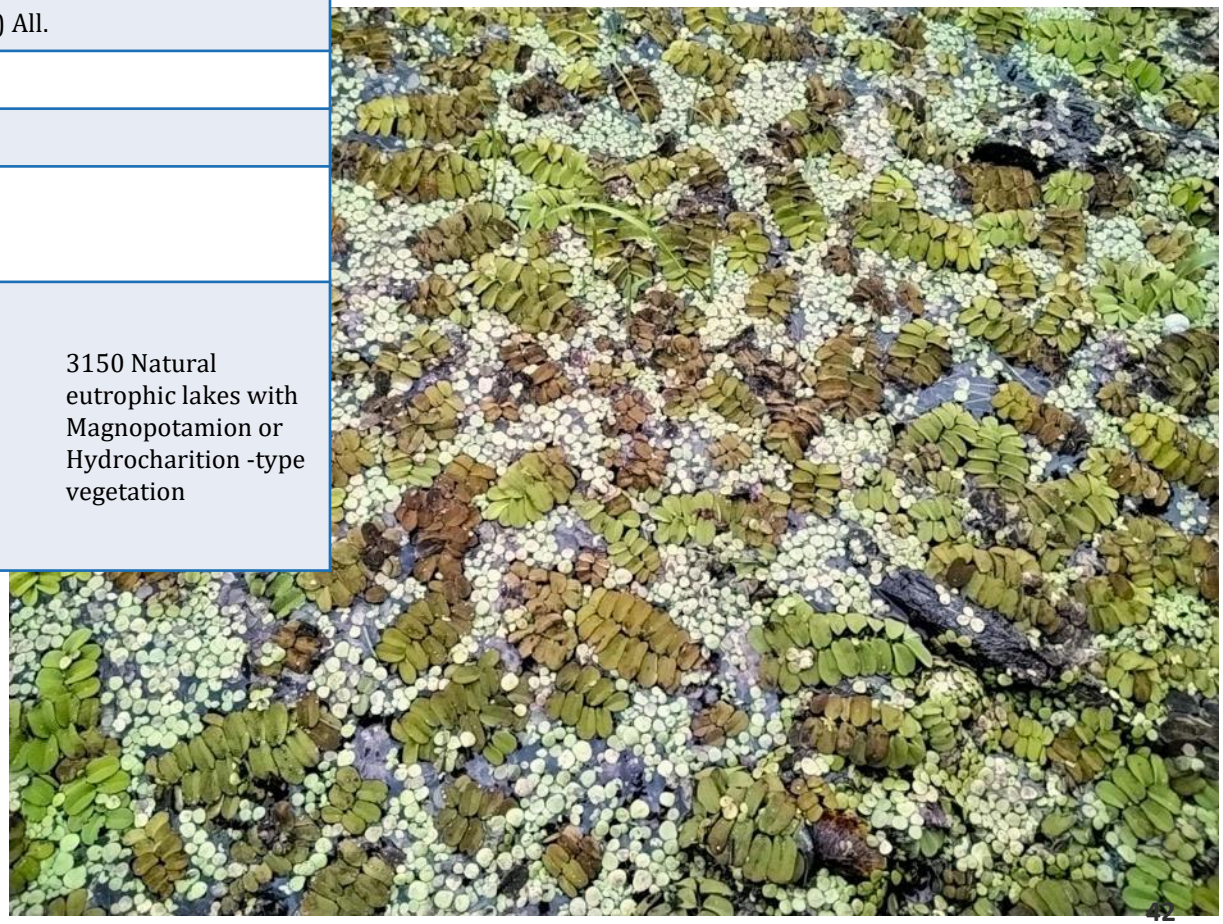
Target species for Natura 2000 site HR2000394 Kopački rit

Species name	Water clover	
Latin name	Marsilea quadrifolia L.	
Status (global)	LC	
Status (HR)	EN	
Protection (EU Directives, Conventions)	Annex II. (HD)	Annex I. (BC)
Habitat type(s) most preferred in project area	The edge of water bodies and land, along shallow lakes and ponds.	3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea

Plant species

Salvinia natans

Species name	Floating fern	
Latin name	Salvinia natans (L.) All.	
Status (global)	LC	
Status (HR)	NT	
Protection (EU Directives, Conventions)	Annex I. (BC)	
Habitat type(s) most preferred in project area	The edge of water bodies, stagnant waters	3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition -type vegetation



Plant species

Polygonum arenarium

Species name	Water clover
Latin name	Polygonum arenarium Waldst. & Kit.
Status (global)	Not evaluated
Status (HR)	CR
Protection (EU Directives, Conventions)	- -
Habitat type(s) most preferred in project area	Continental sand habitats -

Plant species

- 36 species – alien or invasive alien species

Amorpha fruticosa - false indigo bush

Latin name	Common name (HR)
Abutilon theophrasti	Teofrastov mračnjak
Acer negundo	perastolistni javor
Ailanthus altissima	žljezdasti pajasen
Amaranthus blitoides	zapadnoamerički šćir
Amaranthus retroflexus	oštrodlakavi šćir
Ambrosia artemisiifolia	pelinolisni limundžik
Amorpha fruticosa	grmasta amorfa
Artemisia dracunculus	estragonski pelin
Asclepias syriaca	prava svilenica
Aster novi-belgii	novobelgijski zvjezdan
Azolla filiculoides	pacifička azola
Bidens frondosa	listnati dvozub
Capsella bursa-pastoris	obična rusomača
Carpesium abrotanoides	šumski vratnjak
Conyza canadensis	kanadska grmika
Datura stramonium	bijeli kužnjak
Echinocystis lobata	uljna bučica
Erigeron annuus	jednogodišnja hudoljetnica
Fraxinus americana	američki jasen
Galinsoga parviflora	trepavičava konica
Impatiens glandulifera	žljezdasti nedirak
Impatiens parviflora	sitnocvjetni nedirak
Juglans nigra	crni orah
Juglans regia	obični orah
Juncus tenuis	nježni sit
Morus alba	bijeli dud
Oxalis fontana	europski cecelj
Panicum dichotomiflorum	kasni proso
Parthenocissus quinquefolia	petolisna lozika
Phytolacca americana	američki kermes
Platanus x acerifolia	londonska platana
Populus x canadensis	kanadska topola
Portulaca oleracea	povrtni tušanj
Prunus dulcis	badem
Solidago canadensis	gustocvjetna zlatnica
Solidago gigantea	velika zlatnica

Future actions?

