

## POPULATION DYNAMICS OF FIVE RIVERBED BREEDING BIRD SPECIES ON THE LOWER DRAVA RIVER, NE SLOVENIA

### Populacijska dinamika petih gnezdilk struge spodnjega dela reke Drave (SV Slovenija)

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In 2006–2017, annual censuses of breeding bird species regarded as indicators of natural rivers were carried out on the 38.9 km long lowland stretch of the Drava riverbed between Maribor and Zavrč with altered flow regime due to the operating hydropower plants. Gravel bar habitats were surveyed in four years of the study period by combining orthophoto analysis and analysis of field photographs. Effects of gravel bar management were evaluated based at 20 locations. The Little Ringed Plover *Charadrius dubius* occurred on 39.8% of the gravel bars, but most were occupied only in a few years and held just one breeding pair. Low numbers between 2009 and 2012 (< 30 pairs) were followed by a steep population increase from 2014 onwards to a maximum of 66–73 pairs (1.7–1.9 p/km). Such population dynamics was attributed to the lack of large discharges (>500 m<sup>3</sup>/s) and consequent overgrowing of riverbed in the first part of the study period, while the increase in the second part was due to the creation of extensive shingle areas (from 20.6 ha in 2009/10 to 37.8 ha in 2014) by the extreme flood in early November 2012, subsequent regular occurrence of large discharges outside the breeding seasons and large-scale removals of woody vegetation. Breeding population of Common Sandpiper *Actitis hypoleucos* remained at a rather similar low level (<20 p) during most of the period studied after an initial decline, and did not reflect changes in the overall surface area of riverbed habitats. Contrary to the general situation, the number of breeding pairs on gravel bars subjected to management increased several-fold. Maximum number of pairs on these bars was reached up to four years after the initiation of management measures, as only then the optimal mosaic of early successional stages interspersed with shingle areas developed at main sites. The species was widespread only on lower part of the Drava. Kingfisher *Alcedo atthis* was fairly widely distributed along the riverbed, but occurred in rather low densities throughout (c. one pair on 2–3 km of the studied riverbed on average), probably as a result of limited bank erosion and consequent overgrowing/lack of suitable nest sites. The population was estimated as stable with effects of harsh winter conditions on breeding numbers in some years. The majority of nest holes were excavated in eroded river banks along the main river channel (77.8%), followed by similar sites located in mouth areas of small tributaries of the Drava (14.8%). Regular breeding of Sand Martin *Riparia riparia* since 2012 (up to 259, mostly at only one location annually) was almost exclusively the result of the annual artificial nest site preparation programme. Fairly large gravel bar-breeding population of White Wagtail *Motacilla alba*, monitored

since 2013 and predominantly ground nesting in sparsely vegetated areas, seems unusual considering the prevalent breeding habits of the species at the European scale. Conservation implications and guidelines for future management efforts are discussed.

**Ključne besede:** mali deževnik *Charadrius dubius*, mali martinec *Actitis hypoleucus*, vodomec *Alcedo atthis*, breguljka *Riparia riparia*, bela pastirica *Motacilla alba*, populacijski trendi, upravljanje prodišč, reka Drava

**Key words:** Little Ringed Plover *Charadrius dubius*, Common Sandpiper *Actitis hypoleucus*, Kingfisher *Alcedo atthis*, Sand Martin *Riparia riparia*, White Wagtail *Motacilla alba*, population trends, gravel bar management, Drava River

## 1. Introduction

Alluvial floodplains rank among the most altered and threatened ecosystems worldwide (TOCKNER & STANFORD 2002). In a pristine state, undisturbed cut-and-fill alluviation (erosion, transport, deposition) creates a natural disturbance regime that plays an important role in maintaining a high diversity of habitats by forming a variety of patch types and succession stages. Characteristic geomorphic features of alluvial rivers include numerous gravel bars, eroded banks, deposits of sediment and large woody debris (WARD *et al.* 2002, FLORSHEIM *et al.* 2008). Consequently, gravel-bed rivers harbour disproportionately high biodiversity (ALLAN & FLECKER 1993, ROHDE *et al.* 2004, JENSEN *et al.* 2006, HAUER *et al.* 2016). However, the majority of European rivers have been severely degraded in the past by various anthropogenic interventions including flow regulation, channelization, damming, and water abstraction. Only a small fraction of large rivers or entire catchments remained free-flowing, mainly restricted to remote boreal and arctic regions. As a result, most rivers lost their natural dynamics and patterns with a consequent decline in habitat and species diversity (WARD 1998, BUIJSE *et al.* 2002, PEDROLI *et al.* 2002, LORENZ *et al.* 2009, TOCKNER *et al.* 2009, HAUER *et al.* 2016).

Among species affected are also characteristic riverbed breeding birds, such as the Little Ringed Plover *Charadrius dubius*, Common Sandpiper *Actitis hypoleucus*, Kingfisher *Alcedo atthis* and Sand Martin *Riparia riparia* (VAN VESSEM *et al.* 1997), the breeding populations of which either declined significantly in Central Europe and/or predomi-

nantly shifted from natural to anthropogenic habitats (BAUER *et al.* 2005, PETUTSCHNIG 2006a, b, MAUMARY *et al.* 2007, SCHMID *et al.* 2010, GEDEON *et al.* 2014, BIRDLIFE INTERNATIONAL 2015a, b, RINGERT 2015, SAMWALD *et al.* 2015). These species are widely regarded as indicators of natural river dynamics and alluvial riverine habitats (SZEP *et al.* 2003, NOBLE *et al.* 2008, DRÖSCHMEISTER & SUKOPP 2009, SCHMIDT *et al.* 2015).

Recently, numerous river restoration projects have been implemented, aiming to improve hydromorphological conditions, natural dynamics and connectivity functions of degraded rivers. In most cases these include various river widening measures that, among others, promote the re-establishment of once impoverished habitat diversity (ROHDE *et al.* 2004, JENSEN *et al.* 2006, PALMER *et al.* 2007, JÄHNIG *et al.* 2010). Recoveries of riverbed breeding bird populations due to an increased area of pioneer successional stages and bare alluvial deposits after restorations were reported from rivers in different countries (PETUTSCHNIG 2004, ARLETTAZ *et al.* 2012, UHL & WEISSMAIR 2012). River restoration projects started only recently in Slovenia and their conservation effects on bird populations has not been evaluated or published as yet.

After the first census of riverbed birds on the Drava River in NE Slovenia in 2006 (BOŽIČ & DENAC 2010), DOPPS – BirdLife Slovenia dedicated substantial effort to provide suitable habitats for gravel bar-breeding species by (1) influencing the modification of prevailing harmful water-management practices to more meaningful measures with positive effects on both biodiversity and flood protection objectives (DENAC & BOŽIČ

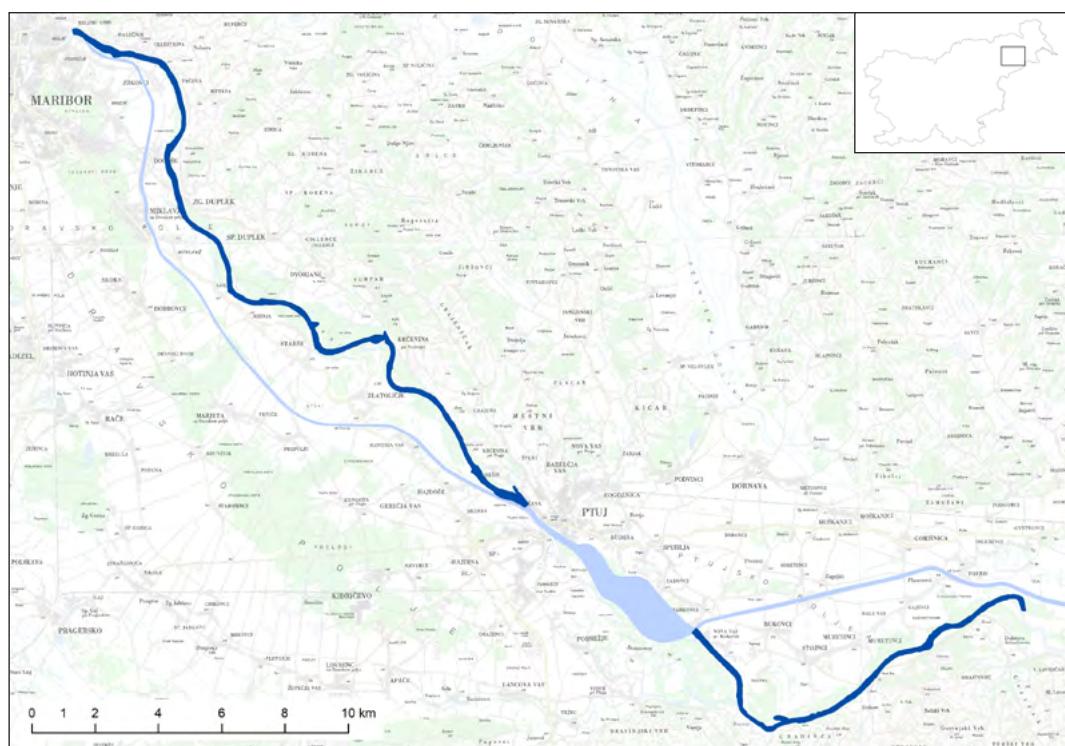
2012), and (2) implementation of shingle area restorations on multiple locations along the river as part of the project “LIVEDRAVA – Riparian Ecosystem Restoration of the Lower Drava River in Slovenia” (<http://livedrava.ptice.si>). At the beginning of this process, an annual census scheme was established to obtain solid background data as support for management decisions and to monitor development of target species populations. An overview of 10-year results is given in this study, with special focus on population dynamics of indicator bird species and effects of gravel bar management.

## 2. Study area

Drava is the fourth largest and longest river in the Danube River Basin spanning over five countries, where it drains an area of over 40,000 km<sup>2</sup>. It has

a glacial-nival flow regime with lowest discharge in January–February and highest in May–June. The second discharge peak occurs in late autumn due to high precipitation in the Southern Limestone Alps. However, the natural flow of the Drava River is strongly influenced by 23 hydropower plants, operating upstream of its confluence with the Mura River (SOMMERWERK *et al.* 2009).

Our study area comprised a 38.9 km long stretch of the Drava riverbed on the westernmost fringes of the Pannonian plain between Melje dam on the outskirts of Maribor city (46.56°N, 15.67°E) and the border with Croatia at Zavrč (46.39°N, 16.06°E) (Figure 1). The hydrological regime here is completely governed by two channel-type hydropower plants with dams at Melje (HPP Zlatoličje, operating since 1969) and at Markovci pri Ptuju (HPP Formin, operating since 1978) (ŠMON



**Figure 1:** Study area of the Drava River between Maribor and Zavrč, NE Slovenia. Riverbed included in surveys is depicted in dark blue.

**Slika 1:** Območje raziskave na reki Dravi med Mariborom in Zavrčem (SV Slovenija). Rečna struga, vključena v popise, je prikazana s temno modro barvo.

2000). The mean discharge is  $321 \text{ m}^3/\text{s}$  (ŠEHIC *et al.* 2010), but only the so-called “ecologically acceptable discharge” ( $20 \text{ m}^3/\text{s}$  downstream of Melje and  $10 \text{ m}^3/\text{s}$  downstream of Markovci, between 15 Mar and 15 Oct and half of these values during the rest of the year) is released in the riverbed while most of the water is diverted into supply channels for generating electric power. Only when the discharge surpasses the capacity of power plants (i.e. installed flow at  $500 \text{ m}^3/\text{s}$  – the maximum flow a plant can process) is the surplus flow diverted to the riverbed (ZRSVN 2006). It was estimated that sediment transport on the Drava River section between Ptuj in Zavrč decreased 400-fold after the construction of HPP Formin (SOVINC 1995). Moreover, considerable stretches of the Drava river have been regulated

by rock ripraps from as early as the first half of the 19<sup>th</sup> century until the present day (BAŠELJ 2014, *own data*).

The riverbed was divided into three survey sections. We defined two sections between Maribor and Ptuj (Maribor–Starše, Starše–Ptuj) as the “upper part of the study area” and the section between Markovci and Zavrč as the “lower part of the study area” (Table 1). The two parts of the study area are separated by the artificial Lake Ptuj reservoir (not surveyed) (Figure 1).

## 2.1. Hydrological data

Discharges at or slightly above the prescribed minimum prevailed during all main breeding seasons (1 Apr–30 Jun), except in 2012 when discharges exceeding  $50 \text{ m}^3/\text{s}$  (equivalent to c.  $20 \text{ cm}$  rise of water level in the riverbed) occurred in the upper part of the study area in 46 days of the season, and in 2013 when the increased discharges in the upper and lower part of the study area lasted for 69 and 91 days, respectively. More than 20 days with discharge  $>50 \text{ m}^3/\text{s}$  in both parts of the study area were also registered in the seasons of 2009 and 2014, while 2011, 2015 and 2017 seasons had fewer than 10 such days (Figure 2).

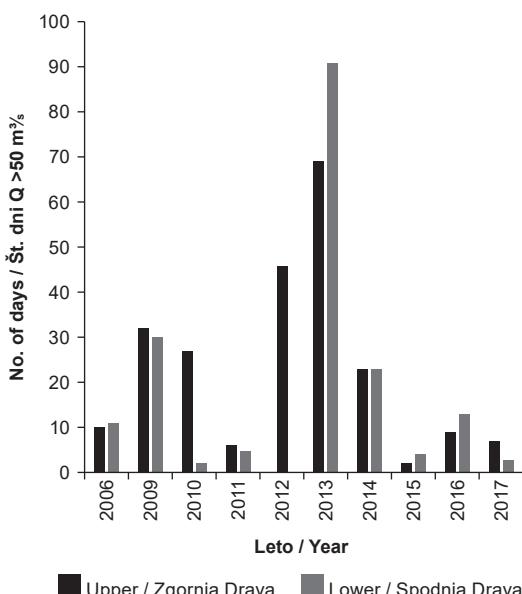
Discharges of  $>500 \text{ m}^3/\text{s}$  were rare throughout the study period, except between late 2012 and the first half of 2013, and did not occur in all years. This situation is even more pronounced for discharges  $>700 \text{ m}^3/\text{s}$  that occurred exclusively outside the main breeding season (Figure 3).

## 3. Methods

### 3.1. Bird census

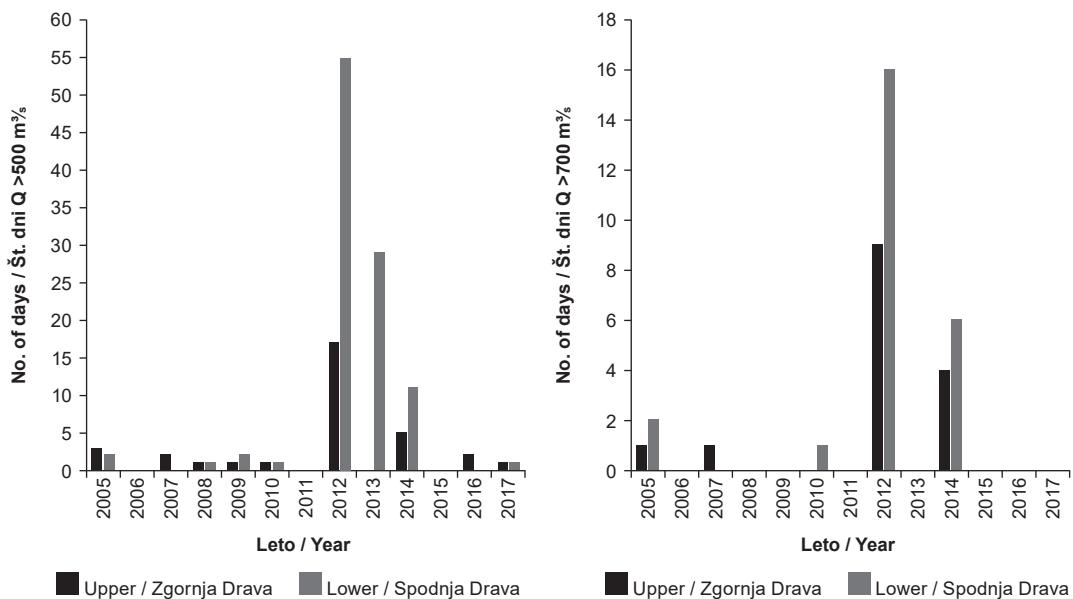
Data were first collected in 2006 and then every year from 2009 to 2017. Target species were indicator breeding birds that exclusively utilize the characteristic, natural and semi-natural features within the riverbed (gravel bars, islands, river banks): Little Ringed Plover, Common Sandpiper, Kingfisher and Sand Martin. From 2013 onwards, White Wagtail *Motacilla alba* was included in the censuses as well.

The bird census was carried out using a boat with a minimum of two observers, inspecting the



**Figure 2:** Number of days with discharges  $>50 \text{ m}^3/\text{s}$  in the Drava riverbed during the main breeding season (1 Apr–30 Jun) of a given year. Data for upper (black bars) and lower part (grey bars) of the study area are separated.

**Slika 2:** Število dni s pretoki  $>50 \text{ m}^3/\text{s}$  v strugi reke Drave v glavni gnezditveni sezoni (1. 4–30. 6.) posameznega leta. Podatki za zgornji (črni nizi) in spodnji del (sivi nizi) območja raziskave so ločeni.



**Figure 3:** Occurrence of large discharges on the upper (black bars) and lower part (grey bars) of the Drava River study area presented as number of days with  $>500 \text{ m}^3/\text{s}$  (left) and  $>700 \text{ m}^3/\text{s}$  (right) in separate years between 2005 and 2017

**Slika 3:** Pojavljanje velikih pretokov na zgornjem (črni nizi) in spodnjem delu (sivi nizi) raziskovanega območja reke Drave, predstavljeno kot število dni s pretokom  $>500 \text{ m}^3/\text{s}$  (levo) in  $>700 \text{ m}^3/\text{s}$  (desno) v posameznih letih med 2005 in 2017

entire area of the riverbed while slowly progressing downstream. Regular stops were made along the transect and most gravel bars suitable for breeding of the target species were carefully walked by at least one observer and systematically checked by binoculars and/or spotting scope. All birds registered were accurately mapped using the most recent edition of orthophoto images produced by the Surveying and Mapping Authority of the Republic of Slovenia, at a scale of 1 : 5,000 and their behaviour recorded. The census was carried out in two visits annually during the breeding season of the target species; the first usually took place in the second half of April (median 21 Apr) and the second in the mid-May–early June (median 1 Jun). Only in 2010 (one survey section) and 2012 (both sections) the census was carried out considerably later in the season in the upper part of the study area due to unfavourable hydrological conditions (Table 1). The lower part remained unsurveyed in 2013 as large discharges persisted during the entire breeding season. Most of the work was carried out

by a permanent team of observers and the census effort remained fairly constant over the entire study period.

### 3.2. Interpretation of results

Special criteria for breeding pair/territory-holding individual were developed for species censused based on our previous experience and recommendations from abroad (ANDRETTKE *et al.* 2005, BOŽIČ & DENAC 2010), and used for interpretation of registrations. (1) Little Ringed Plover individuals registered were distinguished by sex whenever possible. If the number of pairs during the first visit was higher than during the second visit on a certain gravel bar, or plovers were not registered during the second visit, the latter was regarded as the minimum number and the former as the maximum number of pairs. (2) In Common Sandpiper, particular importance was given to the territorial behaviour and intensively displaying individuals due to the large numbers of

**Table 1:** Survey sections on the Drava River, their lengths and dates of counts carried out during the censuses (V1 = 1<sup>st</sup> visit, V2 = 2<sup>nd</sup> visit)**Tabela 1:** Popisni odseki na reki Dravi, njihova dolžina in datum štetij v opravljenih popisih (V1 = 1. obisk, V2 = 2. obisk)

Section / Odsek	Upper part / Zornji del		Lower part / Spodnji del		
	Maribor–Starše	Starše–Ptuj	Markovci–Zavrč		
Geographic coordinates/ Geografske koordinate	46.5603°N, 15.6737°E–46.4700°N, 15.7733°E	46.4700°N, 15.7733°E–46.4243°N, 15.8582°E	46.3880°N, 15.9268°E–46.3929°N, 16.0623°E		
River kilometres / Rečni kilometri	350–336	336–326	319–305		
Length / Dolžina (km)	14.3	10.6	14.0		
Visit / Obisk	V1	V2	V1	V2	V1
2006	13. 4.	12. 5.	14. 4.	14. 5.	17. 4.
2009	22. 4.	3. 6.	27. 4.	4. 6.	9. 5.
2010	21. 4.	1. 6.	22. 4.	25. 6.	26. 4.
2011	20. 4.	19. 5.	21. 4.	20. 5.	22. 4.
2012	20. 4.	20. 6.	23. 4.	22. 6.	22. 4.
2013	24. 4.	20. 5.	25. 4.	21. 5.	-
2014	7. 4.	3. 6.	8. 4.	4. 6.	11. 4.
2015	14. 4.	1. 6.	15. 4.	2. 6.	16. 4.
2016	11. 4.	16. 5.	11. 4.	16. 5.	13. 4.
2017	21. 4.	2. 6.	22. 4.	2. 6.	24. 4.
					3. 6.

migrants during the first visit. (3) All potentially suitable steep natural banks were checked for Kingfisher nest holes and their details recorded or photographed. Registrations of individuals on locations  $\geq 1,5$  km apart were treated as separate pairs, while those  $\leq 500$  m apart were always regarded as belonging to the same pair (cf. CRAMP 1985, ANDRETZKE *et al.* 2005, BAUER *et al.* 2005), unless when simultaneously occupied nests were found. (4) For Sand Martin, a minimum EBCC breeding atlas code 9 (excavating nest-hole, HAGEMEIJER & BLAIR 1997) was required, i.e. only actual nesting colonies were considered in the study. The number of pairs was obtained by direct, prolonged multiple counts of completed holes in a colony, taking into consideration observations of birds flying in and out. No correction factors proposed by KUHNEN (1978) or SZEP *et al.* (2003) were used as these would,

according to our observations, underestimate the number of pairs (see FENYÖSI 2005). Apart from these, no special attempts were made to find nests of target species during any of the census visits. (4) The number of White Wagtail pairs was estimated as maximum of individuals/pairs registered at separate locations, with special significance given to the observations suggesting confirmed breeding (adult carrying food and/or other circumstances indicating occupied nest, nests found, family parties with recently fledged young etc.).

In the analysis it was possible to assign most of the Little Ringed Plover, Common Sandpiper and White Wagtail pairs/territories to individual gravel bars. A gravel bar was defined as any elevated deposit of sediment, protruding above the water surface at usual discharge within the riverbed, either as a point bar, island or peninsula, regardless of successional stage. The minimum

size of the area considered was set at 30 m<sup>2</sup>. The breeding density is given as linear density, i.e. the number of pairs/territories per km of the river (e.g. DOUGALL *et al.* 2004).

For graphical presentation of species' occurrence, the kernel density tool in ArcGIS was used (SILVERMAN 1986, ESRI 2009), based on all available point features (i.e. mapped registrations of individuals in all study years) for each species except Sand Martin. In kernel density, the value of smoothly curved surface fitted over each point is highest at the location of the point and diminishes with increasing distance from the point, reaching zero at the search radius distance from the point (ESRI 2009). Population field value for the point was set to account for number of individuals underlying each point registration.

### **3.3. Habitat survey and effects of gravel bar management**

During census visits large sets of photographs were taken routinely of all gravel bars along the study area from multiple angles (up to 1,500 photos/year). Habitat survey was then carried out by detailed analysis of all available orthophoto image editions produced in the study period (2006, 2009/2010, 2014, 2016) using ArcGIS (ESRI 2009), and ground truthing by field photographs of a given year. Gravel bar habitat types were classified into five broad categories: (1) bare shingle, (2) shingle interspersed with low plants, where vegetation cover does not exceed 50%, (3) herbaceous plants (dense layer of annual or perennial plants), (4) low woody vegetation (small shrubs up to 1 m), and (5) high woody vegetation (shrubs and trees taller than 1 m). Categories 1–2 and 4–5 were later merged, resulting in three main gravel bar habitat types used. During analysis, a basic polygon consisting of gravel bar outlines was cut into smaller features representing single-habitat type units. Thus, habitat changes over time were mapped on a gravel bar as well as study area level, and surface areas of habitat types calculated. For the two exclusively gravel bar-breeding species (Little Ringed Plover, Common Sandpiper), categories 1 and 2 are treated as suitable habitat (termed as "shingle" throughout), although the latter can marginally also select category 3 for

breeding (ANDRETZKE *et al.* 2005, *own data*) (Appendix 1, 2). For the calculation of areas of suitable habitat on managed gravel bars, Google Earth Pro imagery was used for years/periods, for which orthophotos were not available.

The general purpose of gravel bar management carried out by a contracted public service as part of regular water management maintenance works was flood control and no special goals related to nature-conservation issues were set. One of the aims of the LIVEDRAVA project was to develop gravel bar management practices that simultaneously enhance breeding habitats of riverbed bird species, and provide better flood safety by increasing the cross-section of the river (see KLANEČEK *et al.* 2005). Six gravel bars were managed within the project in that way. For the evaluation of gravel bar management effects as of 2013, the following sites were taken into consideration: (1) management consisted of removal of woody vegetation and upper layer of organic matter by heavy machinery, and was subjected to nature-conservation guidelines; (2) held Little Ringed Plover at least once during the study. For gravel bars managed within LIVEDRAVA, additional conditions required included: (a) strictly no gravel was to be removed from the riverbed during management operations, (b) the existing size and height of gravel bars were not reduced, and (c) organic material was removed from the riverbed as much as possible. According to the time-scale of management, the corresponding years were divided into two management periods, 2013–2015 (management period 1) and 2016–2017 (management period 2). In comparisons of number of pairs/habitat area on gravel bars before and after management works, the latest available data were used as reference.