- Processing of data from the Serbian side (integration in internal Oikon's database) (Q1 2024)
- Preparation of final habitat map (Q2 2024)
- Biodiversity Catalogue

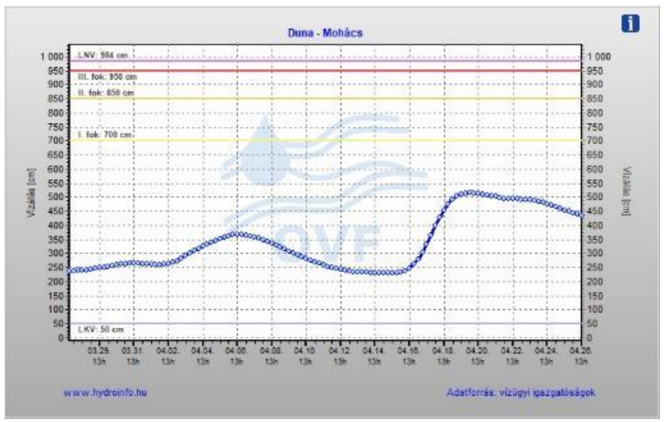
2.3 Bird fauna inventory

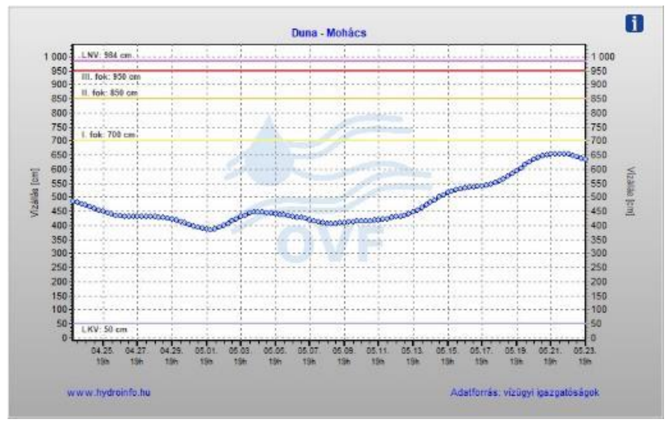
- All planned activities carried out
- Breeding birds of Danube islands and sand bars (May-July)
- Breeding birds of Danube steep banks (May-July)
- Wetlands birds in Danube floodplain (17 sub-sites)
  - colonial waterbirds (April-July)
  - marshland breeding birds (April-July)
  - raptors (February-July)
- Migratory birds along the Danube – (March-May; September-November)
- Wintering birds along the Danube – December-February 2022/2023

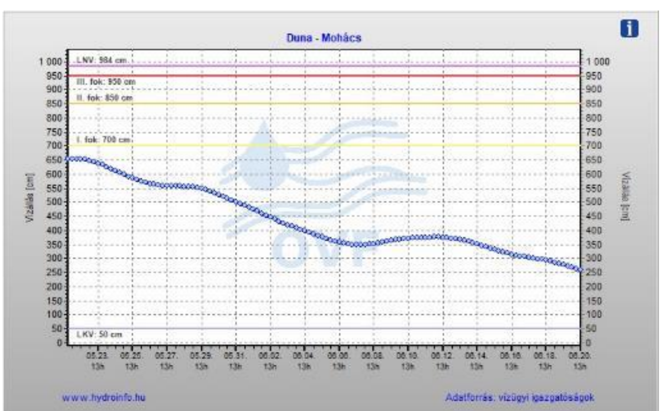
3.2.2.3	Inventarizacija ptica	Predviđeno trajanje	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
3.2.2.3.1	**Istraživanje sprudova**	**5**																		
3.2.2.3.2	**Istraživanje strmih dijelova obala**	**5**																		
3.2.2.3.3	**Istraživanje bara i močvara**	**12**																		
	Istraživanje bara i močvara - kolonijalne gnjezdarice	7																		
	Istraživanje bara i močvara - grabljivice	9																		
	Istraživanje bara i močvara - močvarice gnjezdarice	7																		
3.2.2.3.4	**Monitoring ptica tijekom proljetne i jesenske seobe te zimovanja**	**13**																		
3.2.2.3.5	**Dodatni nesustavni i usputni obilasci terena**	**18**																		

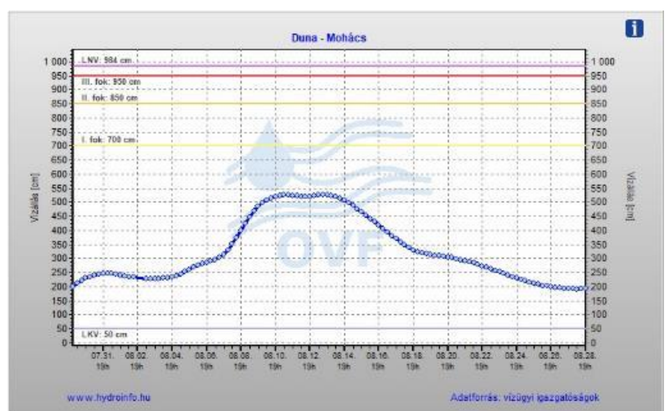
Bird fauna inventory

- Breeding season characterised with high water levels
  - Mid-April to early June
  - Mid-August (9.-17.08)
  - Beginning of September (01.-08.09)







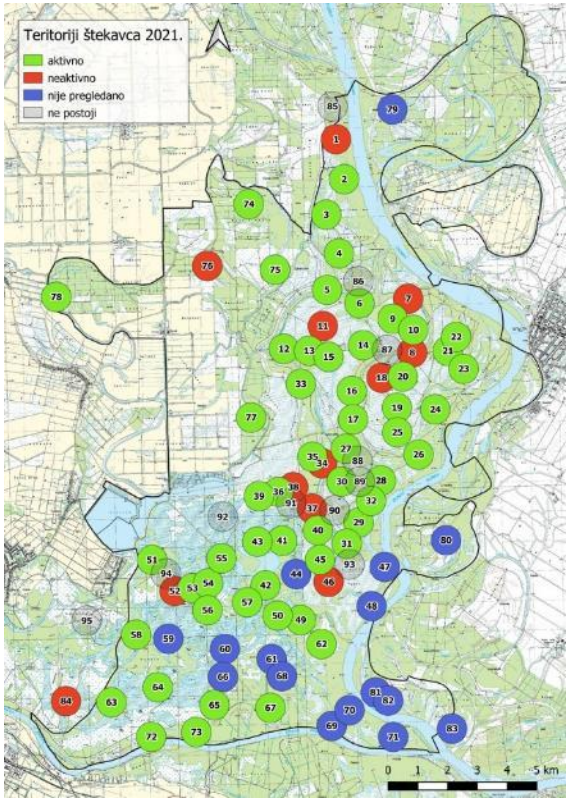


White-tailed Eagle, *Haliaeetus albicilla*

- Largest raptor in the area
- Core area of the Mura-Drava-Danube Biosphere reserve along Danube River – most important nesting place in Pannonian plain = 150+ pairs
- Main requirements:
  - large, old trees for nest support
  - extensive active alluvial floodplains with large food supply
  - sites without disturbance, particularly during breeding season
- Population trend along Danube: increasing (Mikuska et al. 2022)

Methods

- Territory mapping of breeding pairs based on previous studies (Naturavita, Wetland Restore, LIFEline MDD projects, monitoring data from Gornje Podunavlje + own research)
- Monthly counts along the river to observe key feeding areas



White-tailed eagle breeding population size (pairs) along the Danube

Critical sector	Rkm	within critical sector	active floodplain	former floodplain	potential pairs	**Total pairs**
1 Batina	1433-1424	1	1	3	1	**6**
2 Siga	1424-1412	2	1	2	4	**9**
3 Apatin	1412-1399	**3**	**14**	1	1	**19**
4 Židovski dunavac	1399-1389	**10**	**20**	1	4	**35**
5 Ušće Drave	1389-1382	**9**	**18**	0	4	**31**
6 Aljmaš	1382-1378	2	0	0	1	**3**
7 Staklara	1378-1370	1	2	0	1	**4**
8 Erdut	1370-1366	4	0	0	0	**4**
9 Bogojevo	1366-1360	1	0	0	1	**2**
10 Dalj	1360-1351	0	1	0	0	**1**
11 Borovo 1	1351-1340	2	0	0	0	**2**
12 Borovo 2	1340-1334	0	0	0	0	**0**
13 Vukovar	1334-1322	1	1	0	0	**2**
14 Sotin	1322-1319	0	0	0	0	**0**
15 Opatovac	1319-1313	0	1	0	0	**1**
16 Mohovo	1313-1307	2	2	0	0	**4**
17 Ilok	1307-1296	0	0	0	0	**0**
Total		**38**	**61**	**7**	**17**	**123**

Take-home message: larger active floodplain supports higher number of breeding pairs

Black Kite, *Milvus migrans*

- Breeding in Europe, wintering in sub-Saharan Africa
- Habitat requirements:
  - Large river floodplains with fragmented woodland or scattered trees
  - Livestock rearing pastures or low-elevation farmlands
- Population trend along Danube: stable (Haraszty et al. 2021); decreasing in Kopacki rit NP (Mikuska, *unpubl.*)
- Main threats:
  - Loss of habitats, particularly livestock pastures
  - Intensive agriculture and related pesticide contamination
  - Poisoning related to rodent/jackal poisoning
  - Electrocution and collision with power lines
  - Collision with wind turbines

Methods

- Territory mapping of breeding pairs based on observations of birds during breeding season (May-July)
- Monthly counts along the river to observe key feeding areas

Black kite potential breeding population size (pairs) along the Danube

Critical sector	Rkm	within critical sector	active floodplain	former floodplain	**Total**
1 Batina	1433-1424	1	0	2	**3**
2 Siga	1424-1412	0	0	2	**2**
3 Apatin	1412-1399	**2**	**1**	2	**5**
4 Židovski dunavac	1399-1389	**3**	0	0	**3**
5 Ušće Drave	1389-1382	**3**	0	0	**3**
6 Aljmaš	1382-1378	0	1	0	**1**
7 Staklara	1378-1370	1	0	0	**1**
8 Erdut	1370-1366	1	0	0	**1**
9 Bogojevo	1366-1360	1	0	0	**1**
10 Dalj	1360-1351	**2**	1	0	**3**
11 Borovo 1	1351-1340	**1**	2	0	**3**
12 Borovo 2	1340-1334	0	1	0	**1**
13 Vukovar	1334-1322	1	1	0	**2**
14 Sotin	1322-1319	0	0	0	**0**
15 Opatovac	1319-1313	0	1	0	**1**
16 Mohovo	1313-1307	0	0	0	**0**
17 Ilok	1307-1296	0	1	0	**1**
Total		**16**	**9**	**6**	**31**

Take-home message: old alluvial forests near wet meadows critical for protection of this species

Sand Martin, *Riparia riparia*

- Small swallow breeding in colonies in steep sandy banks along the river or sand pits in the former floodplain
- Indicator of good hydro-morphological status of the river (freely meandering parts with newly annually eroded banks)
- Population trend along Danube: uncertain (Podgorelec et al. 2022)
- Population trend along MDD Biosphere Reserve: **decreasing** (Podgorelec et al. 2022)

Methods

- mapping of existing and former colonies along the river (May-July) and estimating breeding population size
- data supplemented with previous studies made during INTERREG lifelineMDD project (Radišić 2022; Grlica 2022; Podgorelec et al. 2022)
- breeding season 2023 negatively affected by floods during nesting period
- since mid-May low-laying river banks flooded = flooding and abandonment of colonies

Number of Sand Martin colonies and breeding pairs along the Danube

Critical sector	Rkm	Active colonies	Former nesting sites	Estimated breeding pairs	**Total nesting sites**
1 Batina	1433-1424	**0**	1	0	**1**
2 Siga	1424-1412	**0**	1	0	**1**
3 Apatin	1412-1399	**0**	4	0	**4**
4 Židovski dunavac	1399-1389	**0**	0	0	**0**
5 Ušće Drave	1389-1382	**0**	1	0	**1**
6 Aljmaš	1382-1378	**0**	0	0	**0**
7 Staklara	1378-1370	**0**	1	0	**1**
8 Erdut	1370-1366	**0**	2	0	**2**
9 Bogojevo	1366-1360	1	1	20-30	**2**
10 Dalj	1360-1351	0	1	0	**1**
11 Borovo 1	1351-1340	1 (+1)	4	15-20	**5 + (1)**
12 Borovo 2	1340-1334	0	0	0	**0**
13 Vukovar	1334-1322	1	2	3-6	**3**
14 Sotin	1322-1319	0	0	0	**0**
15 Opatovac	1319-1313	0	0	0	**0**
16 Mohovo	1313-1307	1	1	180-200	**2**
17 Ilok	1307-1296	(1)	0	6-10	**(1)**
Total		**4 + (2)**	**19**	**224-266**	**23 + (2)**

Main threats

- River regulation and river training infrastructure construction
  - colony at 1345 rkm (left bank) destroyed in 2023 by embankment construction
  - destroyed colonies from Dalj to Borovo (1346 rkm, right bank) by embankment construction
- Intensive pesticide spraying during mosquito control (along settlements and towns) = decrease of food source
- Seasonal drought in the breeding areas (e.g., 2022) = decrease of food source
- Conditions on wintering sites (sub-Saharan Africa) affect breeding population size (large annual fluctuations)
- **Take-home message: remaining steep banks critical for survival of this species in the area**

1345 rkm

1346 rkm

Kingfisher, *Alcedo atthis*

- Solitary and territorial breeder in steep sandy banks along the river or side-arms and channels
- Indicator of good hydro-morphological status of the river (freely meandering parts with eroded banks)
- Dependent on open waters with plenty of small fish for feeding and overhanging bank vegetation
- Population trend along Danube: unknown (Podgorelec et al. 2022)
- Population trend along MDD Biosphere Reserve: **increasing** (Podgorelec et al. 2022)

Methods

- mapping of nesting holes along the river (July) and estimating potential breeding territories, side-arms not properly covered – more breeding territories expected
- data supplemented with previous studies made during INTERREG lifelineMDD project (Radišić 2022; Grlica 2022; Podgorelec et al. 2022)
- breeding season 2023 negatively affected by floods during nesting period
- since mid-May low-laying river banks flooded = flooding and abandonment of colonies

Number of Kingfisher potential breeding territories along the Danube

Critical sector	Rkm	Within critical site	Active floodplain	**Total breeding territories**
1 Batina	1433-1424	**6**	2	**8**
2 Siga	1424-1412	**6**	9	**15**
3 Apatin	1412-1399	**18**	1	**19**
4 Židovski dunavac	1399-1389	**8**	1	**9**
5 Ušće Drave	1389-1382	**8**	0	**8**
6 Aljmaš	1382-1378	1	0	**1**
7 Staklara	1378-1370	**5**	4	**9**
8 Erdut	1370-1366	**7**	0	**7**
9 Bogojevo	1366-1360	1	2	**3**
10 Dalj	1360-1351	2	0	**2**
11 Borovo 1	1351-1340	**7**	6	**13**
12 Borovo 2	1340-1334	1	1	**2**
13 Vukovar	1334-1322	**9**	0	**9**
14 Sotin	1322-1319	3	0	**3**
15 Opatovac	1319-1313	0	0	**0**
16 Mohovo	1313-1307	4	0	**4**
17 Ilok	1307-1296	2	1	**3**
Total		**88**	**27**	**115**