### **3.4. Trends**

Trends were calculated using TRIM, a program designed to analyse time-series of counts with missing observations using Poisson regression (PANNEKOEK & VAN STRIEN 2005). The multiplicative overall slope (trend) estimate for individual bird species is classified by the program into one of the following categories, based on the overall slope and its 95% confidence interval (slope  $\pm 1.96$  SE): strong increase, moderate

**Table 2:** Number of the Little Ringed Plover *Charadrius dubius* breeding pairs in survey sections on the Drava River**Tabela 2:** Število gnezdečih parov malega deževnika *Charadrius dubius* na popisnih odsekih reke Drave

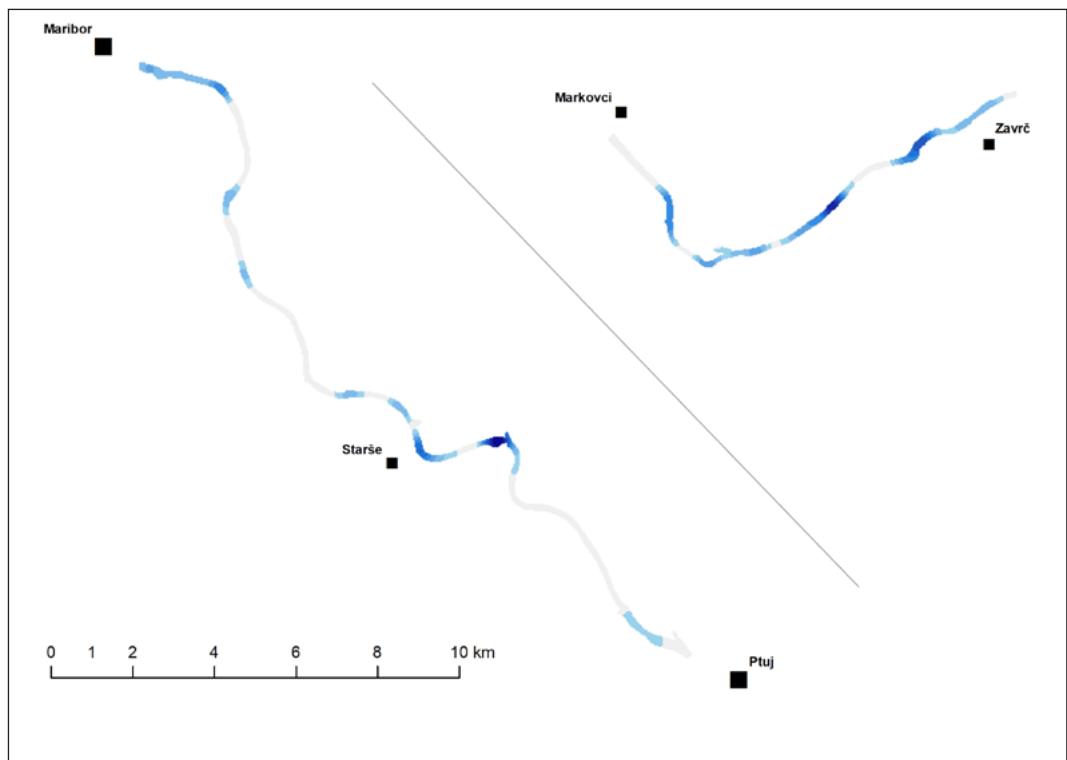
Year/ Leto	Section / Odsek						Total / Skupaj	
	Maribor–Starše		Starše–Ptuj		Markovci–Zavrč		min	max
	min	max	min	max	min	max		
2006	10	12	17	20	22	25	49	57
2009	1	1	7	10	7	12	15	23
2010	2	6	4	7	9	18	15	31
2011	4	6	8	8	13	16	25	30
2012	0	5	9	9	4	6	13	20
2013	4	5	8	10	-	-	12	15
2014	14	15	14	17	38	41	66	73
2015	10	13	11	13	34	38	55	64
2016	10	15	7	10	31	38	48	63
2017	8	12	5	5	24	30	37	47

\* Section Markovci–Zavrč was not surveyed in 2013 due to unfavourable hydrological conditions during the entire breeding season. It is unlikely the species bred there in that year at all. / Odsek Markovci–Zavrč v letu 2013 ni bil popisan zaradi neugodnih hidroloških razmer med celotno gnezditveno sezono. Malo verjetno je, da je vrsta v tem letu tam sploh gnezdila.

**Table 3:** Linear breeding density of Little Ringed Plover *Charadrius dubius* in survey sections on the Drava River**Tabela 3:** Linearna gnezditvena gostota malega deževnika *Charadrius dubius* na popisnih odsekih reke Drave

Year/ Leto	Section / Odsek						Total / Skupaj	
	Maribor–Starše		Starše–Ptuj		Markovci–Zavrč		min	max
	min	max	min	max	min	max		
2006	0.7	0.8	1.6	1.9	1.6	1.8	1.3	1.5
2009	0.1	0.1	0.7	0.9	0.5	0.9	0.4	0.6
2010	0.1	0.4	0.4	0.7	0.6	1.3	0.4	0.8
2011	0.3	0.4	0.8	0.8	0.9	1.1	0.6	0.8
2012	0.0	0.3	0.8	0.8	0.3	0.4	0.3	0.5
2013	0.3	0.3	0.8	0.9	-	-	0.3	0.4
2014	1.0	1.0	1.3	1.6	2.7	2.9	1.7	1.9
2015	0.7	0.9	1.0	1.2	2.4	2.7	1.4	1.6
2016	0.7	1.0	0.7	0.9	2.2	2.7	1.2	1.6
2017	0.6	0.8	0.5	0.5	1.7	2.1	1.0	1.2

\* The Markovci–Zavrč section was not surveyed in 2013 due to unfavourable hydrological conditions during the entire breeding season. It is unlikely the species bred there in that year at all. / Odsek Markovci–Zavrč v letu 2013 ni bil popisan zaradi neugodnih hidroloških razmer med celotno gnezditveno sezono. Malo verjetno je, da je vrsta v tem letu tam sploh gnezdila.



**Figure 4:** Density of Little Ringed Plover *Charadrius dubius* after the kernel method, based on registrations of individuals during the entire study period ( $N = 527$  registrations of 1070 ind.). The darker the shade of blue colour, the greater the density in that area. Outside blue-coloured areas, only single records may exist.

**Slika 4:** Gostota malega deževnika *Charadrius dubius* po kernelski metodi na osnovi registracij osebkov v celotnem obdobju raziskave ( $N = 527$  zapisov o 1070 os.). Temnejši ko je odtenek modre barve, večja je gostota na tistem območju. Zunaj modro obarvanih območij lahko obstajajo le posamezni podatki.

increase, stable, uncertain, moderate decline and steep decline. As our dataset contained numerous zero counts, linear trend model with all change-points selected, except the years without positive count data available (2007 and 2008), was used in the analysis (PANNEKOEK *et al.* 2005). In graphic presentations, imputed time indices with standard errors are given.

#### 4. Results

##### 4.1. Little Ringed Plover

The total breeding population of Little Ringed Plover ranged from 12–15 pairs in 2013 to 66–73 pairs in 2014, resulting in a linear density

of 0.3–0.4 p/km and 1.7–1.9 p/km, respectively. Except in 2012 and 2013, the number of pairs was highest in the lower part of the study area. Linear density exceeded 2 p/km in the years from 2014 to 2016 (max 2.7–2.9 p/km in 2014) only there, while in the first survey section it remained below 1 p/km in all years except for 2014 (Tables 2, 3).

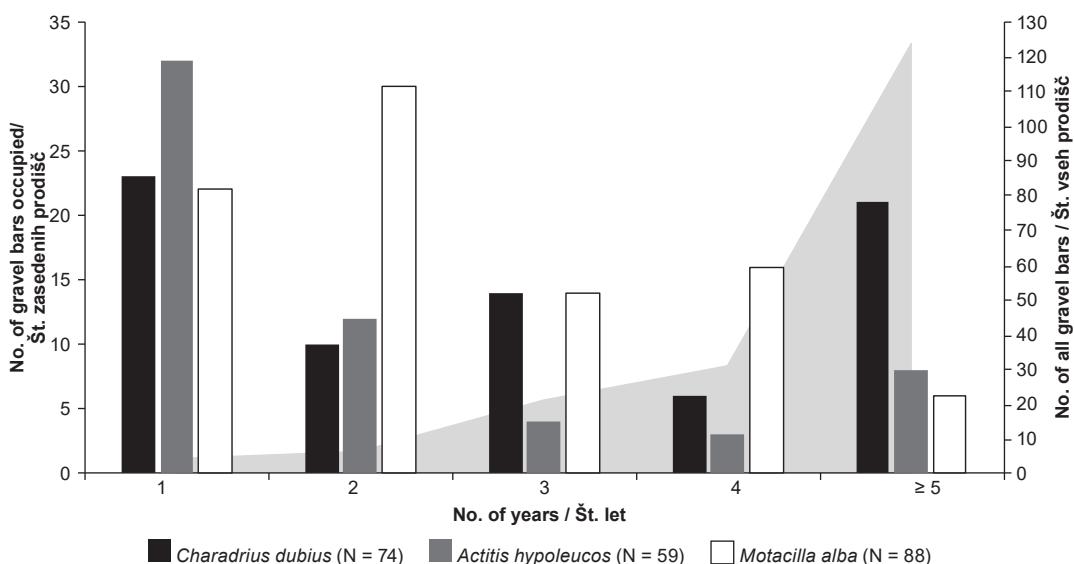
Its distribution along the study area was not continuous; up to several kilometres long gaps were typical, especially in the upper part of the study area (Figure 4).

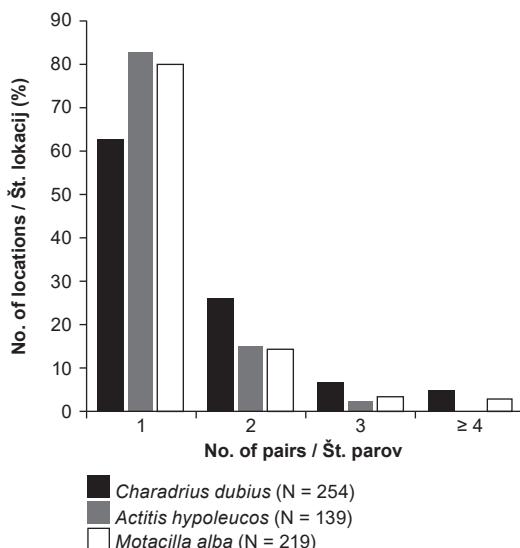
Little Ringed Plover occurred on 74 gravel bars in total (annual range 12–36), 39.8% of all present within the study area during the entire study period. However, the species only bred in all years at two gravel bars in the upper part of

**Table 4:** Number of the Common Sandpiper *Actitis hypoleucos* breeding pairs in survey sections on the Drava River**Tabela 4:** Število gnezdečih parov malega martinca *Actitis hypoleucos* na popisnih odsekih reke Drave

Year/ Leto	Section / Odsek						Total / Skupaj	
	Maribor–Starše		Starše–Ptuj		Markovci–Zavrč		min	max
	min	max	min	max	min	max		
2006	5	5	3	4	17	20	25	29
2009	4	4	4	4	14	16	22	24
2010	3	3	1	1	13	14	17	18
2011	1	1	2	2	11	12	14	15
2012	1	1	1	1	13	14	15	16
2013	1	1	1	1	-	-	2	2
2014	2	2	1	1	12	13	15	16
2015	1	1	1	1	10	11	12	13
2016	2	3	1	1	11	12	14	16
2017	2	2	1	1	12	14	15	17

\* Section Markovci–Zavrč was not surveyed in 2013 due to unfavourable hydrological conditions during the entire breeding season. It is unlikely the species bred there in that year at all. / Odsek Markovci–Zavrč v letu 2013 ni bil popisan zaradi neugodnih hidroloških razmer med celotno gnezditveno sezono. Malo verjetno je, da je vrsta v tem letu tam sploh gnezdila.

**Figure 5:** Gravel bars occupied by individual breeding bird species (bars) and all existing gravel bars (grey area chart, N = 186) in a given number of years during the study period (10 years)**Slika 5:** Prodišča, ki so jih zasedale posamezne gnezdeče vrste ptic (stolpci) in vsa obstoječa prodišča (sivi polotčinski grafikon, N = 186) v določenem številu let obdobja raziskave (10 let)



**Figure 6:** Percentage of locations occupied by a given number of pairs of individual breeding bird species in study area of the Drava River

**Slika 6:** Odstotek lokacij, ki jih je zasedalo določeno število gnezdečih parov posameznih vrst ptic na raziskovanem območju reke Drave

the study area, and two further gravel bars were occupied in all years except in 2013 in the lower part. Overall, breeding took place in at least half of the study years at only 28.4% of gravel bars (Figure 5). On most gravel bars (62.6% locations), one pair bred. Four or more pairs on a single gravel bar were registered only at two locations in the upper part (one year, max 5 p) and at two locations in the lower part of the study area (all years of the 2014–2017 period, max 10 p) (Figure 6).

The 2009–2013 period with lower number of breeding pairs was followed by a substantial population increase from 2014 onwards. The multiplicative overall trend of Little Ringed Plover was estimated as a moderate increase with an annual increase of 4.3% ( $\pm 1.7$ ) (Figure 7).

#### 4.2. Common Sandpiper

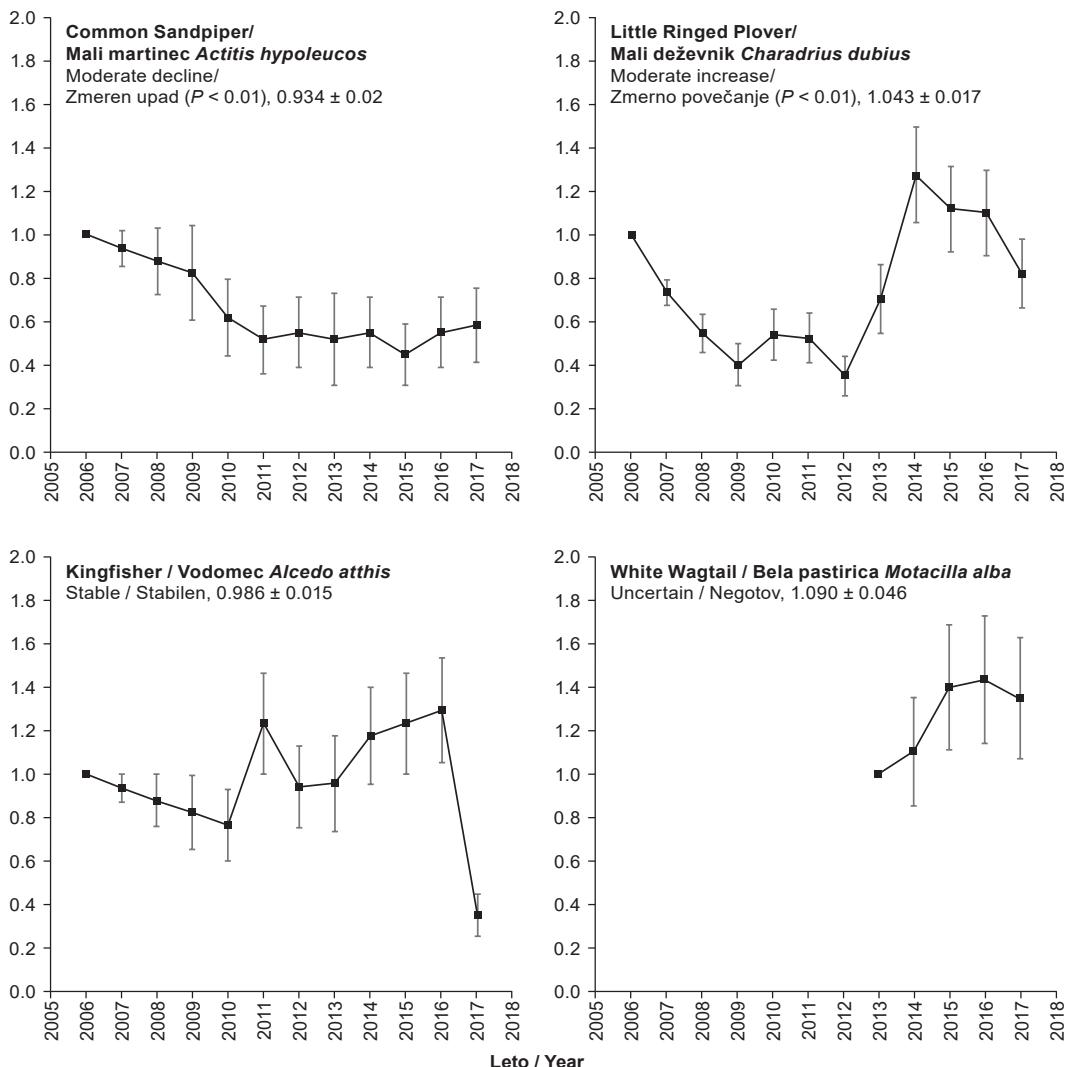
The Common Sandpiper breeding population was 25–29 pairs at the beginning of the study in 2006, but never exceeded 20 pairs after 2009. In the upper part, numbers were always fairly low and only single or few pairs bred there in most years (Table 4). Overall linear density varied from less than 0.1 p/

**Table 5:** Linear breeding density of Common Sandpiper *Actitis hypoleucus* in survey sections on the Drava River

**Tabela 5:** Linearna gnezditvena gostota malega martinca *Actitis hypoleucus* na popisnih odsekih reke Drave

Year/ Leto	Section / Odsek						Total / Skupaj	
	Maribor–Starše		Starše–Ptuj		Markovci–Zavrč		min	max
	min	max	min	max	min	max	min	max
2006	0.3	0.3	0.3	0.4	1.2	1.4	0.6	0.7
2009	0.3	0.3	0.4	0.4	1.0	1.1	0.6	0.6
2010	0.2	0.2	0.1	0.1	0.9	1.0	0.4	0.5
2011	0.1	0.1	0.2	0.2	0.8	0.9	0.4	0.4
2012	0.1	0.1	0.1	0.1	0.9	1.0	0.4	0.4
2013	0.1	0.1	0.1	0.1	-	-	0.1	0.1
2014	0.1	0.1	0.1	0.1	0.9	0.9	0.4	0.4
2015	0.1	0.1	0.1	0.1	0.7	0.8	0.3	0.3
2016	0.1	0.2	0.1	0.1	0.8	0.9	0.4	0.4
2017	0.1	0.1	0.1	0.1	0.9	1.0	0.4	0.4

\* Section Markovci–Zavrč was not surveyed in 2013 due to unfavourable hydrological conditions during the entire breeding season. It is unlikely the species bred there in that year at all. / Odsek Markovci–Zavrč v letu 2013 ni bil popisan zaradi neugodnih hidroloških razmer med celotno gnezditveno sezono. Malo verjetno je, da je vrsta v tem letu tam sploh gnezdila.



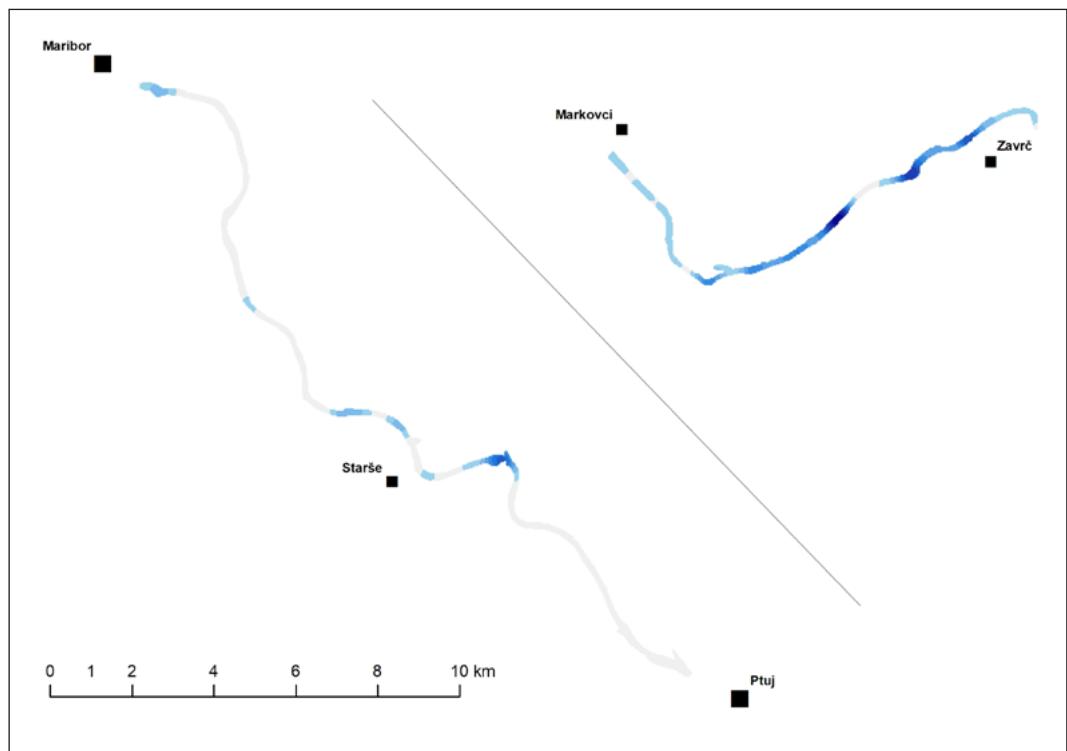
**Figure 7:** Population trends (multiplicative slope) and indices ( $\pm$  SE) of individual breeding bird species over the study period

**Slika 7:** Populacijski trendi (multiplikativen naklon) in indeksi ( $\pm$  SE) posameznih vrst ptic v obdobju raziskave

km in 2013 to 0.6–0.7 p/km in 2006. Only in the lower part of the study area Drava did it occasionally reach 1 p/km (max 1.2–1.4 p/km in 2006) (Table 5).

Common Sandpiper was widespread in the lower part of the study area. In the upper part, it was distributed mainly along some short middle and uppermost stretches, but was absent from most of the river course there (Figure 8).

The species was registered on 59 gravel bars of the study area (31.7% of all, annual range 2–23). Only two gravel bars on the upper part of the study area were occupied in more than two years, but none held breeding Common Sandpipers in all study years. In the lower part, two gravel bars held breeding pairs in all study years except 2013 and further four sites had breeding pairs in at least half of the study years



**Figure 8:** Density of Common Sandpiper *Actitis hypoleucus* after the kernel method, based on registrations of individuals during the entire study period ( $N = 258$  registrations of 415 ind.). The darker the shade of blue colour, the greater the density in that area. Outside blue-coloured areas, only single records may exist.

**Slika 8:** Gostota malega martinca *Actitis hypoleucus* po kernelski metodi na osnovi registracij osebkov v celotnem obdobju raziskave ( $N = 258$  zapisov o 415 os.). Temnejši ko je odtenek modre barve, večja je gostota na tistem območju. Zunaj modro obarvanih območij lahko obstajajo le posamezni podatki.

(13.6% of gravel bars) (Figure 5). On the majority of gravel bars (82.7% locations), single pairs bred. Simultaneous breeding three pairs was registered only at two gravel bars in the lower part of the study area (2009, 2010 and 2017) (Figure 6).

The number of breeding pairs declined notably at the turn of the decade and then remained similar further on. The multiplicative overall trend of Common Sandpipers was estimated as moderate decline with an annual decline of 6.6% ( $\pm 2.02$ ) (Figure 7).

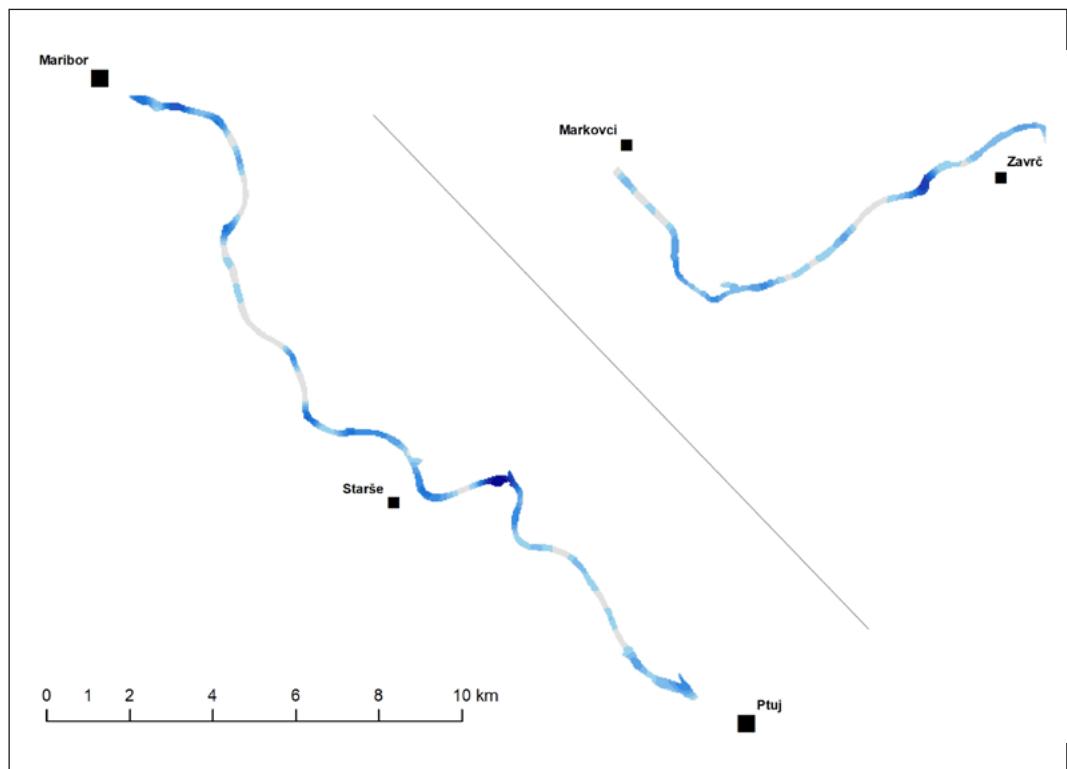
#### 4.3. Kingfisher

The number of Kingfisher pairs reached its lowest point with 6 pairs in the entire study area in 2017,

while the highest total number of 17–22 pairs bred in 2016 (Table 6). Overall linear densities showed little variation from 0.2 p/km to 0.4–0.6 p/km, being fairly similar also on the level of individual survey sections in most years (max 0.5–0.8 on the second in 2011 and 0.6–0.7 p/km on the third section in 2016) (Table 7). The shortest distance between nest sites of two simultaneously breeding pairs was 500 m in the upper part (2006) and 400 m in the lower part of the Drava (2014–2016).

Only a few short gaps (< 2 km) in its distribution were visible along the studied area of the Drava River (Figure 9). The multiplicative overall population trend was estimated as stable (Figure 7).

In total, 54 active Kingfisher nest holes were encountered at 23 locations during the study.