Main threats

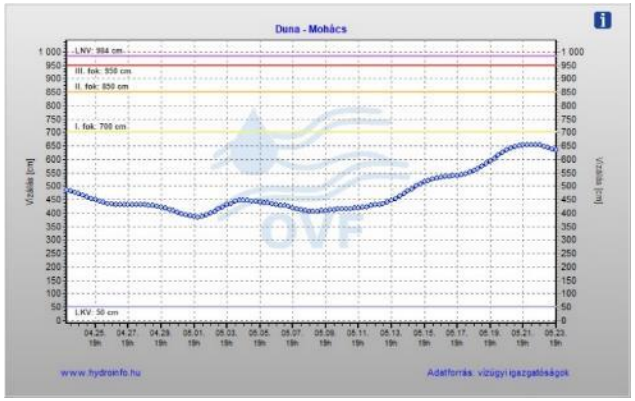
- Canalization of streams and construction of river training infrastructure
- Removal of overhanging vegetation along the banks
- Chemical pollution of waters
- Severe winter can cause population crash
- **Take-home message: no net loss of steep banks in order to secure breeding population**

Little-ringed Plover, *Charadrius dubius*

- Small breeding plover associated with gravel and sand bars along rivers, breeds singly or in loose neighbourhood groups spaced 7-200 m apart
- Fully migratory, winters in tropical Africa
- Breeding habitat requirements:
  - bare or sparsely vegetated sandy islands with shallow standing freshwater pools, lakes or slow-flowing rivers
  - May use temporary artificial habitats: gravel pits, industrial wastelands, open arable land when flooded for prolonged time
  - Avoids islands/banks with tall or dense vegetation
- Population trend along Danube: unknown (Podgorelec et al. 2022)
- Population trend along MDD Biosphere Reserve: **uncertain** (Podgorelec et al. 2022)

Methods

- mapping of adult birds along the river (July) and estimating potential breeding territories
- data supplemented with previous studies made during INTERREG lifelineMDD project (Radišić 2022; Grlica 2022; Podgorelec et al. 2022)
- breeding season 2023 negatively affected by floods during nesting period
  - spring 2023 defined with rain and elevated water levels
  - since April and mid-May all available sand islands fully flooded, emerged during late June
- flooding and abandonment of nesting sites



Number of Little-ringed Plover potential breeding territories along the Danube

Critical sector	Rkm	Within critical site	Active floodplain	**Total breeding territories**
1 Batina	1433-1424	0	0	**0**
2 Siga	1424-1412	1	1	**2**
3 Apatin	1412-1399	0	0	**0**
4 Židovski dunavac	1399-1389	1	0	**1**
5 Ušće Drave	1389-1382	0	0	**0**
6 Aljmaš	1382-1378	0	0	**0**
7 Staklara	1378-1370	2	0	**2**
8 Erdut	1370-1366	0	0	**0**
9 Bogojevo	1366-1360	0	0	**0**
10 Dalj	1360-1351	1	0	**1**
11 Borovo 1	1351-1340	1	0	**1**
12 Borovo 2	1340-1334	0	0	**0**
13 Vukovar	1334-1322	0	0	**0**
14 Sotin	1322-1319	0	1	**1**
15 Opatovac	1319-1313	0	0	**0**
16 Mohovo	1313-1307	0	0	**0**
17 Ilok	1307-1296	0	0	**0**
Total		**6**	**2**	**8**

Main threats

- Canalization of rivers and dredging of existing sand islands/sand bars (incl. sand exploitation for construction purposes)
- Human disturbance during breeding season (leisure, swimming, angling, dog walking)
- Chemical pollution of waters
- **Take-home message: very few remaining sand bars/islands vital for the survival and conservation of this species along the joint HR/SR section**

Colonial waterbirds

- Mixed species colonies of herons and cormorants
- Single species colonies of terns
- Breeding requirements
  - Secure place without disturbance to breed
  - Access to feeding places with rich food source
- No tern colonies recorded during 2021-2023 period on the Danube (breeding on sand islands prevented by floods)
- All active heron and cormorant colonies located in former floodplain, either in oxbows, side-channels or on the fishponds

Methods

- mapping of colonies based on previous studies (Naturavita, Wetland Restore, LIFEline MDD projects, literature data + own research)
- Monthly counts along the river to observe key feeding areas
- Colonies in Croatia additionally photographed using drone and number of nesting pairs counted from the photographs

Results

- 16 heron/cormorant colonies located along the Croatian-Serbian joint section of the Danube
- Only one (Sakadas lake) situated in the active floodplain (Great cormorant/Grey heron)
- 2 breeding species of cormorants (*Phalacrocorax carbo, Microcarbo pygmeus*)
- 7 breeding species of herons (*Ardea cinerea, A. alba, A. purpurea, Egretta garzetta, Ardeola ralloides, Nycticorax nycticorax, Bubulcus ibis*)
- Birds from the colonies forage in the floodplains up to 10 km from the colonies

Threats

- Destruction of breeding habitats (incl. draining the fishponds or oxbows)
- Lack of water bellow colony at the beginning of breeding season
- Seasonal drought = decrease of foraging area and prey base (e.g., 2022)
- Disturbance on foraging grounds (sport angling, leisure activities)
- **Take-home message: navigation projects must not cause river bed deepening or disconnection between river and its floodplain**

2.4 River benthos type inventory

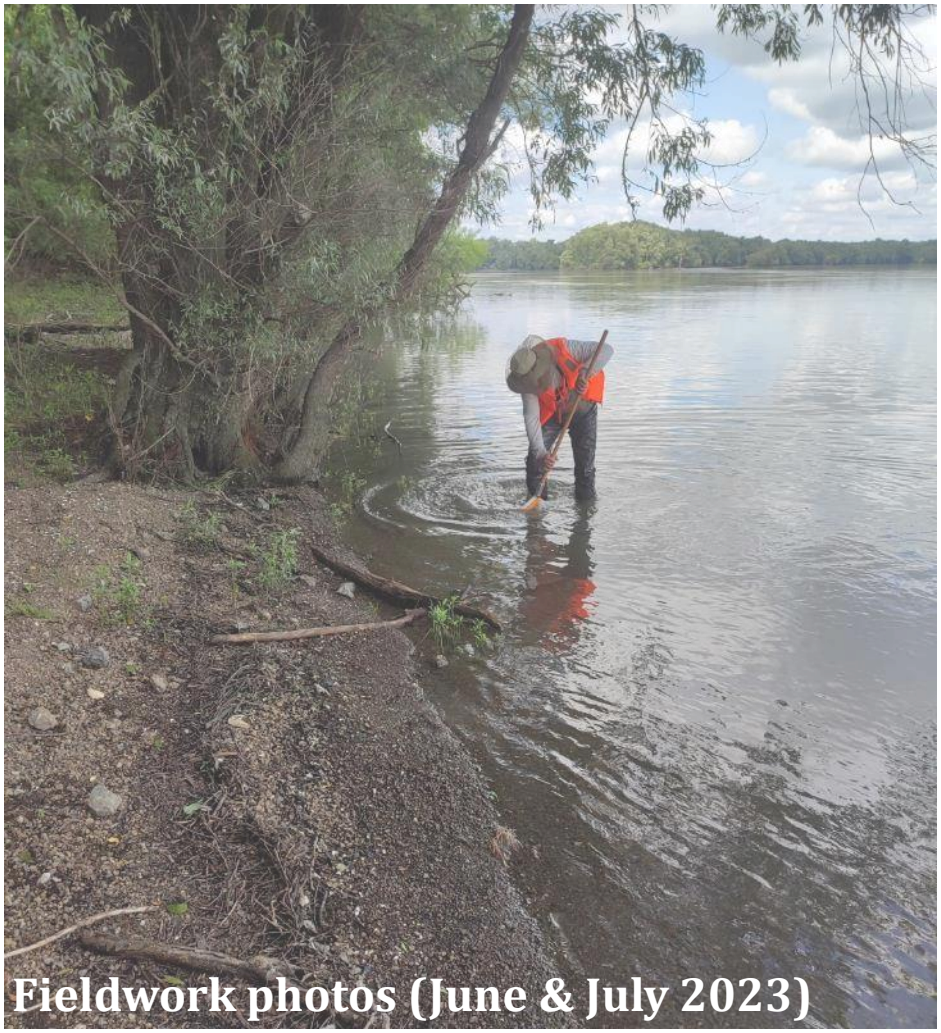
Methods

- 17 critical sections on joint Croatian-Serbian part of Danube
  - Survey river macroinvertebrate community structure in the critical sections of Danube river
  - Integration of data into GIS database and presentation of macrozoobenthic communities within the Biodiversity Catalogue

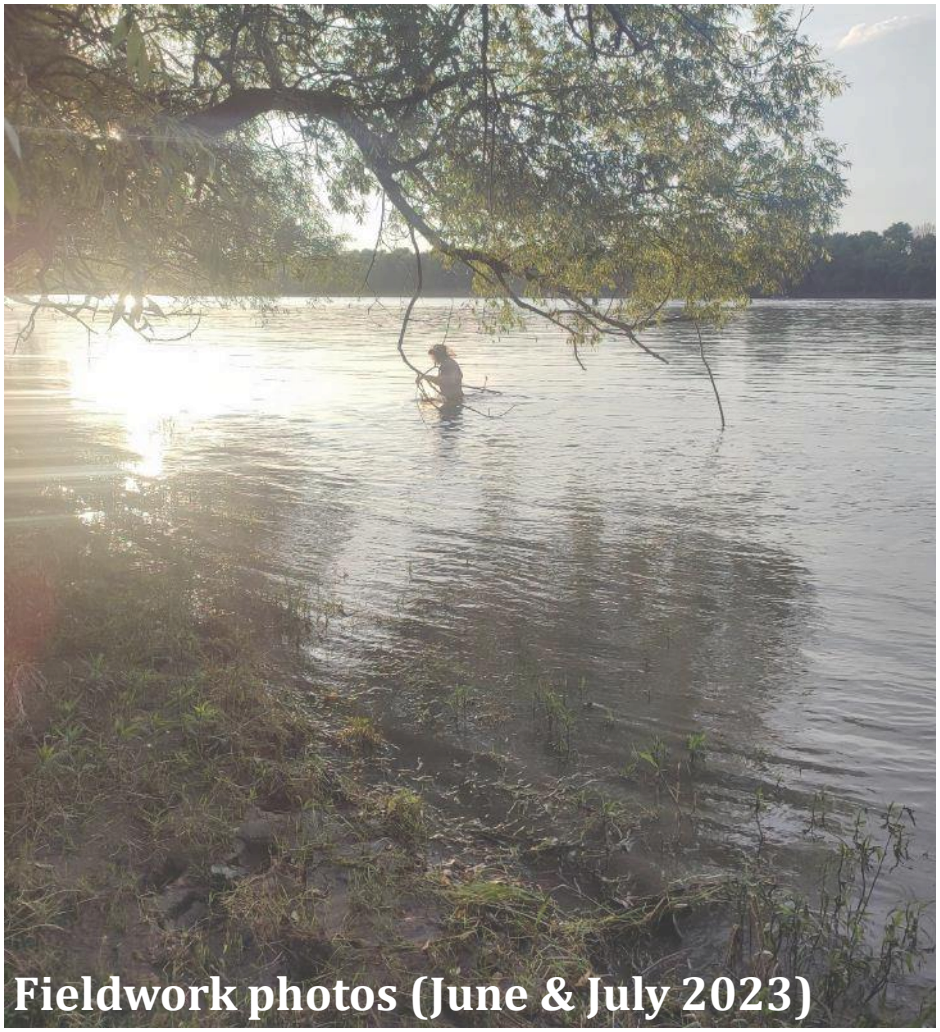
Methods

- Field survey – sampling methodology is following the national (HR) Methodology of sampling, laboratory analyzes and determining the ecological quality ratio for biological quality element

- Field work has been carried completely on all 17 critical sections during summer 2023
  - June 2023 (7 upstream sections, from Batina to Aljmaš)
  - End of July 2023 (downstream sections, from Erdut to Ilok)



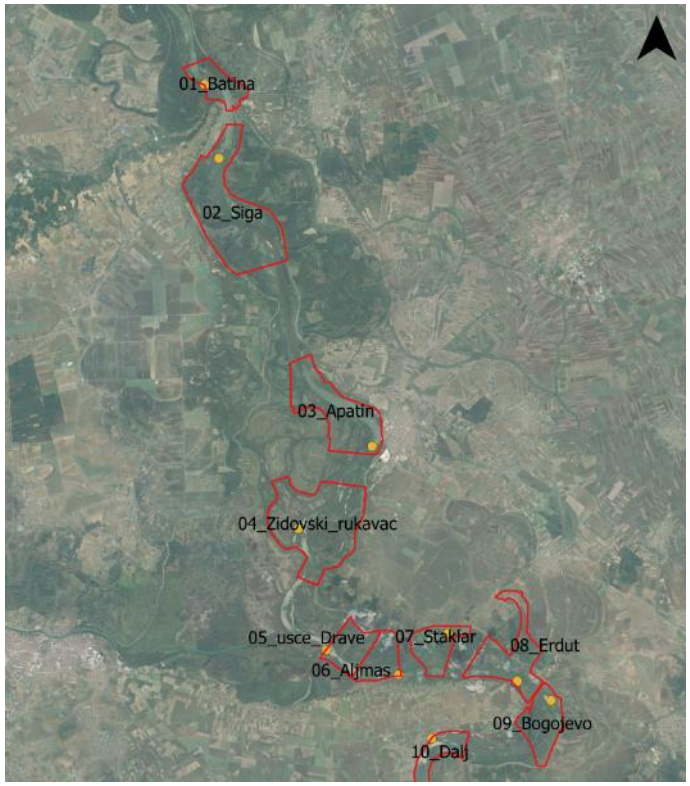
Fieldwork photos (June & July 2023)