**Figure 9:** Density of Kingfisher *Alcedo atthis* after the kernel method, based on registrations of individuals during the entire study period ( $N = 341$  registrations of 373 ind.). The darker the shade of blue colour, the greater the density in that area. Outside blue-coloured areas, only single records may exist.

**Slika 9:** Gostota vodomca *Alcedo atthis* po kernelski metodi na osnovi registracij osebkov v celotnem obdobju raziskave ( $N = 341$  zapisov o 373 os.). Temnejši ko je odtenek modre barve, večja je gostota na tistem območju. Zunaj modro obarvanih območij lahko obstajajo le posamezni podatki.

Half of the nesting locations (52.2%) were occupied in more than one year, while only two locations were used by breeding Kingfishers in at least half of the study years (Figure 10), one in the upper (5 years) and one in the lower part (7 years) of the study area. The majority of nest holes were excavated in eroded river banks with an exposed steep surface of suitable alluvial soil along the main river channel (77.8%), followed by similar sites located in mouth areas of small tributaries of the Drava River (14.8%). Few nest holes were found in vertical sections of the fluvial terrace, and other features within the boundaries of the study area (Figure 11) (Appendix 3). The median height of

the Kingfisher's nest hole above water and nesting wall used was 2.0 m (range 0.3–15 m) and 2.5 m (range 0.5–15 m), respectively (Figure 12). The median length of a nesting wall was 20 m (range 3–350 m).

#### 4.4. Sand Martin

In the studied area of the Drava riverbed, Sand Martin bred from 2012 onwards at three different locations (1 in the upper and 2 in the lower part of the study area), with the number of pairs ranging from 55 to 259 (Table 8, Figure 13, Appendix 4). However, in any given year breeding occurred at

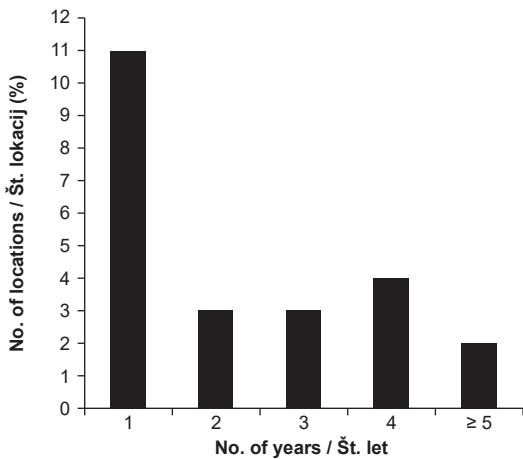
**Table 6:** Number of the Kingfisher *Alcedo atthis* breeding pairs in survey sections on the Drava River**Tabela 6:** Število gnezdečih parov vodomca *Alcedo atthis* na popisnih odsekih reke Drave

Year/ Leto	Section / Odsek						Total / Skupaj	
	Maribor-Starše		Starše-Ptuj		Markovci-Zavrč		min	max
	min	max	min	max	min	max	min	max
2006	4	7	4	5	4	5	12	17
2009	4	4	5	5	5	5	14	14
2010	2	4	1	3	5	6	8	13
2011	6	6	5	8	5	7	16	21
2012	6	7	4	4	4	5	14	16
2013	5	6	3	4	-	-	-	-
2014	5	8	5	6	5	6	15	20
2015	5	7	5	6	7	8	17	21
2016	5	8	4	4	8	10	17	22
2017	1	1	2	2	3	3	6	6

\* Section Markovci–Zavrč was not surveyed in 2013 due to unfavourable hydrological conditions during entire breeding season. / Odsek Markovci–Zavrč v letu 2013 ni bil popisan zaradi neugodnih hidroloških razmer tekom celotne gnezditvene sezone.

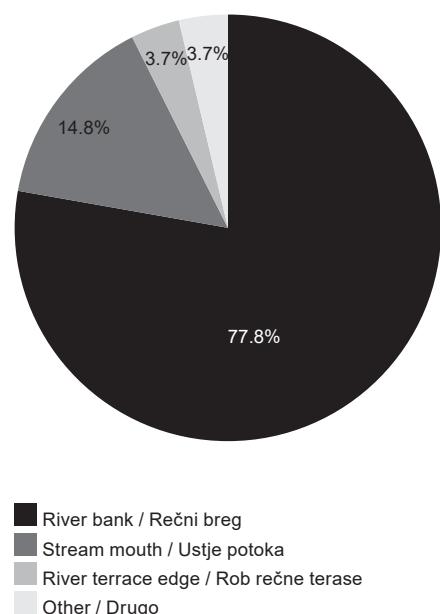
**Table 7:** Linear breeding density of Kingfisher *Alcedo atthis* in survey sections on the Drava River**Tabela 7:** Linearna gnezditvena gostota vodomca *Alcedo atthis* na popisnih odsekih reke Drave

Year/ Leto	Section / Odsek						Total / Skupaj	
	Maribor-Starše		Starše-Ptuj		Markovci-Zavrč		min	max
	min	max	min	max	min	max	min	max
2006	0.3	0.5	0.4	0.5	0.3	0.4	0.3	0.4
2009	0.3	0.3	0.5	0.5	0.4	0.4	0.4	0.4
2010	0.1	0.3	0.1	0.3	0.4	0.4	0.2	0.3
2011	0.4	0.4	0.5	0.8	0.4	0.5	0.4	0.5
2012	0.4	0.5	0.4	0.4	0.3	0.4	0.4	0.4
2013	0.3	0.4	0.3	0.4	-	-	-	-
2014	0.3	0.6	0.5	0.6	0.4	0.4	0.4	0.5
2015	0.3	0.5	0.5	0.6	0.5	0.6	0.4	0.5
2016	0.3	0.6	0.4	0.4	0.6	0.7	0.4	0.6
2017	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2



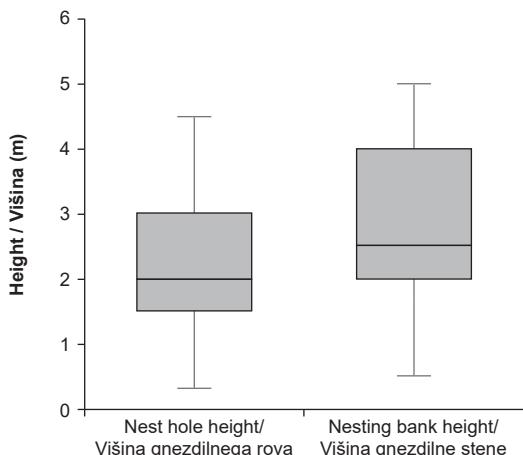
**Figure 10:** Occupancy of the Kingfisher *Alcedo atthis* nesting locations ( $N = 23$ ) in a given number of years during the study period (10 years)

**Slika 10:** Zasedenost gnezditvenih lokacij vodomca *Alcedo atthis* ( $N = 23$ ) v določenem številu let obdobja raziskave (10 let)



**Figure 11:** Odstotki različnih tipov gnezdišč vodomca *Alcedo atthis* ( $N = 54$  aktivnih gnezdlilnih rovov) na raziskovanem območju reke Drave

**Slika 11:** Odstotki različnih tipov gnezdišč vodomca *Alcedo atthis* ( $N = 54$  aktivnih gnezdlilnih rovov) na raziskovanem območju reke Drave



**Figure 12:** Height of Kingfisher *Alcedo atthis* nest hole and nesting bank in study area of the Drava River

**Slika 12:** Višina gnezdlilnega rova in gnezdlilne stene vodomca *Alcedo atthis* na raziskovanem območju reke Drave

only one location throughout, except in 2015, when a small colony (20 pairs) was established in an unaltered natural river bank beside the location specifically managed for the species.

#### 4.5. White Wagtail

Several tens of White Wagtail pairs bred in the study area from 2014 onwards, giving an overall linear density of up to 1.9–2.1 p/km. In all years with complete data, population was the highest in the lower part of the study area, where linear density reached 2.8–3.0 p/km in 2016 (Tables 9, 10).

The species was widespread along the entire study area, missing only along few short stretches (Figure 14). After somewhat lower numbers registered in the first two study years, population size remained remarkably similar further on, including the three survey sections. The multiplicative overall population trend of White

**Table 8:** Number of the Sand Martin *Riparia riparia* breeding pairs in survey sections on the Drava River in separate years. All separate pairs belonged to a single colony.

**Tabela 8:** Število gnezdečih parov breguljke *Riparia riparia* na popisnih odsekih reke Drave v posameznih letih. Vsi ločeno prikazani pari so pripadali eni koloniji.

Year/ Leto	Section / Odsek			Total/ Skupaj
	Maribor –Starše	Starše– Ptuj	Markovci –Zavrč	
2006	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	55	0	55
2013	0	259	0	259
2014	0	113	0	113
2015	0	40	20	60
2016	0	0	64	64
2017	0	0	96	96

Wagtail in the 2013–2017 period was estimated as uncertain (Figure 7).

White Wagtails were registered on 88 gravel bars in total (47.3% of all, annual range 46–53), constituting the stronghold of population breeding in the Drava riverbed. At six gravel bars on the upper part of the study area, the species bred in all years of the 2013–2017 period (5), and on further 16 in four years of the given period. Overall, three quarters of sites were occupied in two or more years (Figure 5). The majority of gravel bars (79.9% locations) held one pair (Figure 6). Furthermore, smaller numbers of White Wagtails also bred in natural and stabilised river banks on regular basis (Figure 15) (Appendix 5).

#### 4.6. Gravel bar habitats

The number of gravel bars and their total surface area in the studied area of the Drava River increased in the second half of the 10-year study period, from 91 in 2006 and 104 in 2009/10 (75.6–80.2 ha) to 135 in 2014 and 144 in 2016 (98.2–104.8 ha). From

**Table 9:** Number of the White Wagtail *Motacilla alba* breeding pairs in survey sections on the Drava River

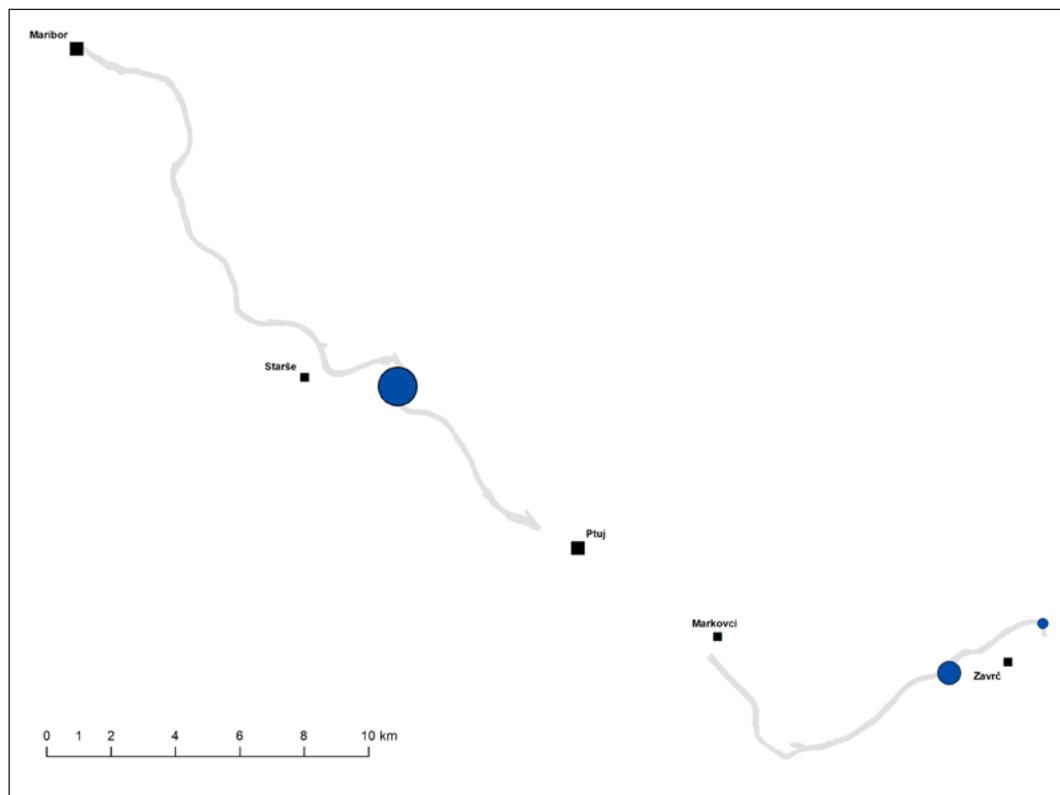
**Tabela 9:** Število gnezdečih parov bele pastirice *Motacilla alba* na popisnih odsekih reke Drave

Year/ Leto	Section / Odsek								Total / Skupaj
	Maribor–Starše		Starše–Ptuj		Markovci–Zavrč		min	max	
	min	max	min	max	min	max	min	max	
2013	12	12	16	17	-	-	-	-	-
2014	19	21	14	16	25	26	58	63	
2015	17	17	18	22	38	41	73	80	
2016	19	20	17	20	39	42	75	82	
2017	19	21	16	19	35	37	70	77	

2006 to 2009/2010, shingle area of gravel bars declined by one third (−32.9%), while herbaceous (+55.1%) and woody vegetation (+26.8%) increased substantially. In 2014, areas of shingle and herbaceous plants increased by 83.5% and 134.9%, respectively, reaching their highest values in the study period. At the same time area covered with woody vegetation declined by 35.0% to the lowest level recorded. Until 2016, however, significant

reduction of shingle area and expansion of woody vegetation occurred once more (Figure 16).

Management of gravel bars as defined herein was implemented at 20 sites (Figure 17). The majority of management works were carried out prior to the 2014 (10 sites) and 2017 (11 sites) breeding seasons and eight sites were managed in both periods. In the first period, the number of Little Ringed Plover and Common Sandpiper



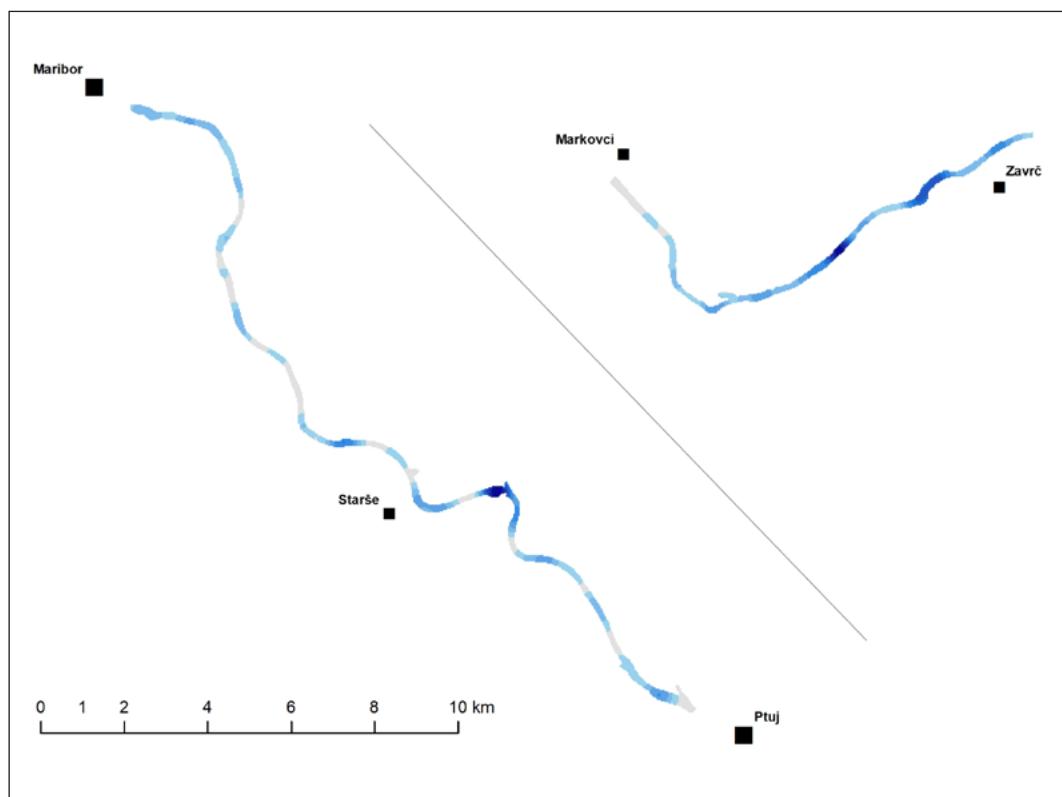
**Figure 13:** Locations of the Sand Martin *Riparia riparia* breeding colonies in study area of the Drava River. Size of the point corresponds to the maximum number of pairs registered.

**Slika 13:** Lokacije gnezditvenih kolonij breguljke *Riparia riparia* na raziskovanem območju reke Drave. Velikost točke ustreza največjemu zabeleženemu številu parov.

**Table 10:** Linear breeding density of White Wagtail *Motacilla alba* in survey sections on the Drava River

**Tabela 10:** Linearna gnezditvena gostota bele pastirice *Motacilla alba* na popisnih odsekih reke Drave

Year/ Leto	Section / Odsek							
	Maribor–Starše		Starše–Ptuj		Markovci–Zavrč		Total / Skupaj	
	min	max	min	max	min	max	min	max
2013	0.8	0.8	1.5	1.6	-	-	-	-
2014	1.3	1.5	1.3	1.5	1.8	1.9	1.5	1.6
2015	1.2	1.2	1.7	2.1	2.7	2.9	1.9	2.1
2016	1.3	1.4	1.6	1.9	2.8	3.0	1.9	2.1
2017	1.3	1.5	1.5	1.8	2.5	2.6	1.8	2.0



**Figure 14:** Density of White Wagtail *Motacilla alba* after the kernel method, based on registrations of individuals during the entire study period (started in 2013, N = 392 registrations of 659 ind.). The darker the shade of blue colour, the greater the density in that area. Outside blue-coloured areas, only single records may exist.

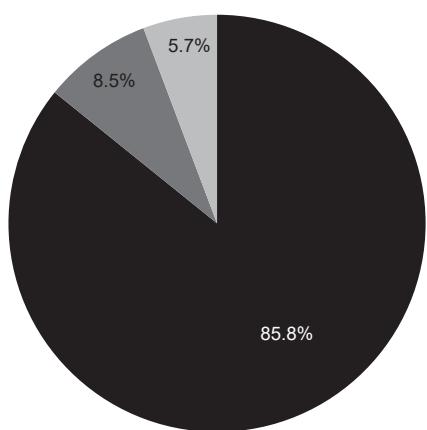
**Slika 14:** Gostota bele pastirice *Motacilla alba* po kernelski metodi na osnovi registracij osebkov v celotnem obdobju raziskave (začetek 2013, N = 392 zapisov o 659 os.). Temnejši ko je odtenek modre barve, večja je gostota na tistem območju. Zunaj modro obarvanih območij lahko obstajajo le posamezni podatki.

pairs (4,08-fold and 3,5-fold, respectively) as well as shingle area (5,07-fold) increased several-fold at these sites after the management implementation. Within 1–3 years thereafter (median = 2 years) the area of suitable habitat declined by 56.3%, but gravel bar-breeding species responded differently: Little Ringed Plover declined by one third (-32.7%), while the number of Common Sandpipers remained the same. After conclusion of the management during the second period, the shingle area increased again to 77.5% of the first-period level. At the same time, the number of Little Ringed Plover pairs at a given subset of gravel bars increased only slightly (+9.1%), while

Common Sandpiper increased by a further 42.9% (Figure 18, Appendix 6). Development of habitats at one of the major gravel bars throughout both management periods is presented in Appendix 7.

## 5. Discussion

Long-term monitoring enabled an insight into population development of several riverbed-breeding bird species over a 10-year period. Owing to a constant inter-annual fieldwork effort that followed the same protocol, and highly-efficient census of birds using a boat, supplemented by certain interpretation criteria, the population estimates obtained

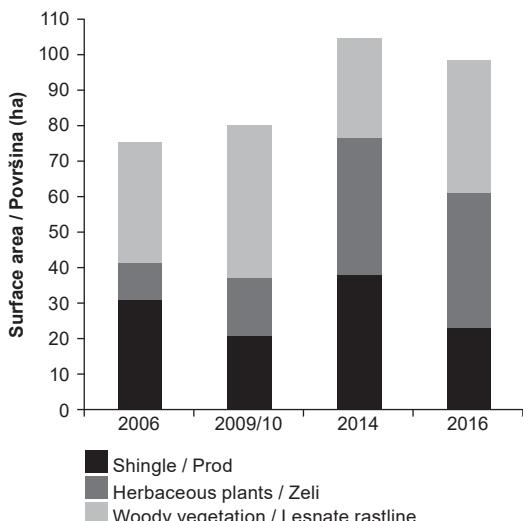


**Figure 15:** Percentages of the different White Wagtail *Motacilla alba* nest site types (N = 331 breeding pairs) in study area of the Drava River

**Slika 15:** Odstotki različnih tipov gnezdišč bele pastirice *Motacilla alba* (N = 331 gnezdečih parov) na raziskovanem območju reke Drave

are comparable between years and probably fairly close to their true values (e.g. GREGORY *et al.* 2004, FLETCHER & HUTTO 2006). The latter indication is supported by a high detection probability for territory-holding Little Ringed Plovers and especially Common Sandpipers found in different studies, resulting in high efficiency of line transects along rivers in estimating breeding numbers (YALDEN & HOLLAND 1993, D'AMICO 2002, ARLETTAZ *et al.* 2012).

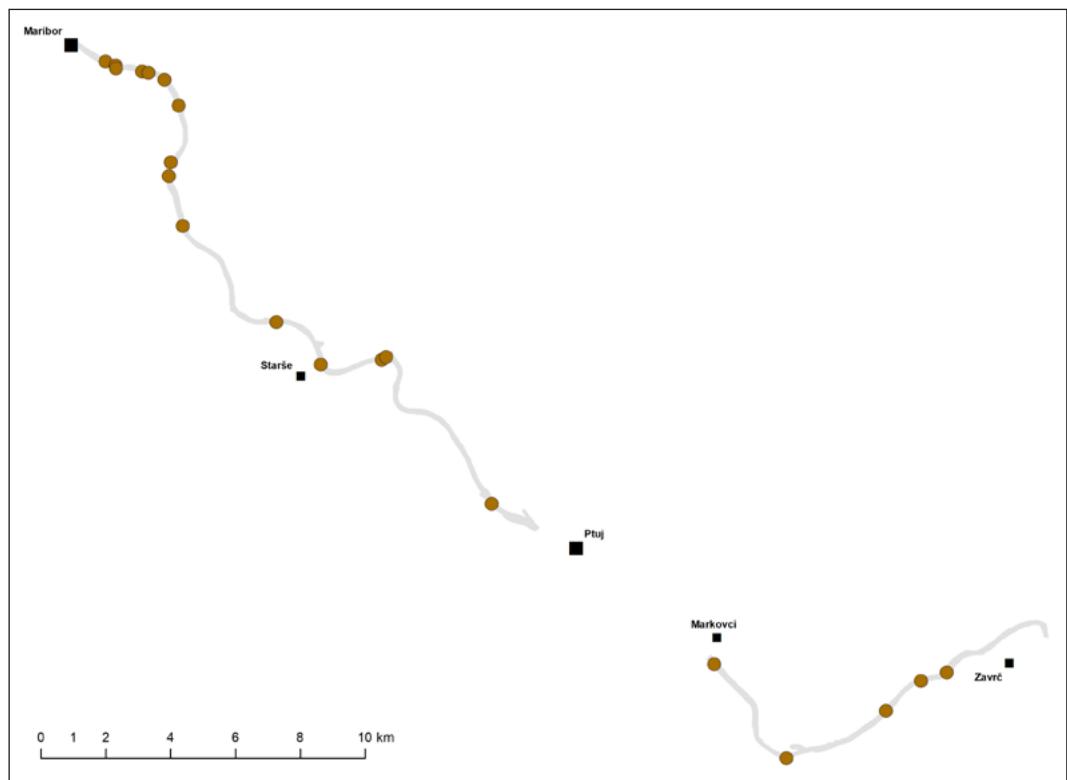
Among variations in numbers detected over time, large decline of Little Ringed Plover in the first part of the study period and subsequent rapid several-fold increase are remarkable. The most plausible explanation for such population development can be ascertained from substantial changes in surface area and proportions of the main habitats in the riverbed that reveal the same pattern of occurrence: reduction in shingle area and simultaneous encroachment of woody vegetation caused a decline of breeding pairs, while the reverse triggered a population recovery. In terms of well-known and rather simple habitat



**Figure 16:** Surface areas of the main gravel bar habitat types in study area of the Drava River in years with orthophoto images available (N = 186 gravel bars)

**Slika 16:** Površine glavnih tipov habitatov prodišč na raziskovanem območju reke Drave v letih z razpoložljivimi ortofotami (N = 186 prodišč)

requirements of the species (e.g. GEISTER 1997, BAUER *et al.* 2005, see also Appendix 1), this conclusion seems straightforward. However, underlying causes of the observed changes are fairly complex and comprise an interplay of occurrence of large discharges and implementation of appropriate management practices. 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 (GILVEAR *et al.* 2008). However, rivers with altered flow regime and diminished bedload transport are subjected to overgrowing, evolving over time into a stage where typical infrequent and reduced floods are insufficient to suppress vegetation growth (JUNK *et al.* 1989, REICH 1994, HICKS *et al.* 2008). This is also the case in the studied area of the Drava River where most of today's gravel bars are more or less stabilised remains of higher parts of the former riverbed bottom, which became dry after the reduction of discharges due to operation of hydroelectric power

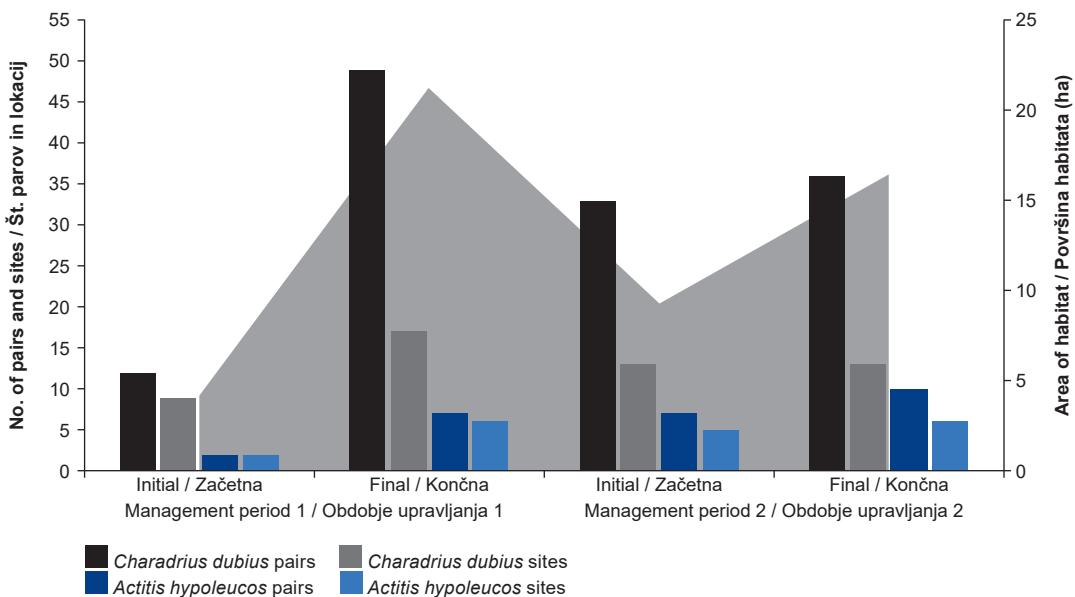


**Figure 17:** Locations of gravel bars in study area of the Drava River with management carried out between 2013 and 2017 ( $N = 20$ )

**Slika 17:** Lokacije prodišč na raziskovanem območju reke Drave, na katerih je potekalo upravljanje med letoma 2013 in 2017 ( $N = 20$ )

plants (SOVINC 1995, KLANEČEK *et al.* 2005). The amount of early successional stages and formation of new gravel bars is therefore dependent on rare and unpredictable high-flow events capable of starting bedload transport and mobilising confined gravel bars, i.e. discharges of min. 400–600 m<sup>3</sup>/s (hereafter referred to as “large discharges”) as estimated for the study area by KLANEČEK *et al.* (2005). This situation is reflected in: (1) the very low number of locations suitable for both specialised gravel bar-breeding bird species for more than a couple of years throughout the entire decade, and (2) the small area of individual patches of early successional stages, a phenomenon noted also on other rivers with a similarly altered flow regime (REICH 1994), making most of the gravel bars unable to hold more than

a single breeding pair. Therefore, the low Little Ringed Plover numbers during 2009–2012 can largely be attributed to the lack of large discharges and consequent overgrowing of the riverbed in this period. The intensity of any kind of management works was also fairly low at that time. As the turning point for the population increase after 2013, the following is of particular importance: (1) the extreme flood in early November 2012 when discharge in the riverbed reached the modern-time record value of 3,300 m<sup>3</sup>/s (KLANEČEK 2013), (2) the subsequent regular occurrence of large discharges prior to the 2014 and 2015 breeding seasons, (3) large-scale removal of woody vegetation on multiple gravel bars in the study area with several of them within the LIVEDRAVA project



**Figure 18:** Number of the Little Ringed Plover *Charadrius dubius* and Common Sandpiper *Actitis hypoleucus* breeding pairs and gravel bars occupied (bars) and surface area of suitable shingle habitat (area chart) in two management periods, 2013–2015 and 2016–2017. Initial and final situation for each management period is given (before and after the management implementation).

**Slika 18:** Število gnezdečih parov in zasedenih prodišč malega deževnika *Charadrius dubius* in malega martinca *Actitis hypoleucus* (nizi) ter površina primernega prodnatega habitata (ploščinski grafikon) v dveh obdobjih upravljanja, 2013–2015 in 2016–2017. Za vsako obdobje upravljanja je predstavljena začetna in končna situacija (pred in po izvedbi upravljanja).

specifically targeting habitat restoration of gravel bar breeding birds. Extreme floods are known to act as major drivers of intensive geomorphic processes within river corridors (JUNK *et al.* 1989). These can result in notable diversification of the river channel and formation of extensive areas of natural riverine habitats, followed by sudden several-fold increases of riverbed breeding bird populations, as demonstrated by KAJTOCH & FIGARSKI (2013). Evidently, both geomorphic changes mentioned took place in our study area (diversification by increased overall number of gravel bars, formation of new shingle areas) with similar-scale consequences for the Little Ringed Plover population. Also, management works carried out in the aftermath of the extreme flood created further new shingle areas, thus contributing substantially to the total surface area of suitable habitat for the species. Both major floods as well as restoration

measures were assessed as important factors in the Little Ringed Plover population increase on the Swiss section of the Rhone River (ARLETTAZ *et al.* 2012). Several high water events that coincided with management works in this period prevented immediate overgrowing of restored sites (see Appendix 7). It is known that large discharges have landscape-level implications in rivers by creating natural disturbance necessary to counter natural successional trends (WARD *et al.* 2002). Some evidence suggests that frequent large discharges can maintain stable Little Ringed Plover population by sustaining a favourable state of its breeding habitat (ZINTL 1988). Moreover, successive occurrence of both factors proved to be an effective combination for creating extensive shingle areas due to flushing of exposed organic material and soil particles from formerly overgrown gravel bars that became devoid of vegetation cover after management, and

enabled partial mobilisation and/or relocation of these gravel bars. By 2017, however, after an absence of large discharges prior to the two consecutive breeding seasons, the total Drava River Little Ringed Plover population declined again. At the same time, the number of pairs at sites managed during the second period increased only marginally despite substantial increase of suitable habitat area there. Thus, the notion that floods are a major factor in river channel restoration (KAJTOCH & FIGARSKI 2013) can be supported from the perspective of the Little Ringed Plover. However, very frequent increased discharges during the breeding season may have affected breeding in some years (e.g. low numbers on the upper part of the study area in 2009, 2010 and 2012), further aggravating the negative impact of riverbed overgrowing in that period. The disruptive effect of high water levels on the occupancy of the Little Ringed Plover and Common Sandpiper territories in the riverbed is reported by FENYÖSI (2005) and SCHMIDT (2016). The extreme situation in 2013 presumably completely prevented breeding in the lower part of the study area Drava as all gravel bars were under water due to constant large flow in the first half of the year.

On the other hand, causes of Common Sandpiper population development are more difficult to ascertain. Obviously, the total breeding population size of this species did not reflect changes in overall surface area of the main riverbed habitats, but instead, after an initial substantial decline, remained at a rather similar level during most of the study period. It seems that the decline noted in the study period is merely a continuation of a long-term negative trend as the total breeding population of the Slovenian lowland part of the Drava River in the late 1990s was even higher than in 2006 (ŠTUMBERGER 2000, BOŽIČ & DENAC 2010). This is in accordance with the decreasing European population trend, more pronounced in the EU countries (BIRDLIFE INTERNATIONAL 2015b). Some evidence exists that depletion of the Common Sandpiper populations is at least partly due to declining adult survival rates, related to changing conditions in wintering and migratory stopover areas, i.e. factors largely operating outside its European breeding grounds (PEARCE-HIGGINS *et al.* 2009). However, contrary to the general

situation, the number of breeding pairs on gravel bars subjected to vegetation removal first increased several-fold after the start of management and then again to a lesser extent by the end of it. Common Sandpiper readily accepts restored areas as several cases of population increases and re-colonisations, even on fairly short such sections of riverbed are documented from a wide array of rivers, from alpine to lowland. Different studies state promotion of alluvial habitats with some grass and bush/small trees cover, creation of richly structured areas with sufficient proportion of open surface, areas with numerous river islands and large gravel bars and river widening as main causes for population recovery (METZNER 2002, PETUTSCHNIG 2004, ARLETTAZ *et al.* 2012, UHL & WEISSMAIR 2012). Unlike the Little Ringed Plover, the Common Sandpiper numbers did not decline in a relatively short time scale between the two management episodes despite the accompanying reduction in shingle surface area. This can be explained by the fact that breeding habitat of the species at least partly consists of some areas with denser herbaceous vegetation as well, herein not treated as shingle habitat category (cf. FRÜHAUF & DVORAK 1996, ELAS & MEISSNER 2014, see also Appendix 2). Preference of Common Sandpiper for slightly more advanced succession stages also means that it is a later colonizer of newly created areas in river systems, as some time is needed before suitable habitats are progressively formed (ARLETTAZ *et al.* 2012). It is therefore possible that only as late as 2017, i.e. up to four years after the start of management measures, an optimal mosaic of early successional stages interspersed with shingle areas developed at main sites in our study area. Reasons for the scarcity of Common Sandpiper along the upper Drava, notably after 2009, despite existence of apparently suitable breeding sites there, remain unknown.

Although fairly widely distributed along the riverbed, the Kingfisher occurred in rather low densities throughout the study period. Similar low number of breeding locations occupied more than a few years throughout the study period to both specialised gravel bar breeders, suggests that causes for such a state probably originated in the altered flow regime with rare high-flow events, resulting in limited bank erosion and consequent overgrowing/lack of suitable nest sites. The latter was often judged

as a limiting factor for the Kingfisher populations (ČECH 2006, SCHMIDT & ZUNA-KRATKY 2009). Otherwise, long-term, up to several decades long, use of preferred nest sites is typical of the species (ČECH 2006, WIGGLER *et al.* 2015). This assumption is supported by (1) the moderate increase in number of pairs after the extreme 2012 flood that created some new exposed vertical surfaces by opening previously uniformly vegetated and/or consolidated river stretches, and (2) observations indicating that most of the new potential nest sites, even suboptimal (e.g. low above usual water level exposed to high risk of flooding), are usually occupied already in the first breeding season after formation (*own data*) as observed elsewhere (WESTERMANN & WESTERMANN 1998). Kingfisher is known to be susceptible to harsh winter conditions that can decimate its numbers, mainly through high mortality of adults caused by starvation due to prevented fishing on frozen waters (MORGAN & GLUE 1977, LIBOIS 1997, SACKL 1997, ČECH 2006, SCHMIDT & ZUNA-KRATKY 2009). Therefore, the prolonged period of the exceptionally severe winter temperatures in January 2017 (CEGNAR 2017) is probably responsible for very low number of pairs registered in the breeding season that year. Characteristics of nest sites in our study confirm the preference for nesting close to the bank top (ISOTTI & CONSIGLIO 1998, HARTWIG 2005, STRAKA & GRIM 2007), however, these features can also be related to the availability of a suitable soil layer in a situation of general nest site shortage.

Sufficiently sizeable exposed banks with suitable substrate for colonially nesting Sand Martin (e.g. HENEBERG 2003, BAUER *et al.* 2005) are only very rarely found along the studied area of the Drava riverbed. Such situation differs substantially from the remaining vast natural stretches of other major rivers in the region, including the Drava downstream of confluence with the Mura River (SZEP *et al.* 2003, REEDER *et al.* 2006, MIKUSKA & GRLICA 2013), but is typical for rivers with altered flow regime (e.g. SCHMIDT *et al.* 2015). Regular breeding since 2012 was almost exclusively a result of the annual artificial nest site preparation programme (manual removal of vegetation and shaping of proper inclination by a team of volunteers) initiated in that year.

The discovery of a previously unknown fairly large gravel bar-breeding population of White

Wagtail in the study area is interesting, considering the prevalent breeding habits of the species on the European scale. The species is a widespread breeding bird of open landscapes, in recent times closely associated with areas of various anthropogenic activities from agricultural land to settlements, while riverine habitats such as natural banks and gravel bars are considered its primary breeding habitat (BAUER *et al.* 2005). The latter were not described as nest sites neither in the old Slovenian ornithological literature (PONEBŠEK & PONEBŠEK 1934, KREČIČ & ŠUŠTERŠČ 1963) nor in more recent species accounts where only nesting in steep eroded banks, overhanging vegetation atop of melioration ditches and uprooted trees is mentioned (GEISTER 1995, BRAČKO 1997, TOME *et al.* 2005). Elsewhere, natural nest sites along rivers are mostly different cavities, niches or crevices and old holes of burrow-nesting species. Ground nesting in sparsely vegetated area, presumably the predominant nest placement type along the studied Drava riverbed, is usually only briefly mentioned as uncommon (BAUER *et al.* 2005, MAUMARY *et al.* 2007) and mainly confined to gravel bars (GLUTZ VON BLOTZHEIM & BAUER 1985). In a small proportion of ground nests found in dedicated studies, these were usually placed in holes, in dense herbaceous vegetation or well-sheltered by plant cover (woody or grass tussock). Nests in more or less open areas as recorded in the study area (see Appendix 5c) were rarely reported (LEINONEN 1974, MASON & LYCZYNSKI 1980). However, field observations and occupancy of breeding locations indicate that the White Wagtail readily selects more advanced succession stages there as well.

The Slovenian lowland part of the Drava River is among the most important areas for all riverbed breeding bird species of conservation concern in the country (DENAC *et al.* 2011). Linear densities of the Little Ringed Plover breeding pairs calculated for the good years (2006, 2014–2017) are higher than recorded on most comparable sections in Central Europe, where these only rarely exceed 1 p/km, mostly on wide, natural or restored stretches of large rivers (BOŽIČ & DENAC 2010, ARLETTAZ *et al.* 2012, SCHMIDT 2016). On the other hand, densities of Common Sandpiper were similar to the prevailing situation (THEISS *et al.* 1992, FRÜHAUF & DVORAK 1996, SCHÖDL 2006, SCHMIDT & ZUNA-KRATKY 2009, BOŽIČ & DENAC 2010,

SCHMID *et al.* 2010, SCHMIDT 2016). Densities in the lower part of the study area exceeded 1 p/km, a value characteristic of high-quality sections on a diverse array of rivers, only in the first two years (BOŽIČ & DENAC 2010, ARLETTAZ *et al.* 2012). However, exceptional densities along vast natural river corridors can surpass this value for both species by several-fold (e.g. REICH 1994, ELAS & MEISSNER 2014). The Kingfisher densities of well below 1 p/km found in the study area (c. one pair on 2–3 km of the studied riverbed on average) are typical of the rivers in Central Europe (BOŽIČ & DENAC 2010).

Our findings have some important conservation implications that should be considered in future management decisions tackling the lowland part of the Drava riverbed. The large carrying capacity of the study area for Little Ringed Plover under suitable conditions was clearly demonstrated. However, most of the time this carrying capacity is reduced substantially due to suppressed natural disturbance regime resulting in a relatively small amount of available breeding habitat (see CATLIN *et al.* 2016, ZIEGLER *et al.* 2017). Therefore, the ultimate goal would be to alter the prevailing regime towards one more similar to the natural disturbance flow regime (i.e. magnitude, frequency, seasonal timing, predictability, and/or duration of high-flow events) that would maintain a sufficient area of suitable habitat, supported by moderate management interventions. The evidence gathered suggests that synchronization of management with high-flow events, an outcome that occurs only on fairly rare occasions under currently existing river management and electric power generation practices, is probably the most feasible and cost-effective method to achieve good results in our situation. However, this estimate relies only on observed effects of these on population size and disregards the demographic aspects of the species. Plovers breeding in dynamic alluvial habitats exhibit behavioural adaptations to natural disturbances, including extreme floods, e.g. they increase their dispersal rates and reproductive output following high-flow events, with major influence of these on dynamics and the persistence of individual populations (CATLIN *et al.* 2016). A metapopulation viability analysis found that peak population persistence and abundance of

sand bar-breeding plover species would occur at a four-year return interval of high-flow events (ZIEGLER *et al.* 2017). Furthermore, dedicated studies indicate that neither artificially constructed or managed gravel bars cannot appropriately substitute natural river dynamics due to lower demographic parameters on these and/or rapid vegetation encroachment (CATLIN *et al.* 2011 & 2015, HUNT *et al.* 2018), the latter experienced at our managed sites as well. Important features of flood-created alluvial habitats were lower nesting densities over substantially increased areas of sandbar, and decreased nest and chick predation (HUNT *et al.* 2018). Based on these observations, future management efforts in the Drava riverbed should also incorporate the following: (1) regular bankfull discharges achieved by planned release of water over dams during extended periods without natural high-flow events; (2) implementation of river restoration measures that would enable bank erosion during high-flow events and consequent formation of new gravel bars through provision of gravel sediment (limited under existing conditions), such as removal of dysfunctional/unnecessary rock riprap; (3) large-scale (most of the gravel bars included) and complete removal of woody vegetation on regular basis, and synchronized with occurrence of high-flow events that would promote flood-assisted formation of extensive open and/or sparsely vegetated shingle areas.

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## 6. Povzetek

Med letoma 2006 in 2017 smo na 38,9 km dolgem odseku nižinskega dela struge Drave s spremenjenim pretočnim režimom zaradi hidroelektrarn med Mariborom in Zavrčem opravili vsakoletni popis gnezdilk, ki so indikatorske vrste naravnih rek. V štirih letih raziskave smo popisali tudi prodišča s kombinirano analizo ortofoto posnetkov in fotografij s terena. Vpliv upravljanja s prodišči smo preučili na 20 lokacijah. Mali deževnik *Charadrius dubius* se je pojavljal na 39,8 % vseh prodišč, vendar jih je bila večina zasedena le po nekaj let z enim samim gnezdečim parom. Nizkim številkom med letoma 2009 in 2012 (< 30 parov) je sledil strm porast populacije do maksimuma 66–73 parov (1,7–1,9 para/km) od leta 2014 naprej. To populacijsko dinamiko smo pripisali izostanku velikih pretokov (>500 m<sup>3</sup>/s) in posledičnemu zaraščanju struge v prvem delu raziskovalnega obdobja, porast v drugem delu pa nastanku številnih prodišč ( površina 20,6 ha v letih 2009/10 in 37,8 ha leta 2014) po izredni poplavi v zgodnjem novembру 2012, pojavlanju velikih pretokov med naslednjimi gnezditvenimi sezonomi in odstranjevanju lesne vegetacije. Gnezditvena populacija malega martinca *Actitis hypoleucus* je bila majhna in stabilna (< 20 parov) po začetnem upadu, spremembe v površini habitatov rečne struge nanjo niso imele vpliva in ni odražala splošnih sprememb v površini habitatov rečne struge. V nasprotju s celotnim območjem se je število gnezdečih parov na upravljenih prodiščih močno povečalo. Najviše število parov je bilo doseženo do štirih let po začetku upravljanja, saj je na glavnini območij še tedaj nastal optimalen habitatni mozaik zgodnjih sukcesijskih stadijev in prodnate podlage. Vrsta je bila splošno razširjena le na spodnjem odseku Drave. Vodomec *Alceo atthis* je bil splošno razširjen vzdolž struge z razmeroma majhno gostoto (približno en par na 2–3 km rečne struge), verjetno zaradi omejene erozije bregov in posledičnega pomanjkanja primernih gnezdišč. Populacija je ostala stabilna, ugotavljeni pa smo vpliv ostrih zim na

številčnost v posameznih letih. Večina gnezditvenih rogov je bila izkopana v erodiranih bregovih vzdolž glavne struge (77,8 %), manjši del pa v podobnem habitatu na manjših pritokih Drave (14,8 %). Redna gnezditve breguljke *Riparia riparia* po letu 2012 (do 259 parov, večinoma na eni lokaciji vsako leto) je bila skoraj izključno posledica vsakoletne priprave umetnih gnezdišč. Od začetka monitoring te vrste leta 2013 smo spremljali razmeroma veliko populacijo bele pastirice *Motacilla alba* na prodiščih, kjer gnezdi na tleh na skromno poraščenih delih. To je nenavadno, upoštevajoč njene prevladujoče gnezditvene navade v Evropi.

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## APPENDIX 1 / DODATEK 1

Breeding habitat of Little Ringed Plover *Charadrius dubius* in studied area of the Drava River. Presented here is the entire range of nest sites selected by the species in the study area, from completely bare shingle, varying among sites in sediment grain size and surface area (a–e) to gravel bars overgrowing with herbaceous and early stages of woody vegetation (f–l). In all cases, the actually occupied nest sites with confirmed breeding (nests found) are depicted. Photos: T. Basle (b), L. Božič (a, c–l)

Gnezditveni habitat malega deževnika *Charadrius dubius* na raziskovanem območju reke Drave. Predstavljen je celoten razpon gnezdišč, ki jih na območju raziskave izbira vrsta, od popolnoma golega proda, ki se med območji razlikuje v velikosti zrn sedimenta in površini (a–e), do prodišč, zaraščajočih se z zelmi in zgodnjimi fazami lesne vegetacije (f–l). V vseh primerih so prikazana dejansko zasedena gnezdišča s potrjenim gnezdenjem (najdena gnezda). Foto: T. Basle (b), L. Božič (a, c–l)

(a)



(b)



(c)



(d)



(e)



(f)



*Nadaljevanje dodatka 1 / Continuation of Appendix 1*

(g)



(h)



(i)



(j)



(k)



(l)



## APPENDIX 2 / DODATEK 2

Breeding habitat of Common Sandpiper *Actitis hypoleucus* in studied area of the Drava River. Presented are different nest sites of the species on the study area, from mostly unvegetated gravel bars (a-c) to areas with predominant dense herbaceous vegetation (d-f). On the former sites, nests are situated next to solitary herbs or under stranded large woody debris, while on the latter sites they are placed along edges, close to more open areas. In all cases, the actually occupied nest sites with confirmed breeding (nests found) are depicted. Photos: L. Božič

Gnezditveni habitat malega martinca *Actitis hypoleucus* na raziskovanem območju reke Drave. Predstavljena so različna gnezdišča vrste na območju raziskave, od večinoma neporaslih prodišč (a-c) do območij s prevladujočo gosto zarastjo zeli (d-f). Na prvih gnezda ležijo ob posameznih zelnatih rastlinah ali pod naplavljenimi debli, medtem ko so na slednjih nameščena vzdolž robov, v bližini bolj odprtih predelov. V vseh primerih so prikazana dejansko zasedena gnezdišča s potrjenim gnezdenjem (najdena gnezda). Foto: L. Božič

(a)



(b)



(c)



(d)



(e)



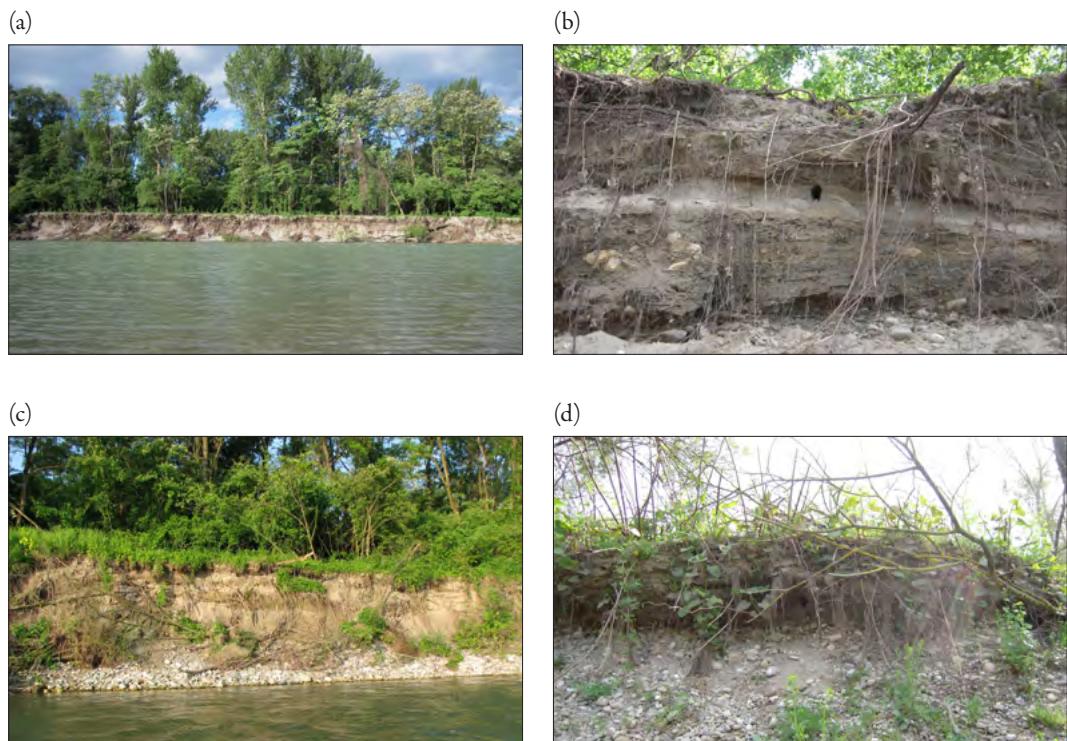
(f)



### APPENDIX 3 / DODATEK 3

Kingfisher *Alcedo atthis* nest sites in studied area of the Drava River: (a) long natural section of concave river bank, (b) freshly eroded river bank with exposed vertical surface of suitable alluvial soil, (c) partly overgrown high river bank, (d) river bank with rather thin layer of suitable soil, (e) river bank completely obscured by overhanging vegetation, (f) the longest occupied nest site in the study area formed by bank erosion at location of damaged old rock riprap, (g) mouth area of small stream, (h) nest hole excavated low above water in a small suitable surface of a stream mouth, (i) river terrace edge 15 m above the river, (j) unusual nest site in a sloping edge of river island with nest hole only 30 cm above water. Photos: L. Božič (a–e, g–j), D. Denac (f)

Gnezdišča vodomca *Alcedo atthis* na raziskovanem območju reke Drave: (2) dolg naraven odsek zunanjega rečnega brega, (b) sveže erodiran rečni breg z izpostavljenim navpično površino, primerne obrečne prsti, (c) delno zaraščen visok rečni breg, (d) rečni breg z dokaj ozko plastjo ustrezne prsti, (e) z visečo vegetacijo povsem zakrit rečni breg, (f) najdlje zasedeno gnezdišče, nastalo z erozijo brega na mestu, kjer je bil poškodovan star kamnomet, (g) območje ustja majhnega potoka, (h) gnezditni rov, izkopan nizko nad vodo v majhni primerni površini ustja potoka, (i) ježa rečne terase 15 m nad reko, (j) neobičajno gnezdišče v poševnem robu rečnega otoka z gnezditnim rovom le 30 cm nad vodo. Foto: L. Božič (a–e, g–j), D. Denac (f)



(e)



(f)



(g)



(h)



(i)



(j)



#### APPENDIX 4 / DODATEK 4

The Sand Martin *Riparia riparia* colonies in specially prepared natural banks in the Drava riverbed: (a) nest holes at location on the upper part of the study area managed between 2012 and 2016 (occupied in 2012–2015), (b) section of nesting wall on the lower part of the study area where management was carried out in the 2014–2017 period (occupied since 2016), (c) view of the entire stretch of natural river bank with the Sand Martin nest sites on the upper part of the study area at the beginning of breeding season. Photos: L. Božič

Kolonije breguljk *Riparia riparia* v posebej pripravljenih naravnih bregovih v strugi reke Drave: (a) gnezditni rovi na lokaciji na zgornjem delu območja raziskave z upravljanjem med letoma 2012 in 2016 (zasedena 2012–2015), (b) odsek gnezditne stene na spodnjem delu območja raziskave, kjer je upravljanje potekalo v obdobju 2014–2017 (zasedena od 2016), (c) pogled na celotno dolžino naravnega rečnega brega z gnezdišči breguljke na zgornjem delu v začetku gnezditvene sezone. Foto: L. Božič

(a)



(b)



(c)



## APPENDIX 5 / DODATEK 5

The White Wagtail *Motacilla alba* nest sites in the study area of the Drava River: (a, b) tuft of herbaceous plants on partly overgrown part of the gravel bar, (c) rather open shingle area with nest unconcealed from above, (d) root system of large tree stranded on gravel bar, (e) natural river bank, (f) crevice between boulders in rock riprap. In all cases, the actually occupied nest sites with confirmed breeding are depicted. Photos: L. Božič

Gnezdišča bele pastirice *Motacilla alba* na raziskovanem območju reke Drave: (a, b) šop zelnatih rastlin na delno zaraščenem delu prodišča, (c) dokaj odprta prodnata površina, kjer gnezdo od zgoraj ni zakrito, (d) koreninski sistem velikega drevesa, naplavljjenega na prodišču, (e) naravni rečni breg, (f) razpoka med skalami v kamnometu. V vseh primerih so prikazana dejansko zasedena gnezdišča s potrjenim gnezdenjem. Foto: L. Božič

(a)



(b)



(c)



(d)



(e)



(f)



## APPENDIX 6 / DODATEK 6

Number of the Little Ringed Plover *Charadrius dubius* and Common Sandpiper *Actitis hypoleucus* breeding pairs and surface area of suitable shingle habitat on all managed gravel bars in two periods, 2013–2015 and 2016–2017. Initial and final situations for each period and year of data are given. Bold font denotes sites with management carried out in a given period. Gravel bars 35 (Starše), 37 and 700 (Krčevina pri Vurbergu), 49 (Hajdoše), 6000 (Dravci), 76 (Borl) and 82 (Mala vas) were managed within the LIVEDRAVA project.