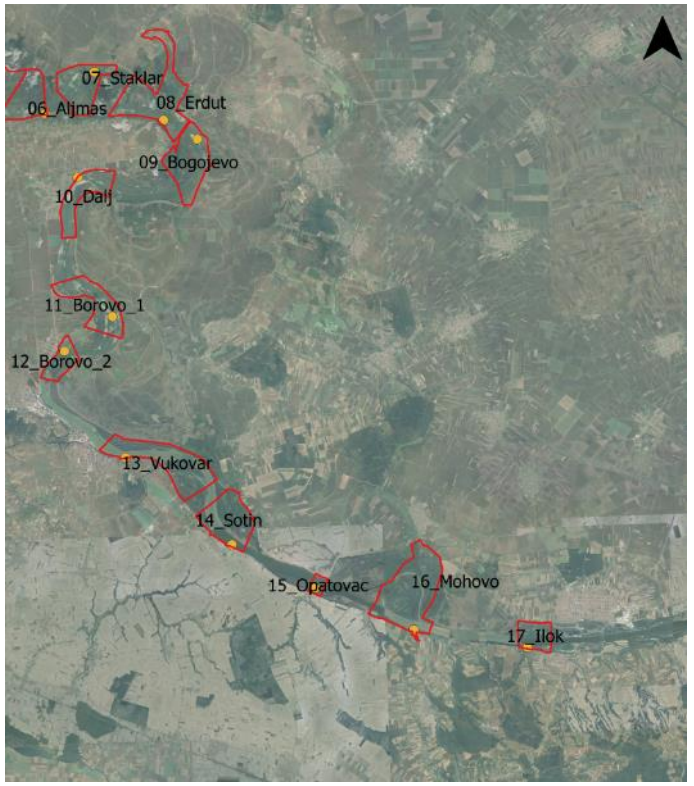


Fieldwork photos (June & July 2023)

Habitat sampling locations on the Danube

1. Batina
2. Siga
3. Apatin
4. Židovski rukavac
5. Ušće Drave
6. Aljmaš
7. Staklar
8. Erdut
9. Bogojevo
10. Dalj
11. Borovo I
12. Borovo II
13. Vukovar
14. Sotin
15. Opatovac
16. Mohovo
17. Ilok





01_Batina

02_Siga

03_Apatin

04_Židovski_rukavac

05_Ušće_Drave

06_Aljmaš

07_Staklar

08_Erdut

11_Borovo_1

14_Sotin

16_Mohovo

17_Ilok

15_Opatovac

During sampling, all relevant data gathered according to the protocol

- water levels
- water temperature of the Danube
- data on physical and chemical parameters gathered (oxygen, pH, conductivity)
- photo documentation

Samples (according to the protocol) are stored and shipped for further laboratory analysis.

Laboratory analysis

- Laboratory analyses have started in September 2023
- Laboratory processing of samples include isolation of animal from the samples, and later determination of taxa.
- Isolation of animals from samples is in progress, determination has not yet started
- Isolation of animals and further determination of taxa are the most time-consuming activities
- Determination of animals will be done to the lowest possible taxa level, but at least to obligatory taxa level according to prescribed methodology

- At the moment, isolation of animals from samples is still in progress
- Macrozoobenthos taxa determination will follow afterwards, during 2024
- Preliminary observations indicate that several alien species, belonging to different benthic taxa groups (the list is probably not complete) have widespread distribution in joint Croatian-Serbian sector of the Danube

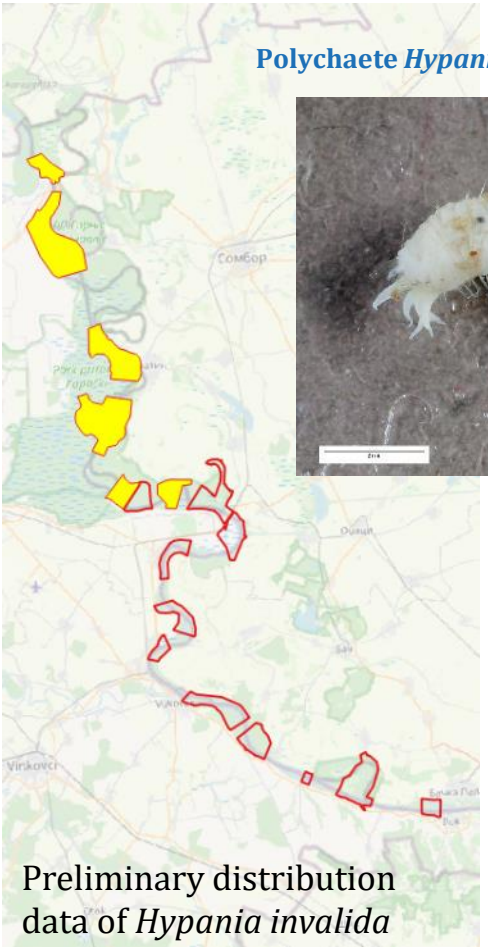
Occurrence of alien species (preliminary qualitative observations, not complete for all critical sections of the Danube)

Latin name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Dikerogammarus villosus (Amphipoda)						+											
Dikerogammarus bispinosus (Amphipoda)						+											
Hypania invalida (Polychaeta)	+	+	+	+	+		+										
Jaera istri (Isopoda)	+	+	+	+	+	+	+										
**the list is not complete for all critical sections*																	

***Dikerogammarus villosus* „killer shrimp"**

Source: NOAA Great Lakes Environmental Research Laboratory, 2004, Creative Commons License

Two alien species already confirmed in more than 30% of sampled sections



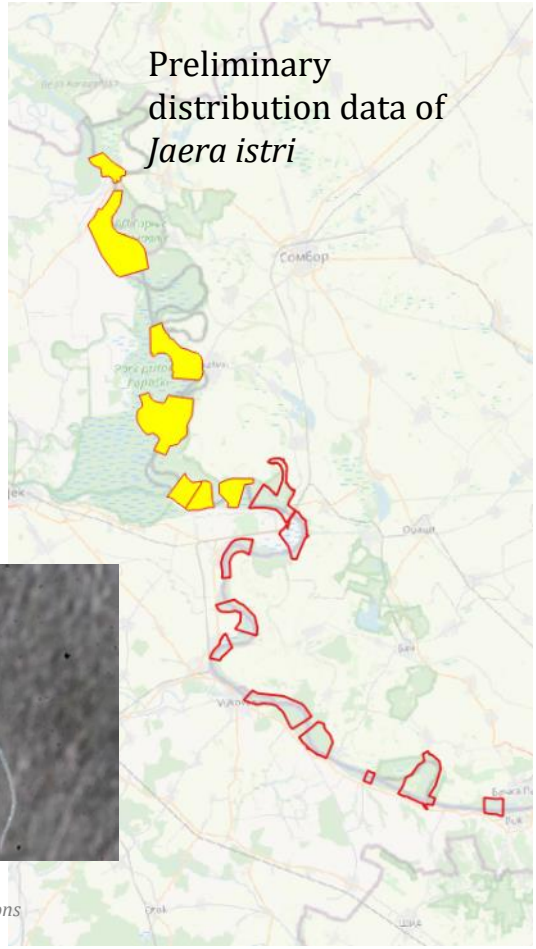
Preliminary distribution data of *Hypania invalida*

Polychaete *Hypania invalida*

Source: Alexander Koenig, Zoologisches Forschungsmuseum, 2018, Creative Commons License

Isopod crayfish *Jaera istri*

Source: Alexander Koenig, Zoologisches Forschungsmuseum, 2017, Creative Commons License



Preliminary distribution data of *Jaera istri*

Future actions?

- Planned continuation of laboratory processing of field samples (finishing the isolation of animals from the samples, determination of animals)
- Input for Biodiversity Catalogue and GIS database

3. ESTABLISHMENT OF A GEOINFORMATION SYSTEM (GIS)

- Activities within the scope of the project:
  - Set-up and configuring of a server +
  - Implementation of a WebGIS system (user requirement analysis, application development and implementation) +/-
  - Collection of monitoring data, systematization and GIS database establishment +/-

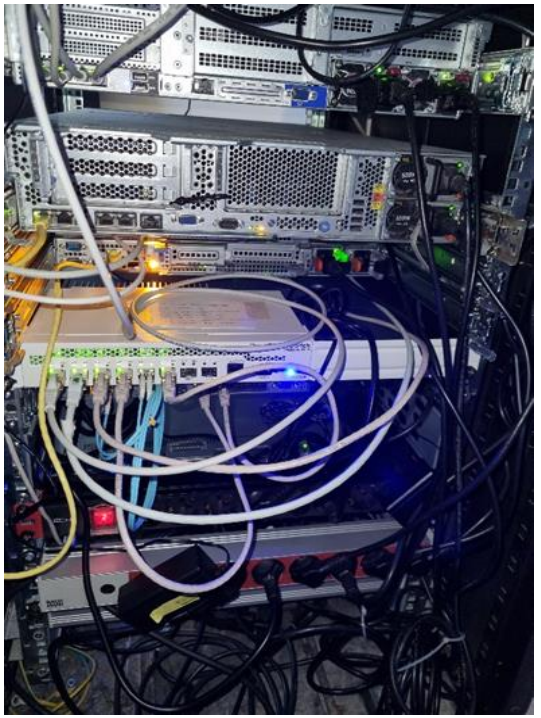
Set-up and configuring of a server

- The server is set-up and configured at the Client's location

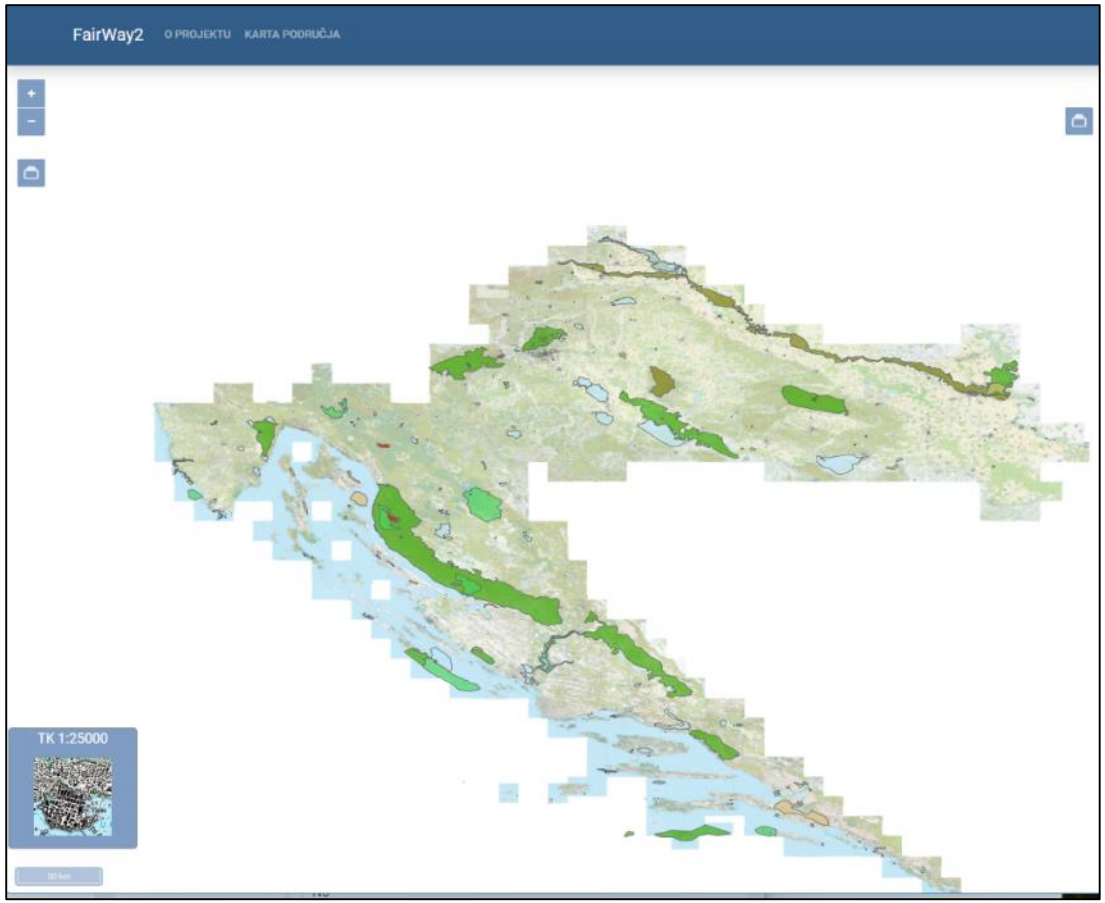
Technical characteristics of server

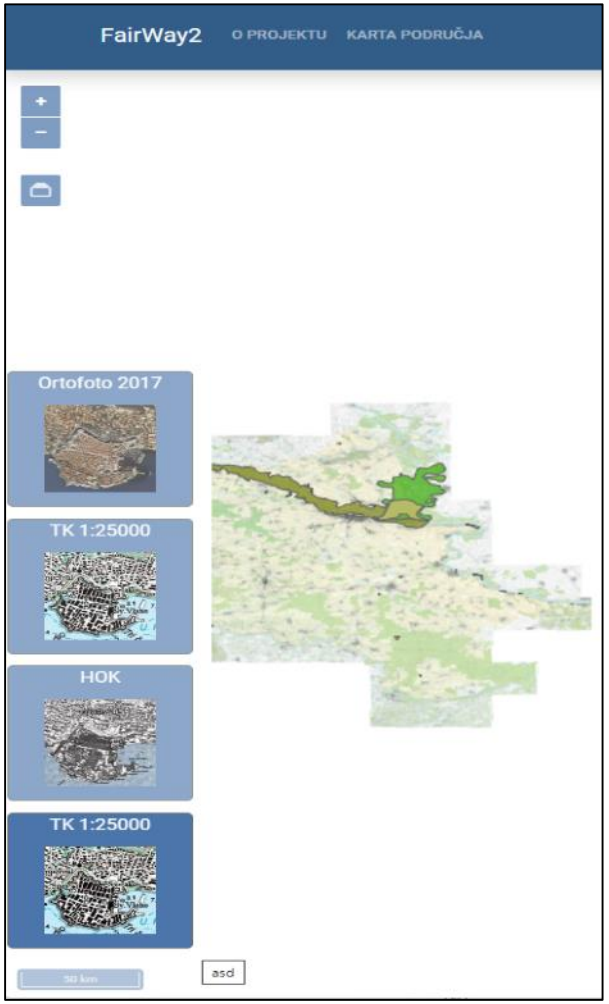
- local server - at least 5 TB of disk space (upgradable)
- interface requirements - at least 128 GB of RAM
- min 2xIntel Xeon processors