Število gnezdečih parov malega deževnika *Charadrius dubius* in malega martinca *Actitis hypoleucus* ter površina primerrega prodnatega habitata na vseh upravljanih prodiščih v dveh obdobjih, 2013–2015 in 2016–2017. Za vsako obdobje sta predstavljena začetna in končna situacija ter leto podatka. Krepka pisava označuje območja, na katerih je v določenem obdobju potekalo upravljanje. Na prodiščih 35 (Starše), 37 in 700 (Krčevina pri Vurbergu), 49 (Hajdoše), 6000 (Dravci), 76 (Borl) in 82 (Mala vas) je bilo upravljanje opravljeno v okviru projekta LIVEDRAVA.

Gravel bar ID/ ID prodišča	Management period 1 / Obdobje upravljanja 1								
	Initial situation / Začetna					Final situation / Končna			
	CHADUB pairs / pari	ACTHYP pairs/ pari	Habitat (m <sup>2</sup> )	Year/ Leto	CHADUB pairs / pari	ACTHYP pairs/ pari	Habitat (m <sup>2</sup> )	Year/ Leto	
0	1	0	7449	2013	<b>2</b>	0	<b>39828</b>	<b>2014</b>	
401	0	0	6427	2013	1	1	7082	<b>2014</b>	
402	0	0	0	2011	<b>1</b>	0	<b>5838</b>	<b>2013</b>	
601	0	0	308	2013	<b>2</b>	0	<b>2092</b>	<b>2014</b>	
602	0	0	0	2013	<b>1</b>	0	<b>5764</b>	<b>2014</b>	
7	1	0	544	2011	<b>3</b>	0	<b>12032</b>	<b>2014</b>	
901	0	0	0	2013	<b>1</b>	0	<b>2381</b>	<b>2014</b>	
132	0	0	1836	2013	<b>2</b>	0	<b>9118</b>	<b>2014</b>	
15	1	0	317	2011	<b>0</b>	0	<b>8513</b>	<b>2013</b>	
18	0	0	238	2011	<b>1</b>	0	<b>12286</b>	<b>2013</b>	
27	0	0	1210	2014	<b>0</b>	0	<b>4493</b>	<b>2015</b>	
35	1	0	2540	2013	<b>3</b>	0	<b>8958</b>	<b>2014</b>	
37	1	1	2617	2014	<b>4</b>	1	<b>16639</b>	<b>2015</b>	
700	3	0	4020	2013	<b>3</b>	0	4016	<b>2014</b>	
49	1	0	784	2014	<b>1</b>	0	<b>5459</b>	<b>2015</b>	
512	0	0	0	2013	<b>2</b>	1	<b>3852</b>	<b>2014</b>	
6000	2	1	3807	2014	<b>3</b>	1	8081	<b>2015</b>	
76	1	0	3263	2013	<b>9</b>	2	<b>12642</b>	<b>2014</b>	
3800	0	0	0	2013	0	0	403	2014	
82	0	0	6910	2013	<b>10</b>	1	<b>43279</b>	<b>2014</b>	
Total / Skupaj	12	2	42270		49	7	212756		

Management period 2 / Obdobje upravljanja 2									
Gravel bar ID/ ID prodišča	Initial situation / Začetna					Final situation / Končna			
	CHADUB pairs / pari	ACTHYP pairs/ pari	Habitat (m <sup>2</sup> )	Year/ Leto	CHADUB pairs / pari	ACTHYP pairs/ pari	Habitat (m <sup>2</sup> )	Year/ Leto	
0	1	1	6942	2016	2	0	7982	2017	
401	1	0	1924	2016	1	1	4441	2017	
402	0	0	852	2016	1	1	22281	2017	
601	2	0	1248	2016	0	0	0	2017	
602	0	0	1135	2016	2	0	3767	2017	
7	2	0	298	2016	2	0	7945	2017	
901	1	0	754	2016	0	0	0	2017	
132	2	0	2330	2016	0	0	320	2017	
15	0	0	1780	2016	0	0	0	2017	
18	1	0	7279	2016	2	0	4815	2017	
27	0	0	4021	2016	0	0	0	2017	
35	2	0	1350	2016	2	0	13516	2017	
37	3	0	6981	2016	3	0	15264	2017	
700	2	1	3737	2016	2	0	4574	2017	
49	0	0	1571	2016	0	0	671	2017	
512	0	0	176	2016	0	0	0	2017	
6000	2	1	5376	2016	2	1	5026	2017	
76	7	2	7671	2016	7	3	15400	2017	
3800	0	0	0	2015	2	2	13487	2016	
82	7	2	37274	2016	8	2	45715	2017	
Total / Skupaj	33	7	92699		36	10	165204		

## APPENDIX 7 / DODATEK 7

Development of habitats on one of the most important gravel bars in studied area of the Drava River at Borl (ID No. 76, 46.37°N, 16.00°E) throughout the two management periods (all photos taken from bridge above the uppermost tip of the gravel bar at usual discharge except where noted): (a) situation before the start of management 1 – lower two thirds are completely overgrown with trees and bushes, 29 Aug 2013, (b) view after the conclusion of management 1, carried out in late Sep–first half of Oct, and several following high water events with max discharge 580 m<sup>3</sup>/s, 12 Dec 2013, (c) the first breeding season after management 1, 29 May 2014, (d) autumn aspect after several high water events with max discharge 1063 m<sup>3</sup>/s, 13 Oct 2014, (e) the second breeding season after management 1, 7 Jun 2015, (f) autumn situation without preceding large discharges, 8 Oct 2015, (g) almost completely submerged gravel bar at c. 320 m<sup>3</sup>/s, 15 Oct 2015, (h) the third breeding season after management 1, 26 May 2016, (i) late autumn situation without preceding large discharges, just prior to the start of management 2, 15 Nov 2016, (j) gravel bar immediately after conclusion of management 2 that was not followed by any large discharge during the corresponding non-breeding period, 29 Nov 2016, (k) the first breeding season after management 2, 4 Jun 2017; series of available aerial photographs (orthophotos): (l) situation before the extreme 2012 flood and the start of management, 30 Apr 2010, (m) during the first breeding season after management 1, 20 May 2014, and (n) during the third breeding season after management 1, 21 Apr 2016; photos: A. Koren (a, b), L. Božič (c–k), The Surveying and Mapping Authority of the Republic of Slovenia (l–n).

Razvoj habitatov na enem izmed najpomembnejših prodišč na raziskovanem območju reke Drave pri Borlu (ID št. 76, 46.37°N, 16.00°E) v času dveh obdobjij upravljanja (vse fotografije so bile narejene z mosta nad zgornjim koncem prodišča pri običajnih pretokih, razen kjer je navedeno drugače): (a) situacija pred začetkom upravljanja 1 – spodnji dve tretjini sta v celoti zaraščeni z drevesi in grmovjem, 29. 8. 2013, (b) pogled po zaključku upravljanja 1, opravljenega med koncem septembra in prvo polovico oktobra, in več sledеčih visokovodnih dogodkih z največjim pretokom 580 m<sup>3</sup>/s, 12. 12. 2013, (c) prva gnezditvena sezona po upravljanju 1, 29. 5. 2014, (d) jesenski vidik po več visokovodnih dogodkih z največjim pretokom 1063 m<sup>3</sup>/s, 13. 10. 2014, (e) druga gnezditvena sezona po upravljanju 1, 7. 6. 2015, (f) jesenska situacija brez predhodnih velikih pretokov, 8. 10. 2015, (g) skoraj v celoti potopljeno prodišče pri c. 320 m<sup>3</sup>/s, 15. 10. 2015, (h) tretja gnezditvena sezona po upravljanju 1, 26. 5. 2016, (i) poznojesenska situacija brez predhodnih velikih pretokov, tik pred začetkom upravljanja 2, 15. 11. 2016, (j) prodišče takoj po zaključku upravljanja 2, ki mu v pripadajočem negnezditvenem obdobju ni sledil noben velik pretok, 29. 11. 2016, (k) prva gnezditvena sezona po upravljanju 2, 4. 6. 2017; serija razpoložljivih aerofotografij (ortofotov): (l) situacija pred ekstremno poplavo leta 2012 in začetkom upravljanja, 30. 4. 2010, (m) med prvo gnezditveno sezono po upravljanju 1, 20. 5. 2014, (n) med tretjo gnezditveno sezono po upravljanju 1, 21. 4. 2016; foto: A. Koren (a, b), L. Božič (c–k), Geodetska uprava Republike Slovenije (l–n).

(a)



(b)



(c)



(d)



(e)



(f)



(g)



(h)



*Nadaljevanje dodatka 7 / Continuation of Appendix 7*

(i)



(j)



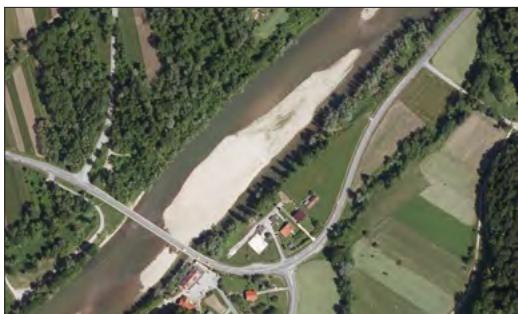
(k)



(l)



(m)



(n)



## TRENDI PTIC KMETIJSKE KRAJINE NA GORIČKEM

### Population trends of Goričko agricultural landscape birds

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Due to numerous bird surveys in the past 20 years, the avifauna of Goričko is relatively well known. For some species, the very first national ecological researches were conducted in this area. The article summarizes all bird surveys so far. It presents population trends of farmland species which is one of the most threatened bird groups in Europe. Most of the qualifying species of this habitat that are protected within the Natura 2000 network have suffered a decline at Goričko, specifically Quail *Coturnix coturnix*, Scops Owl *Otus scops*, Hoopoe *Upupa epops*, Woodlark *Lullula arborea* and White Stork *Ciconia ciconia*. The number of breeding pairs of the latter has not changed, but its fecundity has decreased. Furthermore, populations of other farmland bird species have decreased, for example Skylark *Alauda arvensis*, Stonechat *Saxicola rubicola*, Serin *Serinus serinus* and Common Linnet *Linaria cannabina*, as well as butterfly populations and tracts of grassland habitat types. National agricultural and nature conservation policies are evidently inefficient in protecting the biodiversity of Goričko. The most probable cause for bird population decline is agricultural intensification, which manifests itself at Goričko as disappearance and intensification of meadows, land consolidation, degradation of traditional orchards and use of pesticides. As a result of land consolidation hedges, uncultivated strips between fields, individual trees and bushes and minority habitat types are disappearing, whereas the surface of arable fields is increasing. Nature conservation measures performed by the Public Institute Goričko Nature Park with the support of DOPPS – BirdLife Slovenia volunteers seem to be efficient, but are spatially and temporally constrained. For this reason, they cannot serve as a substitute for insufficient systemic financing which could be improved by substantive and financial reform of the agri-environmental scheme. Currently, a negligible percentage (1% in 2016) of Goričko is covered by agri-environmental scheme measures with positive influence on qualifying species and habitat types. As a consequence, only an insignificant share of subsidies from the Rural Development Plan is used for nature protection at Goričko. If the system of agricultural subsidies remains unaltered, no improvement of the conditions for bird conservation at Goričko can be expected.

**Ključne besede:** ptice, populacijski trend, kmetijska krajina, območje Natura 2000 Goričko

**Key words:** birds, population trend, agricultural landscape, Natura 2000 site Goričko

## 1. Uvod

Populacije pogostih ptic kmetijske krajine v Evropi so v obdobju 1980–2006 upadle za skoraj polovico (Voříšek *et al.* 2010). Njihov upad je bil v obdobju 1982–2014 manjši (-46 %) v novih članicah Evropske unije (EU), kamor sodi tudi Slovenija, kot pa v starih članicah EU (-57 %) (EBCC 2017a). Hitreje upadajo populacije stalnic in selivk na kratke razdalje, kar kaže na slabšanje njihovih življenjskih razmer v EU (Voříšek *et al.* 2010). Največji upad številčnosti in biomase so doživele pogoste vrste, medtem ko so nekatere redke vrste zaradi usmerjenih varstvenih ukrepov doživele celo porast (INGER *et al.* 2015). V Sloveniji so ptice kmetijske krajine v obdobju 2008–2016 doživele 24,6-odstotni upad (KMECL & FIGELJ 2016). Varstvo ptic, uvrščenih na Dodatek I Direktive o pticah, je glede na populacijske tendre na nivoju EU sicer uspešno (DONALD *et al.* 2007), ne pa tudi v Sloveniji, kjer populacije mnogih kvalifikacijskih vrst ptic na območjih Natura 2000 kljub formalnemu varstvu upadajo (DENAC *et al.* 2016).

Poglavitni habitat polovice od 14 kvalifikacijskih vrst ptic območja Natura 2000 Goričko (Ur. l. RS 33/2013) je kmetijska krajina. Prvi sistematični popisi ptic so se na Goričkem pričeli konec 90. let 20. stoletja. V letih 1997 in 1998 je bil na 22 popisnih ploskvah opravljen popis vrst odprte kmetijske krajine, ki je bil nato ponovljen v letih 2014 in 2016. Leta 1997 je bil narejen prvi popis velikega skovika *Otus scops* (ŠTUMBERGER 2000), leta 1999 pa popis bičeje trstnice *Acrocephalus schoenobaenus* pri Ledavskem jezeru (Božič 2000). Od leta 1999 redno spremljamo populacijo bele štoklje *Ciconia ciconia* (DENAC 2001, 2010), od leta 2004 velikega skovika in od leta 2005 hribskega škranca *Lullula arborea* (DENAC *et al.* 2015, 2016), pri čemer popise kot del državnega monitoringa območij Natura 2000 od leta 2004 sofinancira Republika Slovenija. Druge vrste kmetijske krajine so od leta 2008 vključene v popise za izračun slovenskega indeksa ptic kmetijske krajine (SIPKK). Za namen SIPKK na Goričkem popisujemo pet dvokilometrskih transektov (KMECL & FIGELJ 2016). Opravljena sta bila tudi dva celostna transektna popisa ptic, in sicer v obdobju 2003–2010 za novi ornitološki atlas gnezdk (35 transektov) ter leta 2012 za projekt Upkač (59 transektov) (DENAC & KMECL 2014). V okviru slednjega sta bili napravljeni

tudi ekološki raziskavi smrdokavre *Upupa epops* in velikega skovika, v katerih smo raziskali njuno prehrano in prehranjevalne habitate (DENAC & KMECL 2014, PODLETNIK & DENAC 2015). Za nekatere izmed kvalifikacijskih vrst smo opravili tudi posebne popise v okviru projekta Gorički travniki (npr. DENAC 2015a, b, KMECL 2015a, b), hkrati pa smo s pomočjo GPS-telemetrije nadgradili tudi znanje o prehranjevalnih habitatih velikega skovika (DENAC & KMECL 2016). Večina rezultatov izkazuje, da se je na Goričkem od konca 20. stoletja zgodil upad populacij ptic kmetijske krajine, ki je pri nekaterih vrstah znaten (npr. pri prepelci *Coturnix coturnix*, DENAC 2015a). Namen članka je predstaviti njihove trende na podlagi vseh dosedanjih popisov in ponuditi razlago zanje. V podporo slednji smo zbrali tudi vse pomembnejše doslej uresničene varstvene ukrepe za vrste in habitatne tipe ter podatke o obsegu vpisanih kmetijsko okoljskih in kmetijsko okoljsko podnebnih ukrepov v obdobju 2007–2016, ki naj bi prispevali k varstvu narave na Goričkem.

## 2. Metode

### 2.1. Opis območja

Goričko je eno od 31 območij Natura 2000 za ptice (SPA) v Sloveniji, hkrati pa je opredeljeno tudi kot krajinski park (Ur. l. RS 101/2003) (slika 1). SPA Goričko meri 40.203 ha, krajinski park pa 46.268 ha. Goričko je kot območje Natura 2000 varovano tudi po Direktivi o habitatih, in sicer za 7 habitatnih tipov in 25 vrst (URADNI LIST RS 2016a).

Goričko je gričevnat svet s slabo rodovitnimi kislimi in peščenimi prstmi, zaradi česar so možnosti za razvoj kmetijstva slabše kot na Pomurski ravnini. Po nekaterih kazalnikih je to naša najbolj demografsko ogrožena pokrajina, ki jo označuje dolgoletna prometna izoliranost brez kakršnegakoli večjega središča (SENEGAČNIK 2012). Posledično je bilo Goričko do nedavnega ena najbolj ekstenzivno obdelanih pokrajin v Sloveniji, še sedaj pa se tam prepletajo suhi, vlažni in mezofilni travniki, visokodebelni sadovnjaki, njive, površine v zaraščanju, gozd, mejice, mokrišča in vode (umetna jezera, reke, potoki, kali). Pestrost habitatov se kaže v velikem pomenu Goričkega za dvoživke (CIPOT & LEŠNIK 2007), ribe (GOVEDIČ & ŠALAMUN 2006), ptice (DENAC 2000, Božič



**Slika 1:** Primerjava meja Krajinskega parka Goričko (črna črta) in SPA Goričko (šrafirano). Vir: topografska karta 1:500.000, GURS

**Figure 1:** A comparison of boundaries of Goričko Nature Park (black line) and the Goričko SPA (shaded grey).  
Source: Topographic map 1:500,000, GURS

2003, DENAC *et al.* 2011a), netopirje (KRYŠTUFEK *et al.* 2003, PRESETNIK 2006), vidro (HÖNIGSFELD ADAMIČ 2003, 2009), metulje (REBEUŠEK *et al.* 2006, ZAKŠEK *et al.* 2012, VEROVNIK *et al.* 2015, VEROVNIK 2015), hrošče (VREZEC *et al.* 2006, 2007), kačje pastirje (KOTARAC *et al.* 2006, ŠALAMUN & KOTARAC 2016) ter travniške in gozdne habitatne tipe (JOGAN *et al.* 2004, TRČAK *et al.* 2012).

## 2.2. Pregled popisov ptic Goričkega

Na območju Krajinskega parka Goričko je bilo med letoma 1997 in 2016 opravljenih več popisov ptic. Le popisi za novi ornitološki atlas Slovenije (NOAGS) so zajeli vse vrste gnezdilk, medtem ko so se vsi drugi popisi osredotočili na posamezne vrste oziroma skupine ptic (tabela 1). Popise ptic je opravilo Društvo za opazovanje in proučevanje ptic

**Tabela 1:** Popisi ptic, opravljeni na Goričkem med letoma 1997 in 2016

**Table 1:** Bird surveys conducted in Goričko between 1997 and 2016

Ime popisa/ Survey name	Metoda popisa/ Survey method	Št. popisnih enot / No. of survey units	Obdobje zajema podatkov in viri objav / Time period and bibliographic sources	Financiranje raziskave/ Survey financing	Opombe / Notes
ploskovni popis	popis na površini (»area count«) (VAN DIJK 1992)	22 ploskev (glej sliko 2 v Prilogi)	<b>prvi popis:</b> 1997 (14 ploskev) in 1998 (8 ploskev) <b>ponovitev</b> <b>popisa:</b> 2014 (19 ploskev) in 2016 (3 ploskev)  podatki prvič objavljeni v tem delu (glej Prilogo)	lastna raziskava DOPPS	Ploskev, razporejene v vzhodnem in osrednjem delu Goričkega, gozd ni bil popisan. Skupna površina ploskev 1333 ha. Popisi opravljeni konec junija in v začetku julija. Popisovalci so v jutranjem času med sončnim vzhodom in 10. uro počasi prehodili celotno popisno ploskev in beležili število parov vseh ptic kmetijske krajine, pri čemer so kot pare šteli pojoče samce, speljane družine, odrasle osebke, ki so krmili mladiče ter razburjene odrasle ptice. Pripisani jim je bil status gnezdilk.

Nadaljevanje tabele 1 / Continuation of Table 1

Ime popisa/ Survey name	Metoda popisa/ Survey method	Št. popisnih enot / No. of survey units	Obdobje zajema podatkov in viri objav / Time period and bibliographic sources	Financiranje raziskave/ Survey financing	Opombe / Notes
novi ornitološki atlas gnezditih Slovenije (NOAGS)	transektni popis (MIHELIČ 2002)	35 tetrad 2 x 2 km (glej sliko 1 v Prilogi)	2003–2010 (22 transektov leta 2003, 1 leta 2005, 5 leta 2008, 5 leta 2009 in 2 leta 2010)  podatki prvič objavljeni v tem delu (glej Prilogo)	lastna raziskava DOPPS	Znotraj tetrad so popisovalci začrtali 2 km dolg transekt, ki je bil popisan dvakrat v gnezditveni sezoni.
slovenski indeks ptic kmetijske krajine (SIPKK)	transektni popis (KMECL & FIGELJ 2016)	5 transektov z oznakami: 0M_170, 0Z_129, 0D_169, 0Z_148, 0M_147 (glej sliko 1 v Prilogi)	2008–2016 (Božič 2007, 2008, FIGELJ & KMECL 2009, KMECL & FIGELJ 2011, 2012, 2013, 2015, 2016, KMECL <i>et al.</i> 2014a)	državni monitoring	Dolžina posameznega transekta je bila približno 2 km, notranji pas je segal 50 m bočno na vsako stran transepta. Transekti niso reprezentativni za celotno Goričko, saj ležijo v južnem delu, ki je krajinsko različen od severnega.
Upkač	transektni popis (DENAC & KMECL 2014)	59 transektov	2012 (DENAC & KMECL 2014)	projekt Upkač (OP SI-HU 2007–2013)	/
monitoring hribskega škrjanca <i>Lullula</i> <i>arborea</i>	transektni popis (MIHELIČ 2002)	11 transektov (glej Denac <i>et al.</i> 2010, 2016)	2005, 2008, 2010, 2011, 2013, 2014, 2015, 2016 (RUBINIĆ <i>et al.</i> 2005, 2008, DENAC <i>et al.</i> 2010, 2011b, 2013, 2014b, 2015, 2016)	državni monitoring	Transekt Vaneča je bil popisan le trikrat (2005, 2008 in 2010). Zaradi neprimerenega habitata za hribskega škrjanca ga je od leta 2011 zamenjal transekt Kuštanovci.

## Nadaljevanje tabele 1 / Continuation of Table 1

Ime popisa/ Survey name	Metoda popisa/ Survey method	Št. popisnih enot / No. of survey units	Obdobje zajema podatkov in viri objav / Time period and bibliographic sources	Financiranje raziskave/ Survey financing	Opombe / Notes
monitoring velikega skovika <i>Otus scops</i>	točkovni popis s predvajanjem posnetka (SAMWALD & SAMWALD 1992, ŠTUMBERGER 2000)	429 popisnih točk (glej Denac <i>et al.</i> 2015)	1997, 2004, 2007, 2009, 2011, 2012, 2013 in 2015 (ŠTUMBERGER 2000, RUBINIĆ <i>et al.</i> 2004, 2007, 2009, DENAC <i>et al.</i> 2011b, 2013, 2015; DENAC & KMECL 2014)	državni monitoring	Popis smo opravili enkrat v gnezditveni sezoni, med sredino maja in sredino junija.
monitoring bele štoklje <i>Ciconia ciconia</i>	popis (census) vseh obstoječih gnezd in iskanje novih (SCHULZ 1999)	celotno območje Natura 2000 Goričko (SPA)	1999–2016 (DENAC 2001, 2010, RUBINIĆ <i>et al.</i> 2004, 2005, 2006, 2007, 2008, 2009, DENAC <i>et al.</i> 2010, 2011b, 2013, 2014b, 2015, 2016)	državni monitoring	HPa – število parov, ki so zasedli gnezdo JZG – število poletelih mladičev v populaciji (SCHULZ 1999)
popis smrdokavre <i>Upupa epops</i>	popis na površini (»area count«) (DENAC 2015b)	9 ploskev (glej DENAC 2015b)	2015 (DENAC 2015b)	projekt Gorički travniki (Program Finančnega mehanizma EGP 2009– 2014)	Ploskve so bile zarisane v mozaični kmetijski krajini, osredotočeni na območja, kjer so že obstajali podatki o pojavljanju smrdokavre na Goričkem (ATLAS PTIC 2015b, DENAC & KMECL 2014).
popis prepelice <i>Coturnix coturnix</i>	točkovni popis s predvajanjem posnetka (DENAC 2015a)	104 popisne točke (glej DENAC 2015a)	2015 (DENAC 2015a)	projekt Gorički travniki (Program Finančnega mehanizma EGP 2009– 2014)	Popisne točke so bile postavljene v ustrezni habitat (odprtta kmetijska krajina z njivami in travniki) in zarisane predvsem na območjih, kjer so obstajali podatki o pojavljanju prepelice na Goričkem (ATLAS PTIC 2015a, DENAC & KMECL 2014).