- Access is tested and enabled

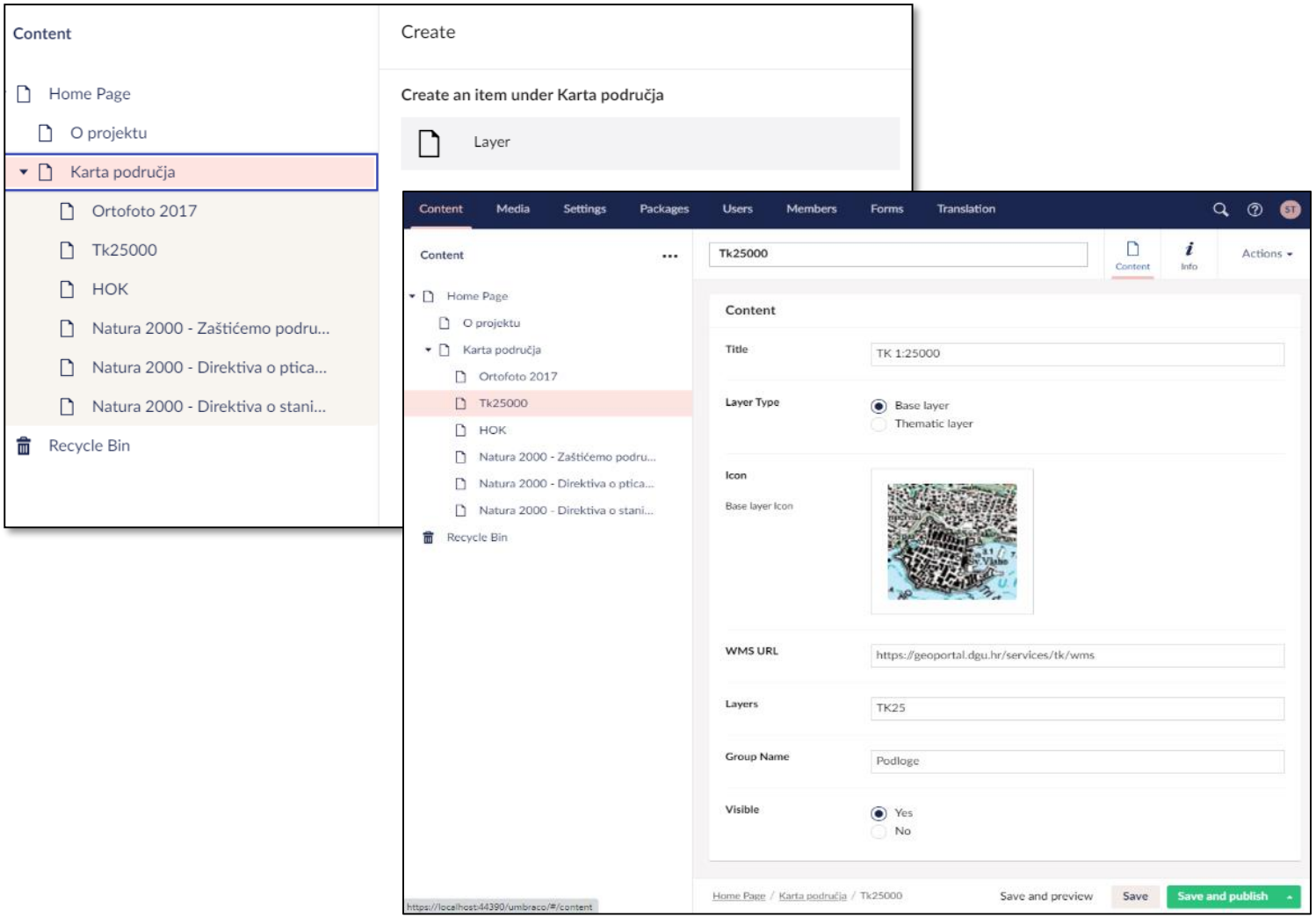


Implementation of a WebGIS system (user requirement analysis, application development and implementation)

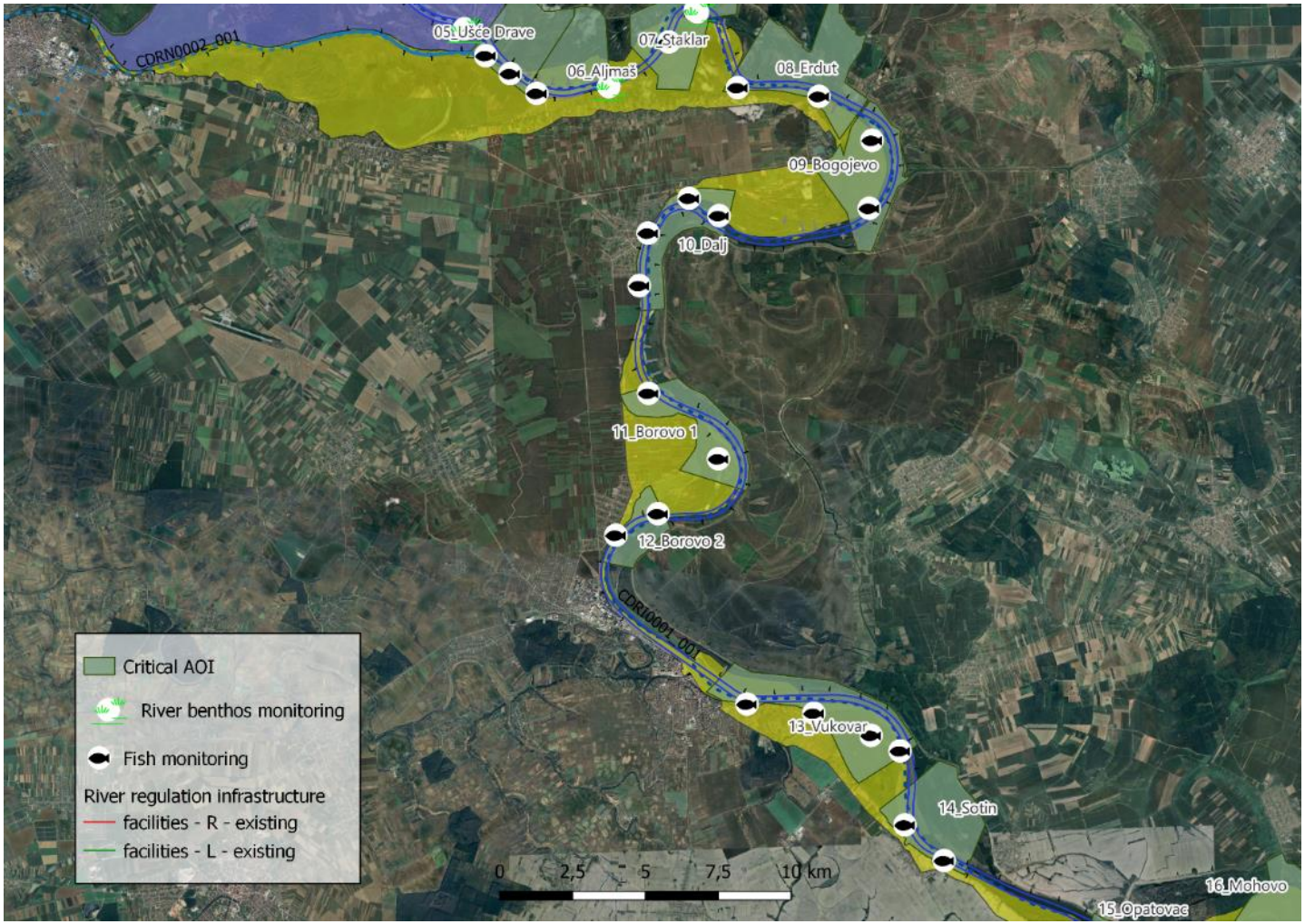




Implementation of a WebGIS system (user requirement analysis, application development and implementation)



Collection of monitoring data, systematization and GIS database establishment



Future steps

- Implementation of a local WebGIS system
- Collection of monitoring data, systematization and GIS database establishment
- User manuals development, system administrator's usage instructions, system management and control manual, and documentation for user training

Thank you
for your attention

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