Nadaljevanje tabele 1 / Continuation of Table 1

Ime popisa/ Survey name	Metoda popisa/ Survey method	Št. popisnih enot / No. of survey units	Obdobje zajema podatkov in viri objav / Time period and bibliographic sources	Financiranje raziskave/ Survey financing	Opombe / Notes
popis rjavega srakoperja <i>Lanius collurio</i>	transektni popis po metodi "distance count" (na ortofoto karte smo vrisovali pare do razdalje 100 m; pare, ki so bili dlje od te meje, smo vrisali tik za robom meje) (BIBBY <i>et al.</i> 2000, BUCKLAND <i>et al.</i> 2005, THOMAS <i>et al.</i> 2010)	10 transektov (glej KMECL 2015b)	2015 (KMECL 2015b)	projekt Gorički travniki (Program Finančnega mehanizma EGP 2009- 2014)	Podatkov popisa nismo uporabili za izračun trenda, saj smo imeli na voljo podatke z daljšo časovno serijo (npr. SIPKK).

Slovenije, ponekod pa so sodelovali tudi zaposleni v Javnem zavodu Krajinski park Goričko.

### 2.3. Obravnavane vrste

V članku smo se osredotočili na pogostejše ptice kmetijske krajine na Goričkem. Vrste, katerih gnezditvena populacija na Goričkem v zadnjih 20 letih ni presegla številčnosti 30 parov, smo iz obdelave izpustili, npr. pribi *Vanellus vanellus*, velikega strnada *Emberiza calandra* in repaljščico *Saxicola rubetra*. Izjema je bila bela štorklja, za katero so nam na voljo podatki o zasedenosti gnezd in rodnosti že od leta 1999 dalje (DENAC 2000, 2010, DENAC *et al.* 2016). Pri vrstah, ki se pogosto pojavljajo v jatah (npr. poljski vrabec, škorec, kmečka lastovka), smo za izračun populacijskih trendov in indeksov uporabili le tiste vire podatkov, kjer zaradi zgodnejšega datuma popisa še ni prišlo do združevanja, oziroma smo v skladu z metodo SIPKK velike jate nad 50 osebkov izvzeli iz izračuna trenda. Jate do 50 osebkov smo pretvorili v število parov tako, da smo število osebkov delili z dva (KMECL & FIGELJ 2016). Kot primer navajamo poljskega vrabca, kjer smo za izračun trenda uporabili le podatke SIPKK, NOAGS in popisa za

projekt Upkač, ne pa tudi podatkov ploskovnega popisa, ki je bil napravljen pozno v gnezditveni sezoni in so zato bile na nekaterih ploskvah večje jate odraslih in mladostnih osebkov, ki jih ni bilo mogoče nedvoumno pretvoriti v število parov. Enako smo storili tudi pri škorcu in kmečki lastovki. V članku tako obravnavamo 31 vrst (tabela 4).

### 2.4. Izračun trendov in indeksov

Izračun trendov je bil mogoč le pri podatkih z daljšim časovnim nizom (vsaj 9 let), in sicer pri podatkih monitoringa SPA in SIPKK. Trende smo bodisi povzeli po zadnjih poročilih monitoringa SPA (hribski škrjanec, veliki skovik; DENAC *et al.* 2015, 2016) bodisi smo jih izračunali na novo posebej za Goričko (SIPKK, bela štorklja). Trende smo v poročilih in v tem članku izračunali s programom TRIM (PANNEKOEK & VAN STRIEN 2009), ki izdela model na osnovi Poissonove regresije. Najbolj pravilen je prikaz naklona (trenda) na osnovi vstavljenih vrednosti: uporabljeni so pravi števni podatki, kjer pa ti manjkajo, jih program nadomesti z vrednostmi iz računskega modela. Kot izhodiščno leto smo v vseh primerih vzeli leto prvega popisa. Povprečne letne trende (multiplikativne trende) za posamezne vrste

ptic program razvrsti v šest kategorij: strm porast, zmeren porast, stabilen, negotov, zmeren upad in strm upad. Kriteriji za razvrščanje so štirje, in sicer velikost in statistična značilnost rasti ali upada, test ali 95-odstotni interval zaupanja ( $\pm 1,96$  standardne napake) zajema vrednost 1 ali ne ter doseg spodnjega in zgornjega limita intervala zaupanja. Strm upad tako pomeni, da indeks statistično značilno upada za več kot 5 % na leto, pri čemer zgornja meja intervala zaupanja ne presega vrednosti 0,95. Zmeren upad pomeni, da indeks statistično značilno upada manj kot 5 % na leto, zgornja meja intervala zaupanja pa je med 0,95 in 1,00. Analogne trditve veljajo za trende v porastu. Negotov trend pomeni, da trend vrste ni statistično značilen, interval zaupanja zajema vrednost 1,00 in je razmeroma širok, kar pomeni, da je bodisi spodnja meja intervala zaupanja manjša od 0,95 ali pa zgornja večja od 1,05. Stabilen trend pomeni, da trend vrste prav tako ni statistično značilen, interval zaupanja pa zajema vrednost 1,00 in je znotraj vrednosti 0,95 in 1,05. Za belo štokljo smo trend izračunali na dva načina, in sicer na podlagi števila zasedenih gnez (HPa) ter na podlagi števila poletelih mladičev (JZG).

Kjer sta bila na voljo le dva podatkovna niza v določenem časovnem razmiku (NOAGS/Upkač, ploskovni popis), smo izračunali enostavne indekse kot količnik med številom popisanih parov v drugem in prvem popisu. Vrednosti indeksa smo razdelili v velikostne razrede in jim pripisali posamezne grafične oznake, prikazane v tabeli 2. Z enakimi grafičnimi oznakami smo v tabeli 4 predstavili tudi trende, izračunane s programom TRIM, pri čemer smo negotovemu trendu dodelili grafično oznako “?”.

**Tabela 2:** Oznake za posamezne vrednosti indeksov

**Table 2:** Index value interpretation

Vrednost indeksa/ Index value	Opis / Description
<50	strm upad / steep decline (- -)
50–89	zmeren upad / moderate decline (-)
90–110	stabilen / stable (0)
111–150	zmeren porast / moderate increase (+)
>150	strm porast / steep increase (++)

Trende in indekse smo izračunali na osnovi podatkov, ki so bili pridobljeni z enakimi ali primerljivimi metodami. V članku tako primerjamo naslednje nize podatkov:

- podatki SIPKK za obdobje 2008–2016
- podatki transektnih popisov za NOAGS (2003–2010) in Upkač (2012) (ustrezno obteženo glede na število popisanih transektov, ki je bilo za NOAGS 35, za Upkač pa 59)
- monitoring SPA za posamezne vrste (bela štoklja 1999–2016, veliki skovik 2004–2015, hribski škrjanec 2005–2016)
- ploskovni popis 1997/98 in 2014/16

Zaradi standardiziranih popisnih enot in metod, dolgega časovnega niza, rednosti popisov in v večini primerov tudi istih popisovalcev so po našem mnenju najbolj zanesljivi podatki o trendih, pridobljeni v okviru SIPKK in monitoringa SPA.

## 2.5. Kmetijske subvencije

Podatke o kmetijsko okoljskih ukrepih (KOP) za obdobje 2007–2014 in o kmetijsko okoljsko podnebnih ukrepih (KOPOP) za obdobje 2015–2016 smo pridobili od Agencije RS za kmetijske trge in razvoj podeželja. Površine pod ukrepi KOP oziroma KOPOP v posameznem letu smo izračunali s programom ArcGIS. Iz celotnega nabora ukrepov smo izbrali le tiste, ki po našem mnenju neposredno prispevajo k varstvu narave. Datum košenj v teh ukrepih so zakasnjeni z namenom varovanja ekstenzivnih travnikov oziroma občutljivih razvojnih stadijev metuljev, ukrep za ohranjanje visokodebelih sadovnjakov pa varuje gnezditveni habitat sekundarnih duplarjev. Za obdobje 2007–2014 smo zato izbrali ukrepe HAB (ohranjanje posebnih travniških habitatov), MET (ohranjanje travniških habitatov metuljev), TSA (travniški sadovnjaki), ETA (ohranjanje ekstenzivnega travinja) in STE (ohranjanje steljnikov), za obdobje 2015–2016 pa HAB\_KOS (posebni travniški habitati), MET\_KOS (travniški habitati metuljev) in KRA\_VTSA (visokodebelni travniški sadovnjaki). V obdobju 2015–2016 ukrep ETA ni bil več na voljo, ukrepa STE pa ni bilo več mogoče vpisati na Goričkem (URADNI LIST RS 2016b - Priloga 3). Zahteve posameznih ukrepov glede datuma košnje in paše ter glede gnojenja so prikazane v tabeli 3.

**Tabela 3:** Značilnosti izbranih naravovarstvenih ukrepov KOP in KOPOP**Table 3:** Characteristics of selected “KOP” and “KOPOP” nature conservation measures

Ukrep/ Measure	Obdobje vpisa/ Years active	Košnja / Mowing	Paša / Grazing	Gnojenje/ Fertilizer use	Vir / Source
MET	2007–2013	prepovedana med 1. 7. in 20. 8. / banned between 1 Jul and 20 Aug	prepovedana med 1. 7. in 20. 8. / banned between 1 Jul and 20 Aug	uporablja se lahko samo kompost, pridelan na kmetijskih gospodarstvih / only compost can be used	MKGP 2007
MET_KOS	2015–2016	prepovedana med 15. 6. in 15. 9. / banned between 15 Jun and 15 Sep	prepovedana med 15. 6. in 15. 9. / banned between 15 Jun and 15 Sep	popolna prepoved/ total ban	URADNI LIST RS 2015, 2016c, MKGP 2015
HAB	2007–2013	prepovedana do 15. 7./ banned before 15 Jul	prepovedana do 15. 7./ banned before 15 Jul	uporablja se lahko samo kompost, pridelan na kmetijskih gospodarstvih / only compost can be used	MKGP 2007
HAB_KOS	2015–2016	v letu 2015 prepovedana do 30. 6., v letu 2016 pa na Goričkem in nekaterih drugih območjih v SV Sloveniji prepovedana do 10. 6. / banned until 30 Jun in 2015, until 10 Jun in 2016	v letu 2015 prepovedana do 30. 6., v letu 2016 pa na Goričkem in nekaterih drugih območjih v SV Sloveniji prepovedana do 10. 6. / banned until 30 Jun in 2015, until 10 Jun in 2016	dovoljen je letni vnos dušika iz organskih gnojil do 40 kg/ha / annual nitrogen input from organic fertilizers limited to 40 kg/ha	URADNI LIST RS 2015, 2016c, MKGP 2015
ETA	2007–2013	opravlja se v obdobju po polnem cvetenju glavnih vrst trav; obvezna kosna ali pašna raba najmanj enkrat letno / after the completed blooming season of grass species	obvezna kosna ali pašna raba najmanj enkrat na leto / mowing or grazing at least once a year	uporablja se lahko samo kompost, pridelan na kmetijskih gospodarstvih / only compost can be used	MKGP 2007
STE	2007–2013	prepovedana do 25. 8./ banned before 25 Aug	prepovedana do 25. 8./ banned before 25 Aug	uporablja se lahko samo kompost, pridelan na kmetijskih gospodarstvih / only compost can be used	MKGP 2007
TSA	2007–2013	ni časovnih omejitvev, kosna ali pašna raba je obvezna / obligatory; no temporal restrictions given	ni časovnih omejitvev, kosna ali pašna raba je obvezna / obligatory, no temporal restrictions given	uporablja se lahko samo kompost, pridelan na kmetijskih gospodarstvih / only compost can be used	MKGP 2007
KRA_VTSA	2015–2016	ni časovnih omejitvev, kosna ali pašna raba je obvezna / obligatory; no temporal restrictions given	ni časovnih omejitvev, kosna ali pašna raba je obvezna / obligatory, no temporal restrictions given	vrsta gnojila in količina nista opredeljeni / no specifications	URADNI LIST RS 2015 & 2016c, MKGP 2015

Poleg značilnosti, predstavljenih v tabeli 3, sta bila ukrepa za ohranjanje visokodebelnih sadovnjakov (TSA, KRA\_VTSA) v obeh obdobjih vsebinsko enaka (gostota 50–200 dreves na hektar, drevje ne sme imeti šibko rastočih podlag, obvezna obnovitvena rez) (MKGP 2007, URADNI LIST RS 2015, 2016c). Ukrep ‐ohranjanje mejic‐ (KRA\_MEJ), ki pozitivno vpliva na biodiverziteto (HINSLY & BELLAMY 2000, BATÁRY *et al.* 2010, MORELLI 2013), v letih 2015 in 2016 še ni bil odprt za vpis, zato v analizi ni zajet. Ukrepa ‐ekološko kmetijstvo‐ (EK) nismo izbrali, ker se je večinoma prekrival z drugimi ukrepi in smo tako preprečili podvajanje površin. Odstotek površine, ki ga pokrivajo izbrani ukrepi KOP in KOPOP, je bil izračunan glede na površino Krajinskega parka Goričko.

Poleg tega smo na spletni strani Agencije RS za kmetijske trge in razvoj podeželja (ARSKTRP 2017) preverili, kolikšni zneski so bili prejemnikom na Goričkem izplačani v letih 2014 in 2015 za kmetijsko okoljske ukrepe in za vse kmetijske subvencije skupaj. Pri tem smo upoštevali le prejemnike sredstev v občinah, ki imajo večino površine (>50 %) znotraj Krajinskega parka Goričko – to so občine Cankova, Gornji Petrovci, Grad, Hodoš, Kobilje, Kuzma, Rogašovci in Šalovci.

## 2.6. Varstveni ukrepi

Z nalogami ohranjanja biotske raznovrstnosti in krajinske pestrosti Goričkega se od leta 2004 ukvarja Javni zavod Krajinski park Goričko (JZ KPG), ki je upravljavec zavarovanega območja narave Krajinski park Goričko in območja Natura 2000 Goričko. Park upravlja z nekaterimi varstveno pomembnimi površinami, na katerih si z redno košnjo, prilagojeno ekološkim zahtevam vrst, prizadeva izboljšati stanje ohranjenosti vseh treh travniških kvalifikacijskih habitatov Natura 2000 za Goričko (6210 Polnaravna suha travnišča in grmiščne faze na karbonatnih tleh (*Festuco Brometalia*), 6410 Travniki s prevladajočo stožko (*Molinia* spp.) na karbonatnih, šotnih ali glineno-muljastih tleh (*Molinion caeruleae*) in 6510 Nižinski ekstenzivno gojeni travniki (*Alopecurus pratensis*, *Sanguisorba officinalis*)), metuljev mravljiščarjev *Maculinea* sp., travniškega postavneža *Euphydryas aurinia*, travniških vrst ptic (prepelica,

smrdokavra, rjavi srakoper, bela štoklja, veliki skovik, hribski škrjanec), zavarovanih vrst rastlin (sibirski perunika *Iris sibirica* in rumena maslenica *Hemerocallis lilioasphodelus*) in omejevati razširjenost tujerodnih invazivnih rastlinskih vrst (zlata rozga *Solidago* sp.).

JZ KPG skupaj s prostovoljci Društva za opazovanje in proučevanje ptic Slovenije (DOPPS) od leta 2008 na območju Goričkega namešča, pregleduje, popravlja in po potrebi zamenjuje gnezditnice za sekundarne duplarje (predvsem za zlatovranko *Coracias garrulus*, velikega skovika, smrdokavro). Med letoma 2011 in 2014 je JZ KPG skupaj s partnerji uresničeval projekt Visokodebelni biseri (akronim Upkač), v katerem so potekale aktivnosti za varstvo smrdokavre in velikega skovika. Projekt Učinkovito upravljanje z ekstenzivnimi travniki na območju Natura 2000 Goričko (akronim Gorički travniki), ki je potekal med marcem 2015 in avgustom 2016, je bil osredotočen na vrste in habitatne tipe, ki so po Programu upravljanja območij Natura 2000 za obdobje 2015–2020 (VLADA RS 2015) v slabem ohranjeninem stanju (veliki skovik, strašničin mravljiščar *Maculinea teleius*, temni mravljiščar *Maculinea nausithous*, travniški postavnež, travniški kvalifikacijski habitatni tipi 6210, 6410 in 6510). JZ KPG je v sodelovanju s prostovoljci DOPPS po vzoru avstrijskih kolegov, ki upravljajo SPA Südoststeirisches Hügelland, med letoma 2013 in 2016 na zahodnem delu Goričkega nameščal lovne preže - lesene drogove v obliki črke T, namenjene predvsem varstvu zlatovranke. Od leta 2009 JZ KPG opravlja in koordinira sanacije ogroženih gnezd belih štokelj z nameščanjem novih in zamenjavo poškodovanih in neustreznih gnezditvenih podstavkov in dotrajanih drogov.

## 3. Rezultati

### 3.1. Populacijski trendi izbranih vrst

Večina rezultatov popisov, na katerih temelji ta članek, je že bila objavljena v različnih virih (DENAC 2000, ŠTUMBERGER 2000, BOŽIČ 2008, FIGELJ & KMECL 2009, KMECL & FIGELJ 2011, 2012, 2013, 2015, 2016, KMECL *et al.* 2014a, DENAC & KMECL 2014, DENAC 2015a, b, DENAC *et al.* 2015, 2016). Tiste, ki so bili kot del širše slike sicer že obravnavani

drugje, vendar iz poročil ni mogoče razbrati rezultatov posebej za Goričko (npr. monitoring bele štoklje; DENAC *et al.* 2016), predstavljamo posebej v Prilogi, ravno tako podatke, ki doslej še niso bili objavljeni (NOAGS, ploskovni popis).

Za 16 vrst smo indeks oziroma značilni trend izračunali iz enega samega niza podatkov (vrste z negotovim trendom SIPKK tu niso upoštevane), za 15 vrst pa iz dveh ali več nizov podatkov (tabela 4). Na podlagi ploskovnega popisa 1997/98 in 2014/16 je bilo mogoče indeks izračunati za 15 vrst. Pri 11 vrstah je bil ugotovljen upad, pri treh porast, pri eni vrsti pa je bila številčnost v obeh popisih enaka. Glede na podatke SIPKK so imele le štiri vrste značilen trend, in sicer ena strm upad, dve zmeren upad in ena zmeren porast. Indeks med podatki popisov Upkač in NOAGS je bilo

mogoče izračunati za 29 vrst, od tega je bil za 14 vrst ugotovljen upad in za 15 porast. V okviru monitoringa SPA smo trend izračunali za tri vrste: veliki skovik je doživel strm upad (slika 2), hribski škrjanec zmeren upad (slika 3), populacija bele štoklje pa je bila glede na število gnezdečih parov stabilna, glede na število poletelih mladičev pa je doživila zmeren upad (tabela 4).

Pri nekaterih vrstah se trendi in indeksi, izračunani na osnovi vsaj dveh različnih nizov podatkov, razlikujejo (prepelica, rumeni strnad, vijeglavka, rjav slakoper, rjava penica, divja grlica), medtem ko se pri drugih vrstah ujemajo (poljski škrjanec, repnik, hribski škrjanec, zelena žolna, prosnik, grilček, smrdokavra). Pri postovki in kukavici en niz podatkov kaže na velik porast, drugi niz pa na stabilno populacijo (tabela 4).

**Tabela 4:** Populacijski trendi in indeksi za posamezne vrste ptic na Goričkem glede na vir podatkov izračuna. Ploskovni popis – indeks ploskovnega popisa 2014/16 in 1997/98. Upkač / NOAGS – indeks transektnih popisov 2012 (Upkač, 59 transektov) in 2003 (NOAGS, 35 transektov). Monitoring SPA – trend monitoringa SPA. SIPKK – trend vrste na 5 transektih v obdobju 2008–2016. Legenda: - - strm upad, - zmeren upad, 0 stabilen, + zmeren porast, ++ strm porast, ? negotov, / podatki za izračun trenda oziroma indeksa niso bili na voljo (glej tudi tabelo 2).

**Table 4:** Population trends and indices for selected bird species in Goričko. Area count – indices from area counts in 2014/16 and 1997/98. Upkač / NOAGS – index of transect counts 2012 (Upkač, 59 transects) and 2003 (NOAGS, 35 transects). SPA monitoring – SPA monitoring trend. SIPKK – Slovenian farmland bird index, species trend on 5 transects in 2008–2016. Legend: - - steep decline, - moderate decline, 0 stable, + moderate increase, ++ steep increase, ? uncertain, / data unavailable (see also Table 2).

Vrsta / Species	Ploskovni popis/ Area count				
	Upkač / NOAGS	Monitoring SPA	SIPKK		
<i>Acrocephalus palustris</i>	/	0	/		?
<i>Alauda arvensis</i>	--	-	/		?
<i>Anthus trivialis</i>	/	++ <sup>1</sup>	/		/
<i>Linaria cannabina</i>	-	--	/		?
<i>Carduelis carduelis</i>	/	-	/		?
<i>Ciconia ciconia</i> <sup>2</sup>	/	/	0		/
<i>Ciconia ciconia</i> <sup>3</sup>	/	/	-		/
<i>Columba oenas</i>	/	++	/		?
<i>Columba palumbus</i>	/	++	/		?
<i>Corvus cornix</i>	/	++	/		?
<i>Coturnix coturnix</i>	--	++	/		?
<i>Cuculus canorus</i>	0	++	/		+
<i>Emberiza citrinella</i>	-	0	/		?
<i>Falco tinnunculus</i>	++ <sup>1</sup>	0	/		?

## Nadaljevanje tabele 4 / Continuation of Table 4

Vrsta / Species	Ploskovni popis/ Area count	Upkač / NOAGS	Monitoring SPA	SIPKK
<i>Galerida cristata</i>	/	--	/	/
<i>Hirundo rustica</i>	/	0	/	?
<i>Jynx torquilla</i>	--	++	/	?
<i>Lanius collurio</i>	-	+	/	?
<i>Lullula arborea</i>	--	--	- <sup>4</sup>	?
<i>Luscinia megarhynchos</i>	/	--	/	/
<i>Otus scops</i>	/	/	-- <sup>5</sup>	/
<i>Passer montanus</i>	/	-	/	?
<i>Phoenicurus phoenicurus</i>	/	0	/	?
<i>Pica pica</i>	/	-	/	?
<i>Picus viridis</i>	++	++	/	?
<i>Saxicola rubicola</i>	--	-	/	--
<i>Serinus serinus</i>	--	0	/	-
<i>Streptopelia turtur</i>	-	0	/	?
<i>Sturnus vulgaris</i>	/	+	/	?
<i>Sylvia communis</i>	++	++	/	-
<i>Sylvia nisoria</i>	/	++ <sup>1</sup>	/	/
<i>Upupa epops</i>	--	--	/	?

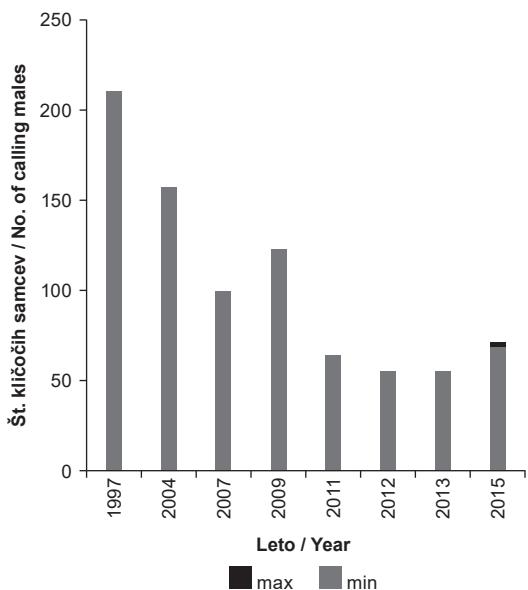
<sup>1</sup> V prvem popisu ni bil zabeležen noben par. Da se izognemo deljenju z vrednostjo 0, smo kot rezultat prvega popisa arbitarno vzeli najmanjšo možno enoto štetja, torej 1 par. / No pairs were recorded in the first survey. To calculate the index, the values was arbitrarily set to 1.

<sup>2</sup> trend je izračunan na podlagi števila zasedenih gnezd (HPa) in se nanaša na obdobje 1999–2016 / trend calculated based on occupied nests (HPa) in 1999–2016

<sup>3</sup> trend je izračunan na podlagi števila poletelih mladičev (JZG) in se nanaša na obdobje 1999–2016 / trend calculated based on fledged birds (JZG) in 1999–2016

<sup>4</sup> obdobje 2005–2016, DENAC *et al.* 2016

<sup>5</sup> obdobje 2004–2015, DENAC *et al.* 2015



**Slika 2:** Rezultati monitoringa velikega skovika *Otus scops* na SPA Goričko v obdobju 2004–2015

**Figure 2:** Results of Scops Owl *Otus scops* monitoring in the Goričko SPA in 2004–2015

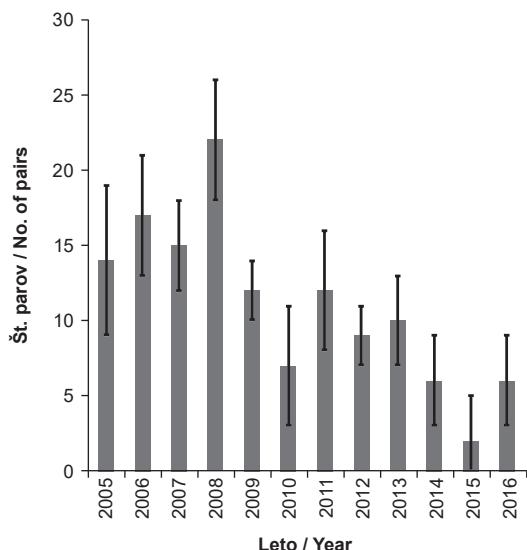
### 3.2. Ukrepi KOP in KOPOP v obdobju 2007–2016

V obdobju 2007–2014 je bilo z naravovarstvenimi ukrepi KOP pokrite 0,2–0,3 % površine Krajinskega parka Goričko, v obdobju 2015–2016 pa z ukrepi KOPOP 0,9–1,0 % površine (tabela 5).

V letu 2014 je bilo za vse kmetijske subvencije na Goričkem izplačanih 7.671.307,71 €, od tega 1.300.372,18 € ali 17,0 % za ukrepe KOP. V letu 2015 je bilo vseh izplačil za kmetijske subvencije 7.174.960,10 €, od tega 1.239.098,03 € ali 17,3 % za ukrepe KOPOP (ARSKTRP 2017).

### 3.3. Uresničeni varstveni ukrepi

V skladu z letnimi varstvenimi cilji upravljanja in v okviru rednega dela je JZ KPG v letu 2016 s košnjo in odstranjevanjem biomase upravljal z 39 ha travniških površin, visokodebelnih sadovnjakov, mejic in manjših gozdnih parcel v lasti Republike Slovenije in v zasebni lasti. Travniške površine vzdržujejo z letno košnjo enkrat ali dvakrat v vegetacijski sezoni med junijem in oktobrom. Dodatno



**Slika 3:** Rezultati monitoringa hribskega škrjanca *Lullula arborea* na SPA Goričko v obdobju 2005–2016. Za izris grafa smo uporabili TRIM vstavljenе vrednosti in njihove standardne napake, saj nekateri transekti v nekaterih letih niso bili popisani.

**Figure 3:** Results of Woodlark *Lullula arborea* monitoring in the Goričko SPA in 2005–2016. TRIM calculated values with their standard errors were used, because not all transects were surveyed in all years.

je JZ KPG v okviru projekta Gorički travniki v letih 2015 in 2016 pokosil in s tem delno obnovil 440 zaraščajočih se travnikov s skupno površino 80 ha (5 ha koda 6210, 2 ha koda 6410 in 73 ha koda 6510), in sicer v občinah Cankova, Rogasovci, Grad, Kuzma, Gornji Petrovci, Puconci, Šalovci, Hodoš in Moravske Toplice. Osnovni kriteriji za izbiro zaraščajočih se površin so bili, da je travnik pripadal enemu izmed treh kvalifikacijskih travniških habitatnih tipov, da lastnik za rabo travnika v letu uresničevanja ukrepov ni prejel nobenih kmetijskih subvencij ali da je bil travnik zaraščen s tujerodnimi invazivnimi vrstami. Z odstranitvijo pokošene biomase, v kateri je prevladovala orjaška zlata rozga *Solidago gigantea*, in odstranitvijo dela lesne zarasti se je izboljšal prehranjevalni habitat tudi za ptice, npr. za rjavega srakoperja, prosnika, prepelico, belo štokljo. Na travnikih so bili puščeni posamezni grmi navadnega šipka *Rosa canina*, drevesa rdečega

**Tabela 5:** Kmetijsko okoljski ukrepi (KOP, obdobje 2007–2014) oziroma kmetijsko okoljsko podnebni ukrepi (KOPOP, obdobje 2015–2016) v Krajinskem parku Goričko (KPG) (v hektarih). Vir: Agencija RS za kmetijske trge in razvoj podeželja

**Table 5:** Agri-environmental measures (KOP; 2007–2014) and agri-environmental-climate measures (KOPOP; 2005–2016) in the Goričko Nature Park (in hectares). Source: The Agency of the Republic of Slovenia for Agricultural Markets and Rural Development

Ukrep KOP / KOPOP	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HAB / HAB_KOS	0,6	0,3	0,0	0,0	0,0	0,0	0,0	0,0	39,4	49,1
MET / MET_KOS	32,5	42,6	54,9	63,7	68,1	78,1	87,2	88,7	350,1	412,4
ETA	31,4	33,2	34,5	43,5	42,9	30,2	27,0	28,6	/	/
STE	11,6	10,5	16,2	20,0	15,1	14,9	14,5	13,2	/	/
TSA / KRA_VTSA	19,0	17,8	16,1	14,9	15,7	8,6	12,2	12,2	19,2	23,3
Skupaj	95,2	104,4	121,7	142,1	141,9	131,9	140,9	142,6	408,8	484,8
% površine KPG pod ukrepi	0,2	0,2	0,3	0,3	0,3	0,3	0,3	0,3	0,9	1,0

bora *Pinus sylvestris* in črne jelše *Alnus glutinosa*, ki so pomembni kot preže, gnezdišča in pevska mesta za nekatere kvalifikacijske vrste ptic.

Od leta 2008 je JZ KPG skupaj s prostovoljci DOPPS na območju Goričkega namestil 245 gnezditelnic za sekundarne duplarje. Gnezditelnice za zlatovranko so bile nameščene na drevesa na brežini reke Ledave, na električne drogove in solitarna drevesa, in sicer v Serdici, Nuskovi, Rogašovcih, Pertoči, Ropoči in Ženavljah, kjer so obstajali podatki o pojavljanju zlatovranke. Preostale gnezditelnice so bile nameščene na severovzhodu (Markovci, Budinci) in na vzhodu (Kančevci, Fokovci), predvsem na lokacijah znanega pojavljanja smrdokavre in velikega skovika. Veliki skovik je med letoma 2014 in 2016 zasedel največ 19 gnezditelnic na leto, smrdokavra največ dve, zlatovranka pa je doslej v gnezditelni gnezdila enkrat leta 2014. Večino gnezditelnic je zasedel škorec (37 % v letu 2016), ali pa so bile prazne (30 % v letu 2016) (tabela 6).

V okviru projekta Upkačeje JZ KPG z različnimi sortami jabolk in hrušk v Budincih in Kančevcih zasadil 2,3 ha visokodebelnih sadovnjakov. Obenem je z namenom ohranjanja habitatalnih dreves za velikega skovika, smrdokavro in druge sekundarne duplarje poskrbel za pomladitveno rez ter odstranitev bele omele na 1328 sadnih drevesih v visokodebelnih sadovnjakih v 28 katastrskih občinah na Goričkem.

Med letoma 2013 in 2016 so prostovoljci DOPPS in zaposleni v JZ KPG namestili 71 prež za zlatovranko. Prvih 24 je bilo postavljenih leta 2013 v Serdici in Nuskovi, in sicer na mejah travniških parcel ali na robovih med travniki in njivami, kjer sta pestrost in količina žuželk navadno največja, obenem pa lastnikom ne povzročajo težav pri rabi travnikov. V letu 2014 je bilo nameščenih dodatnih 15 lovnih prež v Nuskovi in v letu 2016 še 32 prež v Pertoči in Nuskovi.

Od leta 2009 je bilo nameščenih 10 gnezditelnih podstavkov za belo štorkljo, in sicer v Korovcih, Pertoči, Motovilcih, Dolnjih Slavečih, Svetem Juriju, Hodošu, Prosenjakovcih, Kobilju in Šalamencih. V letu 2016 je bilo zasedenih pet gnezditelnic bele štorklje, kjer so bili v preteklosti nameščeni gnezditelni podstavki. Ob namestitvi podstavkov so bili na 5 lokacijah zamenjani električni drogovci.

#### 4. Diskusija

##### 4.1. Populacijski trendi izbranih vrst

Med ptice kmetijske krajine s populacijskim upadom na Goričkem sodijo tudi nekatere varstveno pomembne vrste, za katere je Republika Slovenija dolžna zagotavljati ugodno stanje v okviru omrežja Natura 2000 (URADNI LIST RS 2013). To so bela štorklja, veliki skovik, smrdokavra in hrivski škrjanec. Populacija bele štorklje je bila sicer glede

**Tabela 6:** Pregled zasedenosti gnezdlnic za sekundarne duplarje za obdobje 2014–2016 (R. Gjergjek *pisno*). Vsako leto niso bile pregledane vse namešcene gnezdlnice.

**Table 6:** Nestbox occupancy by secondary cavity breeders in 2014–2016 (R. Gjergjek *pers. comm.*). Not all nestboxes were surveyed each year.

Vrsta / Species	2014	2015	2016
poljski vrabec <i>Passer montanus</i>	5	8	9
škorec <i>Sturnus vulgaris</i>	15	35	55
velika sinica <i>Parus major</i>	2	7	8
veliki skovik <i>Otus scops</i>	19	8	10
lesna sova <i>Strix aluco</i>	1	1	1
smrdokavra <i>Upupa epops</i>	2	1	2
zlatovranka <i>Coracias garrulus</i>	1	0	0
brglez <i>Sitta europaea</i>	1	3	5
pogorelček <i>Phoenicurus phoenicurus</i>	0	1	0
polh <i>Glis glis</i>	1	3	4
veverica <i>Sciurus vulgaris</i>	0	1	4
sršen <i>Vespa crabro</i>	3	19	8
neznano / unknown	1	4	0
prazno /empty	26	19	42
Skupaj / Total	77	110	148

na število zasedenih gnez na Goričkem stabilna, vendar pa se je zmanjšala njena rodnost (za 3,9 % na leto). Veliki skovik je doživel strm upad, in sicer z 210–250 parov leta 1997 (ŠTUMBERGER 2000) na 60–70 parov leta 2015 (DENAC *et al.* 2015). Enako se je pripetilo smrdokavri, saj je njena številčnost upadla za okoli 85 %, s 180-230 parov (DENAC 2000) na 20–40 parov (DENAC & KMECL 2014). Populacija hribskega škrjanca je upadla za okoli 88 %, in sicer s 180-240 parov v obdobju 1997/98 (DENAC 2000) na 20–30 parov v letu 2016 (DENAC *et al.* 2016). Državna naravovarstvena in kmetijska politika sta pri varstvu teh vrst neuspešni, podobno pa je bilo ugotovljeno tudi za vrste kmetijske krajine na Kozjanskem (KMECL *et al.* 2014b).

Različni nizi podatkov in različna časovna obdobja so za nekatere vrste dala podobno kategorijo trenda. Od šestih vrst, pri katerih podatki za

Goričko dosledno kažejo na upad, populacije petih upadajo tudi na nivoju Slovenije, populacije treh pa na nivoju Evrope. Od dveh vrst, ki sta na Goričkem doživelji porast, je ena doživila zmeren upad tako v Sloveniji kot Evropi, druga je v Sloveniji stabilna, v Evropi pa je doživila zmeren porast (tabela 7). Na delu so poleg dejavnikov, povezanih s skupno evropsko kmetijsko politiko, očitno tudi lokalni dejavniki, saj se trendi nekaterih vrst razlikujejo celo na nivoju regij znotraj Slovenije: tako je na primer kukavica, ki je na Goričkem v zmernem porastu, na Kozjanskem v obdobju 1999–2010 upadla (KMECL *et al.* 2014b).

Pri nekaterih vrstah pa se indeksi oziroma trendi, izračunani iz različnih nizov podatkov in za različna obdobja, razlikujejo. Videti je, da so populacije nekaterih vrst sicer v obdobju zadnjih 20 let na Goričkem doživele upad (zmeren ali strm upad pri pleskovnem popisu), vendar pa v zadnjem času njihove populacije naraščajo oziroma so stabilne (sodeč po primerjavi Upkač / NOAGS). Takšne vrste so na primer rumeni strnad, vijeglavka, rjav slakoper in divja grlica. Obraten je primer postovke, ki je v zadnjih 20 letih doživila strm porast, od leta 2003 pa je njena populacija videti stabilna. Pri rjavi penici sicer dva seta podatkov kažeta na strm porast populacije (pleskovni popis in Upkač/NOAGS), vendar je po podatkih SIPKK vrsta doživila zmeren upad. To je posledica precejšnjega zmanjšanja števila preštetih penic za SIPKK v obdobju 2012–2014, in sicer z 11–16 parov v obdobju 2008–2011 na 0–2 para. V letih 2015 in 2016 beležimo ponovno povečanje številčnosti na vrednosti, značilne za obdobje 2008–2011. Tovrstna nihanja v populaciji rjave penice niso nenavadna (BODDY 1993) in so vsaj delno povezana z razmerami na afriških prezimovališčih (BAILLIE & PEACH 1992). Tudi prepelica izkazuje nasprotuječe si indekse, vendar je treba pri tem opozoriti, da gre za zelo mobilno vrsto z velikimi naravnimi nihanji v številčnosti, ki je zato težavna z vidika spremeljanja stanja (RODRÍGUEZ-TEJERO *et al.* 1992, FLADE *et al.* 2006, EUROPEAN COMMISSION 2009, PUIGCERVER *et al.* 2012). Verodostojen trend bi zanjo dobili šele po dolgotrajnem spremeljanju z vrsti prilagojeno metodo (npr. DENAC 2015a). Kljub temu menimo, da je na Goričkem njena populacija dejansko močno upadla, saj na to kaže indeks pleskovnega popisa z vrednostjo 21, poleg tega pa je bil upad enakega velikostnega

**Tabela 7:** Primerjava indeksov oziroma trendov na Goričkem, v Sloveniji in Evropi za vrste, pri katerih različni nizi podatkov z Goričkega dosledno kažejo na upad ali porast. Podatki o trendu za Slovenijo so povzeti po KMECL & FIGELJ (2016) in se nanašajo na obdobje 2008–2016, podatki za Evropo pa po EBCC (2016), pripisano je obdobje, na katero se nanašajo.

**Table 7:** Comparison of population indices and trends at Goričko with Slovenia and Europe for species where the different datasets from Goričko show an unequivocal trend. Data for Slovenia are based on KMECL & FIGELJ (2016) for the 2008–2016 period, European data are based on EBCC (2016) with a time period given for every species.

Vrsta / Species	Trend/Indeks Goričko	Trend Slovenija	Trend Evropa
<i>Alauda arvensis</i>	upad / decline	strm upad / steep decline	zmeren upad / moderate decline 1980–2014
<i>Linaria cannabina</i>	upad / decline	strm upad / steep decline	zmeren upad / moderate decline 1980–2014
<i>Lullula arborea</i>	upad / decline	zmeren upad / moderate decline	zmeren porast / moderate increase 1980–2014
<i>Saxicola torquata</i>	upad / decline	strm upad / steep decline	stabilen / stable 1989–2014
<i>Serinus serinus</i>	upad / decline	strm upad / steep decline	zmeren upad / moderate decline 1982–2014
<i>Upupa epops</i>	upad / decline	negotov / uncertain	negotov / uncertain 1982–2014
<i>Cuculus canorus</i>	porast / increase	zmeren upad / moderate decline	zmeren upad / moderate decline 1980–2014
<i>Picus viridis</i>	porast / increase	stabilen / stable	zmeren porast / moderate increase 1980–2014

razreda v podobnem časovnem obdobju zabeležen tudi na Ljubljanskem barju (TOME *et al.* 2015).

V nadaljevanju smo diskusijo omejili na vrste, pri katerih je bil zabeležen upad populacije, še posebej, če je bil tudi statistično značilen. Za vrste s porastom populacije (zelena žolna, kukavica in postovka) nimamo na voljo lastnih ali tujih raziskav, s katerimi bi lahko verodostojno pojasnili povečanje njihove številčnosti.

#### 4.2. Razlogi za upadanje populacij večine ptic kmetijske krajine na Goričkem

##### 4.2.1. Intenzifikacija kmetijstva

Možnih vzrokov za veliki številčni upad ptic kmetijske krajine v Evropi je več, in sicer so to spremembe v načinu kmetovanja in rabi tal, klimatske spremembe, spremenjene selitvene strategije, pritisk plenilcev, bolezni, medvrstna kompeticija ter pojavi invazivnih vrst. Največ

dokazov kaže na spremembe v načinu kmetovanja in rabi tal kot poglaviti vzrok (DONALD *et al.* 2001, TSCHARNTKE *et al.* 2005, BÁLDI & FARAGÓ 2007, EBCC 2017b). V zadnjih 40 letih so evropske populacije ptic kmetijske krajine izpostavljene delovanju dveh nasprotujučih si dejavnikov, intenzifikaciji kmetijstva ter opuščanju ekstenzivne rabe in posledično zaraščanju krajine (BIGNAL & McCracken 1996, 2000), kar se dogaja tudi na Goričkem. Intenzifikacija se tam kaže v izginjanju ekstenzivnih travnikov (TRČAK *et al.* 2012, ČERPNJAK 2016) in visokodebelnih sadovnjakov (KGZS 2007), povečanju posameznih njivskih površin in komasacijah (DENAC *et al.* 2011b).

##### 4.2.1.1. Izginjanje in intenzifikacija travnikov

Med letoma 2003/04 in 2013/14 je bilo od 221 ekstenzivnih suhih travnikov na vzhodnem Goričkem 79 travnikov (35,7 %) intenziviranih, torej močno gnojenih ali mulčanih, 11 travnikov (5 %) je bilo

spremenjenih v njive, 45 travnikov (20 %) pa se je zaraslo. Zgolj 82 travnikov (37 %) je ostalo v tradicionalni ekstenzivni rabi (ČERPNJAK 2016). Po podatkih kartiranja se je površina kvalifikacijskih travniških habitatnih tipov Natura 2000 (kode 6210, 6410 in 6510) med letoma 2004 in 2012 na vzhodnem delu Goričkega zmanjšala za več kot 800 ha. Izginilo je okoli 29 % polnaravnih suhih travnišč, največ na območju Šulincev in Ženavelj ter Čepincev in Budincev. V omenjenem obdobju je izginila tudi okoli polovica vlažnih travnikov z modro stožko ter skoraj tretjina nižinskih ekstenzivno gojenih travnikov. V istem obdobju se je površina njiv povečala za 260 ha, večinoma na območjih, kjer so bile opravljene komasacije. Največji del izginulih ekstenzivnih travnikov se je zarastel z grmovjem ali pa bil spremenjen v intenzivne travnike in njive (TRČAK *et al.* 2012). Na zahodnem delu Goričkega, v dolini Kučnice, je bilo med letoma 2004 in 2012 v njive preoranih 4,59 ha travnikov, od tega 3,41 ha naravovarstveno pomembnih travnikov s kodo 6510 Nature 2000 oz. 12,9 % vseh travnikov s to kodo iz leta 2004 (PODGORELEC & GOVEDIČ 2013). Na Goričkem se povečuje delež kmetijskih gospodarstev, ki imajo v rabi 10 ha ali več kmetijskih zemljišč, saj manjši kmetje svoje površine prodajajo večjim. Pojavlja se tudi prekupčevanje z zemljišči z namenom izkoriščanja kmetijskih subvencij (GLAVAŠ 2016). Spremembe v obsegu in kvaliteti travnikov na Goričkem se kažejo tako v upadu kvalifikacijskih vrst ptic, ki v tem habitatu gnezdijo ali se prehranjujejo npr. hribski škrjanec, veliki skovik, smrdokavra, bela štoklja; (SACKL 1987, PINOWSKI *et al.* 1991, PODLETNIK & DENAC 2015, DENAC *et al.* 2016, DENAC & KMECL 2016), kot tudi v upadu populacij travniških vrst metuljev (ZAKŠEK *et al.* 2012, VEROVNIK *et al.* 2015, VEROVNIK 2015). Za belo štokljo domnevamo, da se je rodnost poslabšala zaradi zmanjšanja kvalitete prehranjevalnih habitatov. Travniki in pašniki so namreč prehranjevalni habitat te vrste z največjo abundanco in dostopnostjo plena, njihova degradacija pa znano negativno vpliva na rodnost bele štoklje (ALONSO *et al.* 1991, BARBRAUD *et al.* 1999, DZIEWIATY 1992, TRYJANOWSKI & KUŹNIAK 2002, NOWAKOWSKI 2003, TORTOSA *et al.* 2003, TRYJANOWSKI *et al.* 2005). Intenzifikacija travnikov s pomočjo gnojil in dosejevanja travnih ter travno-deteljnih mešanic prepreči rast večini

širokolistnih rastlin, še posebej pionirskim vrstam plevelov (WAKEHAM-DAWSON & SMITH 2000, NEWTON 2004), katerih semena so za zrnojede ptice pomembnejša kot semena trav (ATKINSON *et al.* 2005). Zaradi gnojenja trava raste hitreje in se oblikuje v gostejšo rušo z majhno floristično pestrostjo, ki se kaže tudi v manjši raznolikosti in številčnosti nevretenčarjev. Sklenjena travnata ruša onemogoči prehranjevanje ptic, tako vrst, ki iščejo hrano na tleh, kakor vrst, ki lovijo s preže. Na gnojenih travnikih so omogočene zgodnejše in pogosteje košnje. V gosti travni ruši ne prebiva skoraj nobena vrsta ravnokrilcev, saj potrebujejo mozaik golih tal za odlaganje jajc ter rastja za prehranjevanje in zatočišče (WAKEHAM-DAWSON & SMITH 2000, NEWTON 2004). Tudi ličinke talnih hroščev, rastlinskih os in metuljev, ki so pomemben vir hrane za mladiče nekaterih pevk, so na intenzivnih travnikih manj pogoste (ATKINSON *et al.* 2005).

#### 4.2.1.2. Spremembe na njivskih površinah

Ogrožene so tudi gnezdelke njiv, na primer poljski škrjanec, ki potrebuje redko ali pa strukturno kompleksno vegetacijo, kot sta spomladi sejano žito ali praha (CHAMBERLAIN & SIRIWARDENA 2000, CHAMBERLAIN *et al.* 2000). Na Goričkem je prek 70 % njiv posejanih z žiti, od tega največ s pšenico, koruzo za zrnje in ječmenom (KGZS 2007), večina pšenice in ječmena pa je ozimnega, torej posejanega jeseni (KOCJAN AČKO 2015). Povečanje površin njiv z jeseni sejanimi žiti in oljno repico je bilo v Evropi prepoznano kot eden izmed poglavitnih dejavnikov za upad populacije poljskega škrjanca, saj je na takšnih njivah vegetacija pregosta in prehitro rastoča, da bi mu omogočila vzrejo več legel na leto (CHAMBERLAIN & SIRIWARDENA 2000, CHAMBERLAIN *et al.* 2000). Uporaba herbicidov na njivah je v Evropi povzročila upad repnika, saj so zaradi njih z obdelovalnih površin izginili mnogi pleveli, katerih semena prevladujejo v prehrani mladičev in odraslih osebkov (MOORCROFT *et al.* 2006).

#### 4.2.1.3. Komasacije

Ponekod na Goričkem so komasacije močno sprememile podobo krajine, čeprav naj bi šlo zgolj za upravni postopek, v katerem se zemljišča na

določenem območju zložijo in ponovno razdelijo med prejšnje lastnike tako, da dobi vsak čim bolj zaokrožena zemljišča (URADNI LIST RS 2004). V praksi pa po končanem upravnem postopku pride do uničenja drevesnih in grmovnih mejic, posameznih dreves, pasov neobdelane vegetacije med njivami, manjšinskih habitatnih tipov (npr. mokrišč), povečanja njivskih površin in njihove intenzivnejše izrabe (HARMS *et al.* 1987, LISEC & PINTAR 2005, ŠTEFANOVÁ & ŠÁLEK 2013). Naštete uničene strukture so v spremenjeni pokrajini, kot je kmetijska, ključne in glede na svojo malo površino nadpovprečno prispevajo k biodiverziteti in normalnemu delovanju ekosistema (MANNING *et al.* 2006, HOF & BRIGHT 2010, MORELLI 2013, LACOEUILHE *et al.* 2016). V obdobju 2003–2011 so bile komasacije na Goričkem opravljene na okoli 3500 ha (Denac *et al.* 2011b), kar je 7,6 % površine Krajinskega parka Goričko oziroma 8,7 % površine SPA Goričko. Zajele so ne le večino dolin, temveč tudi mnoga pobočja. Za izginjanje pasov trave med njivami in mejic na Goričkem so poleg komasacij odgovorna tudi pravila za izplačilo subvencij, ki določajo, da se iz GERK (grafična enota rabe zemljišča kmetijskega gospodarstva, ki je osnova za dodeljevanje subvencij) izrežejo vse linijske strukture, širše od 2 m (URADNI LIST RS 2010). To kmete sili v odstranjevanje mejnih habitatov, zato da se jim ne zmanjšuje površina GERK in s tem plačilo. Negativen vpliv komasacij na ptice in habitate je bil ugotovljen že marsikje v Evropi in za različne vrste, na primer repnika (EYBERT *et al.* 1995), hribskega škranca (SACHSLEHNER & SCHMALZER 2011), zelenca *Chloris chloris*, belo štokrlo, grivarja, poljskega vrabca *Passer montanus*, repaljščico, prosnika in pribi (NAGY *et al.* 2009). Na Goričkem vpliv komasacij na naravo še ni bil ovrednoten, vendar je bila na območjih opravljenih komasacij zabeleženo izginotje tako kvalifikacijskih travniških habitatnih tipov in manjšinskih habitatov (npr. visoko šašje, mejice, grmišča) kot tudi nekaterih vrst ptic, na primer prosnika (K. MALAČIČ *pisno*). Ta gnezdi v travnatih robovih ob njivah in jarkih ali na prahi, potrebuje pa tudi številne vertikalne strukture, na primer posušene visoke steblike, posamezne grme, ograje in manjša drevesa, ki jih uporablja kot preže in pevska mesta. V intenzivni kmetijski krajini mu takšnih elementov primanjkuje, zato je tam zelo redek ali pa

ga sploh ni (GREIG-SMITH 1983, REVAZ *et al.* 2008). Hribskega škranca poleg izginutve ekstenzivnih travnikov in uničenja habitata zaradi komasacij močno prizadene tudi splošno zmanjšanje heterogenosti krajine (SIRAMI *et al.* 2011). Na Goričkem so kot pomemben negativni dejavnik prepoznali asfaltiranje makadamskih cest, kjer se je vrsta pogosto prehranjevala (KALIGARIČ *et al.* 2004). Smiselno bi bilo ovrednotiti, kakšen vpliv imata nanj oranje njiv in košnja travnikov tik do gozda, zaradi česar izginjajo heterogeno strukturirani gozdni robovi. Velik pomen slednjih je bil na primer že ugotovljen za dnevne metulje (LEBEN *et al.* 2007) in hrošče (MAGURA *et al.* 2001).

#### 4.2.1.4. Ostalo

Smrdokavro in velikega skovika sta kot sekundarna duplarja poleg že opisanih dejavnikov prizadela tudi propadanje visokodebelnih sadovnjakov (KGZS 2007) ter zapiranje obstoječih dupel (npr. s poliuretansko peno, cementom ali pa mešanico ilovice in blata), ki je običajna praksa na območju (K. DENAC *lastni podatki*). V prehrani obeh vrst na Goričkem se kot pomemben plen pojavlja bramor *Gryllotalpa gryllotalpa* (PODLETNIK & DENAC 2015). Z Goričkega je znan vsaj en primer sočasnega pogina vseh mladičev smrdokavre, pri katerem obstaja sum, da je bil vzrok zaužitje zastrupljenih bramorjev (PODLETNIK & DENAC 2015). Znano je namreč, da pesticid za zatiranje bramorjev z aktivno spojino metiokarb povzroči pogin ptice po zaužitju zastrupljenega plena (MÜNCH 2011).

#### 4.2.2. Opuščanje rabe

Opuščanje in posledično zaraščanje kmetijske krajine je v Evropi splošno razširjen pojav, še posebej izrazito pa je v Sredozemlju (FERANEK *et al.* 2010, KALIGARIČ & IVAJNŠIČ 2014). Na Goričkem je zaraščanje predvsem posledica upada števila velike živine po letu 2000 ter staranja prebivalstva (GLAVAŠ 2016). Specializirane vrste odprte krajine zaraščanje prizadene (RADOVIČ *et al.* 2013, HERRANDO *et al.* 2015), po drugi strani pa je lahko številčnost nekaterih ptic v prvih fazah zaraščanja travnikov in pašnikov večja kot na ekstenzivnih površinah z enako rabo (VERHULST *et al.* 2004, NIKOLOV *et al.* 2010). Številne vrste

namreč za prehranjevanje ali gnezdenje potrebujejo določeno površino grmovja ali visokih zeli. Takšni so na primer veliki skovik (SIERRO & ARLETTAZ 2013, DENAC & KMECL 2014), rjavi srakoper (BRAMBILLA *et al.* 2007), repnik (EYBERT *et al.* 1995), prosnik (GREIG-SMITH 1983, REVAY *et al.* 2008), pisana penica (POLAK 2012, SZYMAŃSKI & ANTCZAK 2013) in rjava penica (STOATE & SZCZUR 2001, STOATE *et al.* 2001). V začetnih in srednjih fazah zaraščanja površin je abundanca ravnokrilcev, ki so pomembna hrana mnogih vrst ptic (LEPLEY *et al.* 2004, MARCHESI & SERGIO 2005, MENZ 2008), praviloma največja, vendar pa z napredovanjem zaraščanja upade (SCHIRMER *et al.* 2011, FARTMANN *et al.* 2012). Na Goričkem še ni bila opravljena nobena raziskava, s katero bi ugotavljal povezavo med vrstno sestavo ptic in stopnjo zaraščanja, zato je težko oceniti, ali je zaraščanje že tako napredovalo, da negativno vpliva na ptice kmetijske krajine. Ena izmed vrst, pri katerih je opuščanje rabe morda povzročilo upad populacije, je grilček (FARINA 1997), vendar pa ima določen vpliv na njegov trend verjetno tudi v Sredozemlju splošno razširjeni (krivo)lov (BIRD LIFE INTERNATIONAL 2017).

Po letu 2003, ko je bila opravljena večina popisov za NOAGS, sta bili na Goričkem povsem na novo zabeleženi dve vrsti, ki kažeta na povečano zaraščanje z grmovjem in drevjem, in sicer pisana penica ter drevesna cipa. Pisana penica gnezdi v gostem grmovju, najraje trnastem (MAUMARY *et al.* 2007, POLAK 2012, SZYMAŃSKI & ANTCZAK 2013). Preferira široke mejice, v ozkih mejicah pa je struktturna raznolikost grmovja tista, ki lahko nadomesti majhno širino (SZYMAŃSKI & ANTCZAK 2013). Poznim sukcesijskim stadijem z veliko visokega grmovja se izogiba, vendar pa posamezna višja drevesa med grmovjem uporablja kot pevska mesta (POLAK 2012, SZYMAŃSKI & ANTCZAK 2013). Drevesna cipa je vrsta odprte krajine, v kateri pa potrebuje gozdne otoke, mejice, grmiča in travnike v začetnih sukcesijskih fazah, ki jih uporablja kot pevska in gnezditvena mesta (LOSKE & SHEPHERD 1997, BURTON 2007, HÜBNER 2009). Tudi rjava penica, katere populacija je na Goričkem v zadnjih 20 letih močno porasla, je vrsta grmiča, hkrati pa za gnezdenje potrebuje še pasove goste, visoke zeliščne vegetacije, na primer v obliku nekaj metrov širokih nepokošenih robov njiv (STOATE

& SZCZUR 2001). Na povečano zaraščanje kažejo tudi porasti populacij rumenega strnada, rjavega srakoperja in divje grlice, ki so očitno nastali med letoma 2003 in 2012 (indeks Upkač / NOAGS nad 100). Za te tri vrste so porast populacij na opuščenih kmetijskih površinah na Madžarskem ugotovili tudi NAGY *et al.* (2009).

#### 4.3. Vpliv opravljenih varstvenih ukrepov in kmetijskih subvencij na ptice

Sistematično vrednotenje uresničenih varstvenih ukrepov sicer ni bilo opravljeno, obstajajo pa določeni podatki, ki kažejo na njihovo uspešnost. Skupina za zlatovranko na Mladinskem ornitološkem taboru Goričko 2014 je ugotovila, da so zlatovranke poleg žic daljnovidov za preže najbolj pogosto uporabljale ravno lesene drogove, postavljene z namenom varstva vrste v letih 2013 in 2014 (DENAC *et al.* 2014a). Tudi redno preverjanje zasedenosti gnezdilnic za sekundarne duplarje izkazuje, da ciljne vrste rade zasedejo ponujena gnezdišča. Videti je, da v nekaterih letih pomemben del populacije velikega skovika gnezdi v gnezdilnicah: leta 2014 je bilo s to vrsto zasedenih vsaj 19 gnezdilnic, populacija pa je štela 60-70 parov (sodeč po štetjih v letih 2013 in 2015, DENAC *et al.* 2013, 2015). To pomeni, da je v gnezdilnicah gnezdilo vsaj 30 % populacije. Obnova zaraščajočih se travnikov v okviru projekta Gorički travniki je imela velik pozitiven vpliv na številčnost in razširjenost dveh vrst metuljev, temnega in strašničnega mravljiščarja. Spremljanje stanja obeh vrst je pokazalo, da so bili odrasli osebki temnega mravljiščarja opaženi na 11 od 13 lokacij, kjer je junija potekala prilagojena košnja (skupaj 146 osebkov), strašničnega mravljiščarja pa na 8 od 13 lokacij (skupaj 54 osebkov). Zasedenost ploskev s temnim mravljiščarjem je bila 85-odstotna, s strašničnim mravljiščarjem pa 62-odstotna, kar je daleč preseglo poseljenost in številčnost obeh vrst na ploskvah z operacijo KOPOP MET\_KOS (VEROVNIK 2015).

Priložnostni in projektni varstveni ukrepi torej pozitivno vplivajo na ciljne vrste, vendar pa ne morejo nadomestiti sistemskih ukrepov, ki jih financira država. Praviloma so namreč malopovršinski in temeljijo bodisi na prostovoljnem delu, ki je omejeno s številom

prostovoljcev in količino njihovega prostega časa, bodisi na časovno omejenem projektnem delu. Po izteku projektov je navadno težko ali celo nemogoče zagotoviti nadaljnje financiranje ukrepov. Večjo trajnost ukrepov bi bilo mogoče zagotoviti s sistemom kmetijskih subvencij, kar pa bi zahtevalo preoblikovanje sedanje sheme plačil v smislu povečanja deleža za ukrepe KOPPOP in vsebinske prenove ukrepov. Manj kot petina kmetijskih subvencij na Goričkem je bila v letih 2014–2015 izplačana za ukrepe KOP oziroma KOPPOP, pričemerjet treba opozoriti, da so med temi ukrepi številni takšni, ki z varstvom biodiverzitete nimajo dosti skupnega. Zgolj 1,2 % vsega denarja, izplačanega za ukrepe KOP v obdobju 2007–2013 v Sloveniji, je bilo namenjenega ukrepom ETA, HAB, MET, STE in TSA, medtem ko je bilo za ekološko kmetijstvo, integrirano poljedelstvo, integrirano vinogradništvo, ohranjanje kolobarja, sonaravno reja domačih živali in ozelenitev njivskih površin izplačanih 84,8 % vseh sredstev (MKGP 2016), nekateri od teh ukrepov pa so neposredno škodovali varstvu habitatov (npr. sonaravna reja domačih živali; T. JANČAR pisno). Z naravovarstvenimi ukrepi KOP oziroma KOPPOP je bilo v obdobju 2007–2016 pokrite 0,2–1,0 % površine Krajinskega parka Goričko, kar je po naši oceni bistveno premalo, da bi se lahko pozitivni učinki pokazali na populacijah varovanih ptic. Poleg tega je vrednotenje prispevka teh ukrepov k varstvu varovanih vrst za zdaj še v povojuh (VEROVNIK 2015, DENAC *et al.* 2016) in mu bo treba v prihodnje posvetiti več pozornosti, seveda pod pogojem, da se bodo površine pod temi ukrepi bistveno povečale.

## Zahvala

Iskreno se zahvaljujemo vsem prostovoljcem in domačinom, ki so nam pomagali pri terenskem zbiranju podatkov o pticah in uresničevanju varstvenih ukrepov zanje. Za pomoč pri organizaciji raziskovalnih taborov v letih 1997 in 1998 se zahvaljujemo Zvezi za tehniško kulturo Slovenije, posebej gospodu Branetu Sotošku, Fakulteti za naravoslovje in matematiko (takrat Pedagoški fakulteti), posebej prof. dr. Mitji Kaligariču, in osebju podružnične osnovne šole v Markovcih na Goričkem.

## 5. Povzetek

Avifava Goričkega je po zaslugu številnih popisov ptic v zadnjih 20 letih razmeroma dobro poznana. Za nekatere vrste so bile na tem območju opravljene prve ekološke raziskave v Sloveniji. V članku je prikazan pregled vseh dosedanjih popisov ptic. Predstavljeni so populacijski trendi vrst kmetijske krajine, ki so v Evropi ena bolj ogroženih skupin ptic. Večina kvalifikacijskih vrst tega habitata, ki so varovane v okviru omrežja Natura 2000, je na Goričkem doživelva upad, in sicer prepelica *Coturnix coturnix*, veliki skovik *Otus scops*, smrdokavra *Upupa epops*, hribski škrjanec *Lullula arborea* in bela štokrlja *Ciconia ciconia*. Pri slednji se število gnezdečih parov sicer ni spremenilo, zmanjšala pa se je njihova rodnost. Upadle so tudi populacije nekaterih drugih vrst ptic kmetijske krajine, na primer poljskega škrjanca, prosnika, grilčka in repnika, ravno tako pa tudi populacije metuljev ter površine travniških habitatnih tipov. Državna kmetijska in naravovarstvena politika sta pri varstvu biodiverzitete Goričkega očitno neučinkoviti. Najverjetnejši razlog za upad populacij ptic je intenzifikacija kmetijstva, ki se na Goričkem kaže predvsem kot izginjanje in intenzifikacija travnikov, komasacij, propad visokodebelnih sadovnjakov in uporaba pesticidov. Zaradi komasacij izginjajo mejice, neobdelani pasovi vegetacije med njivami, posamezna drevesa in grmi ter manjšinski habitatni tipi, povečujejo pa se njivske površine. Varstveni ukrepi, ki jih opravlja Javni zavod Krajinski park Goričko ob podpori prostovoljcev Društva za opazovanje in proučevanje ptic Slovenije, so sicer učinkoviti, vendar prostorsko in časovno omejeni. Zaradi tega ne morejo nadomestiti pomanjkljivega sistemskoga financiranja, ki bi ga bilo mogoče izboljšati z vsebinsko in finančno prenovo sheme kmetijsko okoljsko podnebnih ukrepov (KOPPOP). Trenutno je z operacijami KOPPOP, ki imajo pozitiven vpliv na kvalifikacijske vrste in habitatne tipe (HAB, MET, VTSA), pokrit zanemarljiv odstotek površine Goričkega (1 % v letu 2016), kar posledično pomeni, da je varstvu narave na Goričkem namenjen le neznaten delež denarja iz Programa razvoja podeželja. Ob nespremenjenem sistemu kmetijskih subvencij ni pričakovati, da se bodo razmere za varstvo ptic na Goričkem izboljšale.

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## DODATEK 1 / APPENDIX 1

Rezultati različnih popisov, na podlagi katerih smo izračunali populacijske trende in indekse

Results of censuses on the basis of which population trends and indices were assessed

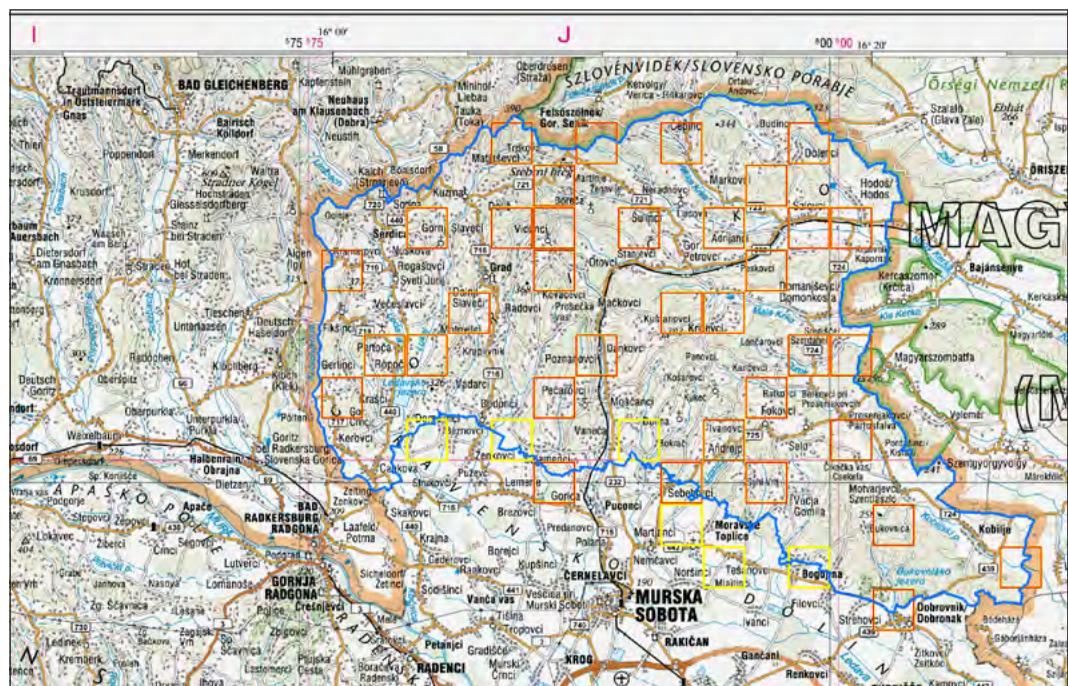
### **Monitoring bele štoklje**

**Tabela 1:** Podatki monitoringa bele štoklje *Ciconia ciconia* na Goričkem za obdobje 1999–2016 – število gnezdečih parov (HPa) in število poletelih mladičev (JZG)

**Table 1:** White Stork *Ciconia ciconia* monitoring data from Goričko for the 1999–2016 period – No. of breeding pairs (HPa) and no. of fledged young (JZG)

Leto / Year	HPa	JZG
1999	11	19
2000	12	25
2001	12	15
2002	12	26
2003	14	25
2004	17	27
2005	11	17
2006	13	7
2007	12	22
2008	12	24
2009	9	20
2010	11	20
2011	7	15
2012	9	18
2013	8	14
2014	11	15
2015	10	6
2016	10	13

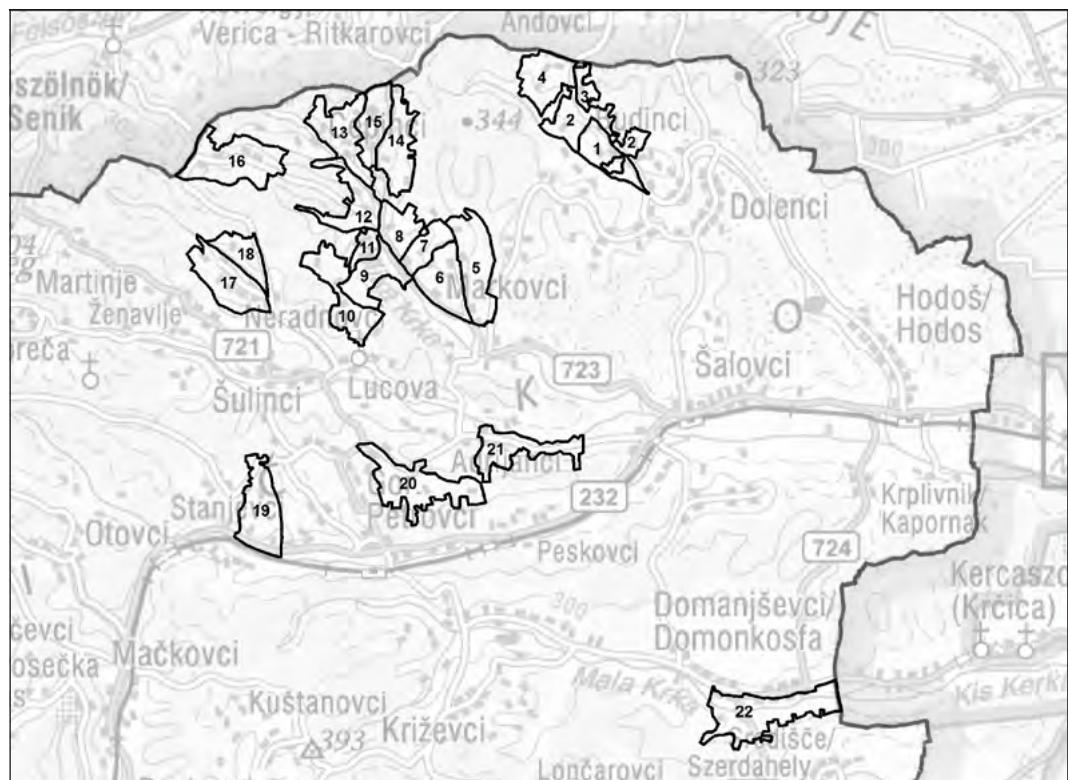
## NOAGS



**Slika 1:** Tetrade ( $2 \times 2$  km), ki so bile popisane na Goričkem v okviru Novega ornitološkega atlasa Slovenije; označeni so tudi transekti, ki se popisujejo v okviru popisov za določitev slovenskega indeksa ptic kmetijske krajine (SIPKK).

**Figure 1:** The tetrads ( $2 \times 2$  km) censused at Goričko within the framework of the New Ornithological Atlas of Slovenia, with marked transects surveyed within the censuses requisite for the stipulation of Slovenian index of agricultural landscape birds (SIPKK)

### Ploskovni popis



**Slika 2:** Popisne ploskve, na katerih je bil opravljeno šteje na površini "area count" v letih 1997/98 ter 2014/16

**Figure 2:** Census plots on which area count was carried out in the 1997/98 and 2014/16 periods

**Tabela 2:** Podatki popisov NOAGS na Goričkem. V zgornji vrstici so oznake transektov. Številke v tabeli se nanašajo na število parov.**Table 2:** NOAGS census data from Goričko. Top row denotes transect codes, with numbers in the table referring to the number of pairs.

	16.60.U	17.57.Z	17.58.M	17.58.Z	17.59.K	17.59.M	17.59.R	17.59.Z	17.60.D	17.60.F	17.60.O	18.57.D	18.57.M	18.58.A	18.58.D	18.58.F
<i>Acrocephalus palustris</i>	1							1				3	1	5	2	1
<i>Alauda arvensis</i>	7		7	1	2			3	5		2		1	3	2	1
<i>Carduelis cannabina</i>				7		4				4						
<i>Carduelis carduelis</i>	3	2		2			2		2			4	2	3	2	2
<i>Columba oenas</i>		1		1						3		1	1			
<i>Columba palumbus</i>	3	4	2	5	2	2	2	1	2	4	1	3	5	4	1	5
<i>Corvus cornix</i>	3	4	4	5	3	2	2	3	2	1	2	7	3	5	2	5
<i>Coturnix coturnix</i>								1	1							
<i>Cuculus canorus</i>	1	2		1		1	3	3	2	2	1	2		1	2	2
<i>Emberiza citrinella</i>	13	5	5	10	5	7	9	12	7	1	10	8	4	8	5	3
<i>Falco tinnunculus</i>	1	1	1									1	1	2	1	
<i>Galerida cristata</i>	3		2									1				
<i>Hirundo rustica</i>	21	10	2	11	2	6	4	9	4		4	10	4	2	8	
<i>Jynx torquilla</i>	2			1		1		1			1	1				1
<i>Lanius collurio</i>	1	1	3	7			3		2	1	2	3	2	4	1	1
<i>Lullula arborea</i>				3		1	1	2			1					
<i>Luscinia megarhynchos</i>									1		1			3	1	
<i>Passer montanus</i>	15	12	3	7	1	12	10	3	5	2	4	19	28	6	6	6
<i>Phoenicurus phoenicurus</i>								2								
<i>Pica pica</i>	1	1		1								4	4	5	1	1
<i>Picus viridis</i>	2	1	1			2	1	2		2		1		2		3
<i>Saxicola torquata</i>	3	2	4	5	2	3	3	3	1		2	3	1	5	2	1
<i>Serinus serinus</i>	6	3			1	2	4		1		4	3	4		1	1
<i>Streptopelia turtur</i>	1			4	2	2	1	4	2	4	4		1	3	1	1
<i>Sturnus vulgaris</i>	10	87	2	12	3	20	2	16	5	3	4	16	43	7	3	1
<i>Sylvia communis</i>						1		2	1	2	1	3	4	2	1	
<i>Upupa epops</i>	2						2	4					1	1	2	

1858.M	1858.O	1858.R	1858.S	1858.Z	1859.Š	1859.D	1859.F	1859.G	1859.M	1859.O	1859.R	1859.Z	1860.A	1860.O	1958.C	1958.D	1959.B	1959.D	Skupaj	
					2	2		2	1		1		1	1			2	26		
	3				6	6		1	3		2		1	6			2	64		
																		15		
2	1				1			2	1		3		2	3			2	41		
																		9		
2	2	3	3	3	1	5	1	2	2	3	4	1	1		4	2	2	89		
1	3		3	2	6	2		6	2	7	6		3	3		3	6	3	109	
																		2		
2	1	1	1	3	1	2	2	4	2	1	1	1	2	2	2	3	2	2	58	
3	3	2	1	6	11	5	1	7	4	12	5	2	12	10	4	5	7	5	217	
	1	1	1		1								1	1				1	15	
																			9	
2	3	2		3	13	2	2	3		3	10		3	14			3	4	164	
					1	1		1			1	1	2	1			1	1	17	
1	2	1		2	1		2	1	2	1			2	2	1	1	3	3	56	
				1	1				1		1	1					1	2	16	
																			7	
12	9	6	5	5	13		2	3		3			6	10	4	2	2	9	230	
																			2	
	1				2				1		1			2				1	26	
1	1	1	1			1		2					2				1	1	28	
	1	1			3	1	1	3	1	1	2	1	2	4	3		1	1	66	
1	2	1		1	1	1		3					1	4					46	
1	1		1	2	1	1		1	1	1	1	1	2	1			1	1	46	
4	6	3	3	1	4	3		7		2	12	1	9	7		5	5	306		
					1	2			1		1			1		2	1	27		
2					1			2	1		1							19		

**Tabela 3:** Podatki ploskovnega popisa na Goričkem v letih 1997/98 in 2014/16. Številke v tabeli se nanašajo na število parov.

**Table 3:** Results of Goričko plot census carried out in 1997/98 and 2014/16, with numbers in the table indicating the numbers of pairs

Vrsta/ Species	<i>Alauda arvensis</i>	<i>Coturnix coturnix</i>	<i>Cuculus canorus</i>	<i>Emberiza citrinella</i>	<i>Falco tinnunculus</i>	<i>Jynx torquilla</i>
Ploskev / Plot	1997/98 2014/16	1997/98 2014/16	1997/98 2014/16	1997/98 2014/16	1997/98 2014/16	1997/98 2014/16
<b>1</b>		1	1	19	9	1
<b>2</b>		3	1	19	10	1
<b>3</b>	1	1	2	6	7	1
<b>4</b>			1	21	12	
<b>5</b>	2	1		3	14	17
<b>6</b>	2	2	2	9	2	1
<b>7</b>	1	1		13	6	1
<b>8</b>		3	1	7	4	1
<b>9</b>		6		2	11	11
<b>10</b>		2		13	5	
<b>11</b>		2		6	3	
<b>12</b>				1	12	1
<b>13</b>					21	1
<b>14</b>		2	1	1	17	1
<b>15</b>	1			1	11	
<b>16</b>				2	20	
<b>17</b>				2	19	1
<b>18</b>					5	
<b>19</b>	2		1		16	8
<b>20</b>		1			19	11
<b>21</b>					11	8
<b>22</b>	11	1			25	23
Skupaj/ Total	20	2	24	5	11	314
						166
					0	9
						8
						3

<i>Lanius collurio</i>	<i>Lullula arborea</i>	<i>Picus viridis</i>	<i>Saxicola rubicola</i>	<i>Serinus serinus</i>	<i>Streptopelia turtur</i>	<i>Sylvia communis</i>	<i>Upupa epops</i>
1997/98	2014/16	1997/98	2014/16	1997/98	2014/16	1997/98	2014/16
2	4	1	1	3	2	3	
11	10	1	1	2	3	6	3
2	4	1		1	2	3	1
8	15		1	1	4	1	5
9	9			5	3	2	1
1	2			1	1	1	1
10	2	1	1	2	6	1	
11	2	2		1	3	1	
12	6	3		2		3	1
14	7	2		1	5	2	
5	2			1	1	1	1
5	4	3		2	1	1	
9	3	2		1	2	1	
8	5		1	3		2	1
12	3	1		2	3	2	
16	6	7		12		3	1
10	1		3	3	6	4	
3				1		1	2
11	2	2	1	1	4	1	2
17	9	3	2	2	4	4	2
11	4	1		3	1	2	
10	7	1	1	2	15	1	
197	107	30	3	15	38	77	19
						19	3
						3	23
						1	19
						6	9